

RoC Consulting, on behalf of Far East Consortium

Plots NT02, NT03 and NT04, Northern Gateway, Dantzic Street

Phase 3a Detailed Remediation Strategy Report

11834 R02 (04)

RSK GEOSCIENCES

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RSK GENERAL NOTES

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by RoC Consulting (RoC), acting on behalf of Far East Consortium (the Client), to prepare a Phase 3a Detailed Remediation Strategy for land associated with Plots NT02, NT03 and NT04 of the Northern Gateway Strategic Regeneration Framework, Dantzic Street, Manchester (the site).

The current Phase 3a Remediation Strategy is an update to the original revision (ref: 11834 R02 (00), dated Nov 2023) which focussed primarily on the remediation requirements for Plots NT03 and 4. This revision has been updated to incorporate remediation requirements for Plot NT02 following completion of supplementary ground investigation works by RoC Consulting in Oct and Nov 2023. This report supersedes and replaces the aforementioned previous version of the remediation strategy for the site.

The project was carried out to an agreed brief as set out in RSK's proposal (email to RoC Ref. 11834 TL01 (00), dated 21 April 2023).

This report is subject to the RSK service constraints given in **Appendix A.**

The site is located in Manchester, at approximate National Grid reference E384690 N399470 and has been divided into three development plots termed NT02, NT03 and NT04. These boundaries are indicated on Drawing 4328-ROC-ZZ-XX-DR-ES-ES200 presented in **Appendix C.**

Development proposals across the site comprise a mixture of high and medium rise residential buildings to heights of between 20 and 35 stories with smaller buildings varying in heights of between 4 and 8 storeys. The development is also anticipated to include small areas of soft landscaping, and a new access road. No basement structures are proposed across the site with ground levels remaining (broadly) around existing to suit tie-ins with adjacent land and highways. Proposed development drawings are included within **Appendix B.**

An initial Enabling stage of works is proposed across the site entailing the demolition of existing structures, grubbing out of below ground foundations/obstructions, reprofiling of the site to provide development/piling platforms, formation of a new piled retaining structure supporting adjacent Network Rail land to the south; and remedial works to address contaminated soils and groundwater.

The site is divided into three distinct areas based on current land uses and master plan requirements, namely:

- Plot NT02 is present at the west of the site and is occupied by two warehouse/light industrial type buildings with associated service yards and hardstanding.
- Plot NT03 occupies the centre of the development site. It is understood that a portion of the south of Plot NT03 is owned by Network Rail. The north of the Plot is largely covered with hardstanding while the southern part and Network Rail land are occupied by two large earth mounds which likely overlap somewhat.
- Plot NT04 occupies the east of the development site is comprised of semi vegetated disused land.

The site has been subjected to a number of geo-environmental site investigations, including:

- Hydrock, December 2015. Ground Conditions Desk Study (ref: R/151819/G001)
- Allied Exploration & Geotechnics Ltd, March 2019. Northern Gateway Final Factual Report (Contract Number: NW1580)
- LK, March 2020. Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy, at **Plot NT02 only** (ref: CL-602-LKC 20 1060-01)
- RoC Consulting, January 2023. Phase 1 Desktop Study (ref: 4328-ROC-ZZ-XX-RP-ES-PH1DTS)
- RoC Consulting, January 2023. Technical Note at **Plot NT03** Network Rail Mound (ref. 4328-ROCZZ-XX-TN-ES-TN2)
- Phase 2 site investigation report covering **all plots**, completed by RoC Consulting in October 2022 (ref. 4328-ROC-ZZXX-RP-ES-P2-101 Rev05), updated following completion of supplementary SI works in June 2023, November and December 2023
- RSK Controlled Waters Risk Assessment (CWDQRA), at **Plot NT02 only,** completed by RSK in July 2023 and updated in December 2023 (ref. 11847 R01 (01))
- RSK Outline Phase 3a Remediation Strategy report dated August 2023 (ref:11834 R01 (00)) covering **all plots.**

It is recommended the findings and results from the above reports are reviewed in tandem with this Remediation Strategy (along with other relevant earthworks, demolition and enabling works drawings, specifications and information).

1.1 Objective and Scope

Following the results of various rounds of ground investigations, the results from these studies indicated that soil, groundwater and ground gas remediation works are required to facilitate the development for both the protection of future site users and the wider environment.

This Remediation Strategy has been developed to support the planning application for the proposed development. The document presents the preferred remediation options, to address the identified geotechnical and contamination risks for the proposed residential end use of the site as shown on **Appendix B.**

The purpose of the current Phase 3a Remediation Strategy is to detail the treatment options considered suitable to redress ground contamination concerns at Plots NT02, NT03 and NT04..

Overall, it considers in general terms the methods to be employed, and general requirements for mitigation of health and safety and environmental controls to be employed during the works, (which the Designer is obliged to consider as part of his formal duties under the CDM regulations). These methods and requirements will be improved and refined within subsequent detailed design upon appointment of a specialist remediation contractor.

The Remediation Strategy will form the basis of the subsequent Remediation Method Statement and detailed design drawings and Remediation Contract Documents, which will form part of the Tender Package to the Contractor.

The Remediation Strategy has been developed in accordance with the guidance provided in Land Contamination Risk Management (LCRM) (Environment Agency 2020). This document supersedes CLR11 Model Procedures for the Management of Contaminated Land and provides best practice for guidance on producing an Options Appraisal and the implementation of a Remediation Strategy.

The Remediation Strategy is a 'live' document and will be revised to reflect subsequent consultations with consultees, planning authority, and other stakeholders any further risks or issues that may be identified within detailed design and following the appointment of specialist contractors and the application for the necessary permits and consents.

1.2 Limitations

The Remediation Strategy is presented to a level of detail considered sufficient for the purposes of planning and regulatory authorities. Whilst it is considered sufficient for this purpose the report on its own does not present a remedial design or specification to the level of detail that will be required for contractual negotiations, quantity surveying, or remediation tendering purposes. It is envisaged this report will instead form the basis from which contractors plan and specify the required program of remediation works across the site, with further detailed information on remediation techniques, results from any pilot trials, site monitoring and validation testing requirements further elaborated upon as part of a Remediation Method statement for the works. The RS can be relied upon for those areas of the site where ground investigation data has been provided. Extrapolation of data to cover areas where no data are available has not been adopted.

It should be noted any change to the development layout, proposed end uses, or other significant amendment will impact on the findings and recommendations of this strategy and may require its full or partial reinterpretation.

This report is subject to the RSK service constraints given in **Appendix A.**

2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 1**.

Table 1: Site location details

Site name	Plots NT02, NT03 and NT04, Dantzic Street, Manchester
Full site address and postcode	M4 4NL
National Grid reference (centre of site)	E384690, N399470

2.2 Site description

The subject site covers an area of circa 2.30 hectares located to the south of Dantzic Street in Manchester and is centred at National Grid Reference E384690, N399470.

The site termed “Plot NT02” covers a roughly rectangular parcel of land within the wider Plot NT03 and 04 development master plan area. The site is bounded by Dantzic Street to the north beyond which lies a Travellers site and the River Irk (flowing roughly northeast to southwest) circa 21.00 m to the north of the site; an electrified railway line on a viaduct to the south with car repair garages; the wider Plot NT0X site to the east (comprising a former waste management operator); and the Victoria Riverside high rise apartment scheme to the west.

The southern light industrial building was operated by Astra Signs Ltd; a sign making company. The topography of the Plot NT02 is relatively flat with levels varying between 31.20 mAOD at the interface with Dantzic Street and 34.80 mAOD in the southern portion of the site. Plot NT02 is accessed from the east through a gate leading from Dantzic Street onto Plot NT03.

Plot NT03 currently comprises a large National Rail owned soil mound built up against the Network Rail Viaduct at the southern boundary of the site. Immediately north of this, and along the wall to the east of the Network Rail mound, are smaller stockpiles of loose, topsoil-like material left in place by the former operators of the site, Ryan Topsoil Ltd. Large portions of the central part of the site are covered in concrete slabs.

The Plot NT03 is also accessed via a gate onto Dantzic Street. A small portion of this Plot, also covered with hardstanding, is fenced off from the remainder and accessed separately, also from Dantzic Street. Levels on the Plot NT03 vary significantly due to the presence of a large stockpile of soil which rises to 45.65 mAOD at its peak and sloping to 33.27 mAOD at its base in the centre of the plot. The hardstanding working area, extending from the base of the mound to the northern boundary, varies in elevation from 33.00 m to 31.38 mAOD.

Plot NT04 is comprised of semi vegetated disused land. The southern boundary is formed by the Network Rail Viaduct. Dantzic Street and Dalton Street form the northern boundary with a disused warehouse and the River Irk beyond.

The eastern boundary is formed by Dalton Street and residential housing. Relic walls of a former structure are present in the northern portion of the Plot, likely part of the historic Dalton Print Works.

Parts of the south of the site are covered with hardstanding, with stockpiles of construction material present at the time of the site works. Levels in this Plot fall from south (41.50 mAOD) to north (32.00 mAOD). Levels in the eastern portion of NT04 generally appears to be higher than the rest with the north-eastern corner of the site generally sitting at circa 39.00 to 40.00 mAOD. The Plot NT04 is accessed via a gate onto Dalton Street in the east of the Plot.

2.3 Development plans

2.3.1 Main development

The proposed layout of the site, at the time of preparing this report, is shown in **Appendix B**.

It is understood that the site is to be developed with a mixture of high and medium rise residential buildings, with the former to heights of between 20 and 35 stories and the latter to heights of between 4 and 8 storeys. It is understood that there will be no basement structures, however some structures may straddle slopes and be stepped, with the ground floor on one side of the building, being lower than the other. A new access road is proposed to be constructed which will pass between NT02 to the west and NT03 and continuing to the east along the southern site boundary.

The development is also anticipated to include small areas of soft landscaping comprising green planting and green paving/soil cell areas in communal spaces, as shown in **Image 1** below:

Image 1: Proposed landscaped areas



2.3.2 Enabling works

The development is to be subject to a site Enabling Works Phase to prepare the site for the follow-on Construction Phase. The scope of these Enabling Works is to include; demolition of existing buildings and hardstanding, vegetation clearance, including invasives, services disconnections, formation of a new piled retaining structure supporting adjacent Network Rail land to the south, general earthworks and site remediation.

An initial cut/fill exercise has been undertaken for the Enabling works on the site (see Drawing RDB/ROC/22/XX/DR/C/0612 within **Appendix D**).

No information on service routes, other than the proposed diversion route for the High Pressure Gas Main are available (shown on Drawing RDB/ROC/22/XX/DR/C/0612 within **Appendix D**).

An area of the development site in the southern portion of Plot NT03 comprises an existing earth embankment belonging to Network Rail. Following ground investigation work on the embankment it is believed that this offers localised support to the track at viaduct level.

As part of the development proposal on the NT03 site, earthworks are proposed to excavate the existing National Rail mound to facilitate construction and the wider regeneration of the site (see Drawings RDB/ROC/ZZ/XX/DR/C/0610 and RDB/ROC/ZZ/XX/DR/C/0611 within **Appendix D**). As the mound offers support to track level, a new retaining structure is required prior to allow removal of in order to maintain stability to the viaduct.

A new retaining wall structure comprised of a CFA or bored contiguous piled retaining wall with an integral in-situ reinforced concrete cantilever retaining wall above is proposed at the interface between the viaduct and the National Rail mound to facilitate its removal and release the NT03 site for development.

2.4 Surrounding land uses

The site is in Manchester city centre, near Victoria Station, within a predominantly commercial/residential setting, though much of the surrounding land is currently vacant. Immediate surrounding land uses are described in **Table 2**.

Table 2: Surrounding land uses

North	Dantzic Street to the north with vacant derelict land, previously used as a caravan site and warehousing/works beyond, which back on to the River Irk.
East	Dalton Street and residential housing.
South	Network Rail viaduct.
West	Plot NT09, Victoria Riverside development.

2.5 Site history/operations

Based on the site's historical use, potentially contaminative activities/land uses at Plot NT02 include: the Victoria Screw and Bolt works (1891 – c. 1950), which later included the Victoria Paint Works (1891 and 1908), Collyhurst Foundry (c.1950 to 1960), Asphalt Works (1968 – 1989) and Tripe Works (c. 1950 – 1989). A waste management company known as Farlam Waste Management is known to have operated in the eastern portion of Plot NT02 only having ceased operation within the past decade. In addition, there is anecdotal evidence to suggest that the southern portion of the plot was used as a storage yard for construction plant.

Potentially contaminative historical activities/land uses include a former unspecified works (1891 to mid-1900s), scrap metal works (late 1968 to 1991), works (1984 – 1989) and finally the site's most recent use as a yard for topsoil stockpile storage. A small area of the southern boundary of the Plot NT03 was previously occupied by a signal box on an embankment adjacent the railway viaduct. It is not clear from historical records if there is a retaining wall which supports the viaduct in this location or if the viaduct is supported by the embankment which is visible on historic plans and aerial photography and still present today.

Potentially contaminative activities/land uses at Plot NT04 include; the Darlton Works print works (present from 1891 and demolished in 20143). The site is also surrounded by potential historic sources of contamination in the general vicinity, that may have impacted the site via migration of contaminated groundwater including a gasworks to the south, a rubber works to the west and gas holders to the north.

3 PREVIOUS REPORTS

A summary of pertinent information from previous investigations is included below in **Table 3.** Relevant information relating to the identified ground and groundwater conditions has not been included within the table below but has been incorporated into **Section 4.**

Table 3: Summary of previous investigation

Report 1	
Report details	LK, March 2020. Phase 2 Geo-Environmental Investigation, Risk Assessment and Remediation Strategy, at Plot NT02 only (ref: CL-602-LKC 20 1060-01) Summary based on review of report presented within the RoC 2023 GI report.
Site coverage	Whole site
Summary scope of works	The LK investigation comprises 7 window sample locations to a maximum depth of 4.45 m below ground level (bgl) and 2 rotary borehole locations to a maximum depth of 20.00 m bgl covering the whole of Plot NTO2.
Does the client have reliance upon the report?	Yes
Key findings relevant for controlled waters	Results from chemical testing undertaken by LK Consult revealed the following issues in the Plot NT02 regarding contamination: • Elevated levels of heavy metals (lead) in soil at WS104, SP1 and SP2 (Likely associated with ash, clinker and coal noted within made ground deposits) • Elevated levels of polycyclic aromatic hydrocarbons (PAHs) - benzo(a)pyrene and naphthalene in soil at WS102, WS103, WS105, TP103, TP105 SP1 and WS205 (likely associated with ash, clinker and coal noted within made ground deposits) • Elevated levels of total petroleum hydrocarbons (TPH) – aliphatic >C12-C16, aromatic >C8-C10 and aromatic >C10-C12 in soil at WS205 (beneath the light industrial building and likely associated with the numerous historic industrial activities in this area of the site) • Elevated levels of VOCs/semi-volatile organic compounds (SVOCs) – benzene and TCE in made ground and superficial deposits at WS205, WS201, WS202 and WS204. Photo-ionisation detector (PID) readings in the southwest of the plot also indicate the presence of volatile contamination with readings between 4.3ppm and 207ppm (likely associated with the historic industrial activity in this area of the site) • Elevated concentrations of contaminants in groundwater including vinyl chloride (VC) at RBH101 and TCE in RBH103. The report hypothesizes these may be linked to historic industrial activity on site or a result of historic industry across the wider area, such as the former gasworks.

Report 2	
Report details	Phase 2 site investigation report, completed by RoC Consulting between October 2022 and December 2023 (ref. 4328-ROC-ZZXX-RP-ES-P2-101).
Site coverage	The 2022 (Phase 2a) RoC site investigation covered the entire site to establish baseline ground conditions and target known or suspected sources of contamination highlighted by the Phase 1 Desk Study. The April to May 2023 (Phase 2e) supplementary SI works were completed to address data gaps identified by the initial site investigation, namely, to further assess the nature and extent of the TCE plume identified within Plot NT02 and to increase coverage across Plots NT03 and 04. Further investigation works were completed within the National Rail (NR) mound within the southern area of Plot NT03, and a final phase of investigation works (Phase 2f) completed in October - November 2023 within NT02 and the western portion of NT03 in order to further characterise the TCE plume.
Summary scope of works	The scope of the October 2022 (Phase 2a) SI comprised 11 window sample locations, 16 trial pits and 10 rotary borehole locations to a maximum depth of 25.00 mbgl spread across the site. The scope of the April-May 2023 (Phase 2e) SI comprised 13 window sample locations, 9 trial pits and 7 rotary boreholes to a maximum depth of 18.00 mbgl. The scope of the September 2023 NR mound investigation comprised 3 window sample with rotary follow-on boreholes to a maximum depth of 21.00 mbgl. The scope of the November 2023 (Phase 2f) SI comprised 5 rotary boreholes across Plot NT02 and the western part of NT03 to maximum depth of 20.00 mbgl.
Does the client have reliance upon the report?	Yes
Soil contamination	**Plot NT02** Lead and PAH concentrations within the unsaturated made ground soils at several locations at Plot NT02 were found to exceed generic assessment criteria (GAC) relating to a proposed commercial land use. A delineation exercise also revealed Trichloroethene (TCE) contamination within the made ground soils beneath the warehouse in the southern area of this site, thought to have arisen as a result of long-term industrial operations on site, possibly the use lubrication or degreasing agents in bolt making operations and their leakage over time into soils through floor slabs or drainage networks. 25 soil samples from Plot NT02 were scheduled for asbestos identification testing, of these, 10 returned a positive result. Quantification testing revealed that only one sample had concentrations of asbestos high event to classify the material as hazardous waste. Generally, distribution of these contaminants across the Plot was observed, either laterally or

	with depth, indicating that the source of these contaminants may have arisen as a result of long-term industrial operations on site. **Plot NT03** Lead concentrations exceeding relevant GACs (either commercial or public open space, depending on the proposed land use at the plot) were also detected within a single location in the west of NT03. Of the 14 samples tested at the main plot, 5 samples returned a positive asbestos result, one of which was determined at a concentration which exceeds the hazardous waste threshold. 3 further samples from the topsoil mounds were tested for asbestos, none of which returned a positive result. The occurrence of soil contamination is thought to be associated with the previous construction/demolition activities, along with the site's former use as an unspecified works and later scrap metal works. During the September 2023 NR soil mound investigation, hydrocarbon odours were noted within the made ground soils of boreholes RBH401 - 403. Given that no residential development is proposed within the mound area, soil samples retained from the mound were screen against criteria for a proposed commercial end use – no exceedances of commercial GACs were reported. Additionally, no positive asbestos results were returned for samples collected from the NR mound. **Plot NT04** Lead contamination appears to be generally widespread across NT04 within made ground deposits. This is likely attributable to a combination of the makeup of the made ground. Furthermore, 3 of the 27 samples tested at this Plot returned a positive result for asbestos, concentrations within these samples were below the hazardous waste threshold.
Ground Gas	P**lot NT03** The results of 6 return ground gas monitoring visits undertaken at Plot NT03 revealed maximum methane and carbon dioxide concentrations of 0.1% and 8.3% respectively, with gas flow rates ranging between 0 and 0.1l/hr. These worst-case gas levels and borehole flow rates equate to a Gas Screening Value (GSV) 0.0083l/hr which falls below the value for the site to be classified at CS1, however CIRIA665 guidance recommends that (CS2) is adopted in instances where carbon dioxide concentrations routinely exceeds 5%. Since carbon dioxide concentrations exceeded 5% at the site during several monitoring visits, the site has been classified as CS2. **Plots NT02 and NT04** Following 6 return rounds of ground gas monitoring undertaken at Plots NT02 and NT04 over the course of 10 weeks, the maximum methane concentration was recorded as 0% and the maximum carbon dioxide level as 4.4% with gas flow rates ranging between 0 and 0.1l/hr. These worst-case gas levels and borehole flow rates equate to a Gas Screening Value (GSV) 0.0044l/hr which corresponds to an anticipated Characteristic Situation of CS1. However, given that several boreholes at

	Plot NT02 recorded concentrations of C02 >5% on several occasions, in line with CIRIA665 Table 8.5, Plot NT02 was classified as CS2. NT04 remains as CS1. Given presence of VOC contamination within soils and groundwater within the Plot NT02 site, and required remediation works, there is a potential for soil vapour ingress into new structures in this area also. However, the severity of this risk will be affected by the proposed remediation works relating to TCE contamination. As such, further consideration of these risks will be required once an approved remediation approach for TCE contamination has been reached.
Groundwater	**Plot NT02** During previous ground investigation phases undertaken by RoC, 12 soil leachate samples in total were collected from across Plots NT02 – 04 to assess the probability of contaminants having entered the groundwater (dissolved phase). The test results were screened against appropriate target concentrations (Drinking Water Standards DWS). Soil leachate concentrations were found to exceed target values at the following locations at Plot NT02: • Arsenic at TP202, WS301, WS397, WS309 • Lead at TP202, WS309 • Nickel WS309 • Sulphate at TP202, TP203, WS301, WS307 • PAH at WS202, WS309, RBH203 • Carbon Tetrachloride at WS202 • TPH at WS202, WS209 and RBH203 • Trichloroethane at WS202, WS304 In addition, samples were collected directly from the groundwater during return monitoring visits. Results of laboratory testing revealed the following exceedances when screened against DWS: • Arsenic at LK BH01, RBH201, RBH301, RBH502 • Sulphate at RBH201, RBH301, RHB502 P2, RBH503 • Carbon Tetrachloride at WS202 • Chloroform at RBH203 • Cis 1,2-Dichloroethene at LK BH1, RBH301, RBH503 • Trans 1,2-Dichloroethene at LKBH01 • Vinyl Chloride at LKBH01, RBH301, RBH503 • TPH at RH502 • Trichloroethane at WS202, WS304 • Benzene at LKBH01, RBH301, RBH502 P2 (385), RBH503, RBH505

	Plot NT03 The results of soil leachate analysis of samples collected from NT03 revealed arsenic, lead, sulphate, PAH and TPH exceedances when screen against DWS within RBH403 (NR mound). The results of a groundwater analysis results screen identified the following exceedances: • Arsenic at RBH403 • Cadmium at RBH403 • Lead at RBH403 • Sulphate at RBH306 and RBH202 • Manganese at RBH205 • Nickel at RBH306 and RBH403 • PAH at RBH403 • Carbon Tetrachloride at RBH303 • Cis 1,2-Dichloroethene at RBH303 • Trichloroethane at RBH303 • Benzene at RBH303 **Plot NT04** Soil leachate concentrations were found to exceed target values at the following locations at Plot NT04: • Lead (leachable) at TP214 and TP216 • Nickel (leachable) at TP307 • Sulphate (leachable) at TP307 In addition, samples were collected directly from the groundwater during return monitoring visits. Results of laboratory testing revealed the following exceedances when screened against DWS: • Sulphate at RBH208 and RBH209 • Arsenic at RBH208 • Manganese at RBH206
Surface water	Due to the presence of River Irk in close proximity to the site, 2 surface water samples were collected from the river (SS301 and SS304, collected up and down stream of the site) provide a direct assessment of the water quality. Contaminant concentrations were screened against relevant EQS and both upstream and downstream samples exhibited concentrations which exceeded EQS for zinc, and the downstream samples exhibited concentrations which exceeded EQS for nickel and copper. Further assessment was undertaken using the UKTAG Metal Bioavailability Tool (M-BAT) approach. The tool was used to calculate the site-specific predicted no effect concentrations (PNEC) for these compounds. Laboratory results were then compared with the PNEC. The regional background concentration of zinc of 2.90µg/l was subtracted from the exceedances.

	The analytical results for surface waters were the PNEC indicating that concentrations of copper, nickel and zinc recorded in groundwater had not resulted in the presence of unacceptable concentrations of determinants within the adjacent surface water.
Geo-environmental conclusions	**Human health risks** Given the elevated concentrations of concentrations of contaminants, including heavy metals, PAH, and asbestos detected in the unsaturated made ground soils across Plots NT02, NT03 and NT04, it was concluded that a risk to human health exists at the site with regards to future site users. It was recommended that detailed remediation design should be undertaken as part of a Remediation Strategy for the site, likely to include provision of a clean soil capping system in areas of proposed soft landscaping, with a minimum thickness of 600 mm, of which 150 mm should be topsoil. It was also recommended that, with regards to the TCE contamination noted within the made ground on the Plot NT02 portion of the site, the risk posed to human health and controlled waters should be further assessed via the production of a DQRA, which in turn would inform site specific remedial targets and remediation design. This work has now been completed and is included within the RSK DQRA report for Plot NT02 (see Report 3 summary below). **Controlled waters** Elevated concentrations of heavy metals, TPH and PAH have been detected in soils across the site, due to the absence of limited thickness of Till, particularly in the west at Plot NT02 and Plot NT03 there is the potential for leaching of contamination from unsaturated soils into the underlying CHES principal aquifer and MM Secondary B aquifer, particularly in areas not covered with buildings or hard standing. i.e. proposed areas of public open space. Additionally, a diffuse TCE source in unsaturated soils has been identified beneath the warehouse in the southern portion of Plot NT02, extending into the southwest of Plot NT03, in an area where historic industrial activities including the bolt works and foundry were located. The leaching potential of the soils was initially investigated in the July 2022 and April 2023 site investigations by the analysis of 12no. soil leachate samples This was later supplemented in subsequent phases of site investigation by groundwater sampling from locations across the site and an additional 3no. soil leachate samples from the Network Rail mound in November 2023. As the primary controlled waters receptor is the Principal aquifer (Chester Formation), the analytical results for groundwater samples have been assessed against DWS protective of groundwater quality. 45no. groundwater samples (plus three duplicate samples) have been tested from across the site (17no. groundwater samples (plus three duplicate samples from September/October 2022, 3no. groundwater samples from January 2023, 13no. groundwater samples from May 2023 and 12no. groundwater samples from November 2023).

	TCE exceedances of the DWS were reported in groundwater in the shallow sandstone in LK BH03, RBH203 and RBH501 located in the south of Plot NT02 and extending over the eastern site boundary to RBH303 and RBH504 located in Plot NT03. Carbon tetrachloride was also reported to exceed the DWS in LK BH01, LK BH03, RBH203, RBH302, RBH501, RBH502 and RBH504 and chloroform exceedances were reported at RBH203. TCE daughter compounds cis-1,2-dichloroethene, trans 1,2-dichloroethene (DCE), vinyl chloride (VC) were reported to exceed the DWS in the shallow sandstone on the outskirts of the TCE groundwater plume and down hydraulic gradient to the north of the site. An exceedance of the DWS was also reported for DCE in the shallow Manchester Marl to the west of the TCE plume core at RBH502 P2. Benzene exceedances were reported in groundwater in the sandstone and marl in the north of Plot NT02 and TPH fractions aliphatic and aromatic C12-C16 and benzene were reported to exceed the DWS in the southwest of the site. The profile of the TPH fractions indicates that these contaminants likely represent two distinct sources of TPH and benzene at the site and considering the absence of benzene detections in soils and leachate, the report concludes that both sources are most likely to have migrated onto site from off-site sources to the west and south. It was noted that the metals, PAH compounds and TPH fractions detected in leachate testing and the other SVOC detected in soils testing were not reported at concentrations exceeding the generic assessment criteria (GAC) in groundwater likely due to degradation in the unsaturated zone and/or more preferential sorption to soils. The report concluded that a potentially complete pollutant linkage for the migration of chlorinated VOC to the wider principal and secondary aquifers and recommended further assessment of potential risks to controlled waters via DQRA specifically for TCE, carbon tetrachloride, cis and trans-1,2-dichloroethene and vinyl chloride. Benzene was detected in the Marl formation at depths circa 15.00-20.00 mbgl with evidence to suggest the contamination is coming from an off-site source (namely a former Gas Works up gradient to the south of the site, and former gas holders to the north). As such we have not considered the Benzene contamination to require further assessment, modelling or remediation as part of the proposed development process.
Report 3	
Report details	Controlled Waters Risk Assessment, Plots NT02 Dantzic Street (Ref. 11847 R01 (01)), prepared for RoC Consulting, December 2023.
Site coverage	Plot NT02
Summary scope of works	Review of previous reports; interpretation of recently acquired hydraulic conductivity field tests data; refinement of the hydrogeological assessment of the

	site; preparation of a controlled waters DQRA, using the EA's Remediation Targets Methodology.
Does the client have reliance upon the report?	Yes
Key findings relevant for the remediation strategy	The main contaminants of concern identified at the site are TCE detected as a diffuse source within the unsaturated soils in the south of the site (Plot NT02) within the footprint of the historic bolt works and TCE, its daughter products, DCE and VC and carbon tetrachloride present as a dissolved phase plume within the underlying the Chester Formation (sandstones), designated as principal aquifer by the EA. The following plausible potential pollutant pathways in relation to sensitive controlled waters: • migration of leachable contaminants from impacted soils present in the unsaturated zone • vertical and lateral migration of dissolved phase contaminants within the Chester Sandstones (CHES) and the Manchester Marls (MM) aquifers. • Lateral migration of dissolved phase contaminants within the CHES and MM to the River Irk approximately 20.00 m to the north pf the site Remediation Targets Values have been derived for the protection of the Chester Sandstone aquifer, using the EA's RTM, at a compliance point of 50.00 m from the boundary of the source zone, has been adopted, in accordance with the current guidance. Screening of the soil and groundwater results against the proposed RTV results in exceedances for TCE in soil at LK WS201, WS302, WS304, WS305 and WS308 in the south of Plot NT02 and three exceedances at for groundwater at LKBH03, RBH203 and RBH303 located in the south of Plot NT02 and approximately 5.00 m beyond the eastern site boundary within Plot NT03. An exceedance of the is also reported in groundwater for DCE and VC at LKBH01 in the north of the site. In accordance with this remediation shall be required at the site. Subject to agreement of the targets derived with the EA, the derived RTVs should be used to inform remedial works at the site.

4 SUMMARY OF CONCEPTUAL MODEL AND RISK ASSESSMENT

4.1 Introduction

The Conceptual Site Model (CSM) is a key tool to enable linkages between contaminant sources, pathways, and receptors to be assessed in accordance with the DEFRA and Environment Agency Environment Agency (EA) publication, the Model Procedures for the Management of Land Contamination (CLR11).

A CSM was initially developed within the RoC Phase 1 Desk Study report (ref. 4328-ROC-ZZ-XX-RP-ES-PH1DTS, dated January 2023) and subsequently refined during the following phases of ground investigations and associated Phase 2 Site Investigation report (SIR) (RoC ref. 4328-ROC-ZZXX-RP-ES-P2-101, dated December 2023), as reported in **Section 3.** In addition, a conceptual site cross section indicating the various relationships and interactions between the underlying geology and contamination has been collated and is provided at **Figure 2.**

Based on the findings of the previous works, but largely based on the RoC (2023) SIR, a summary of the refined CSM is presented in the following sections and tables, in terms of geology, hydrology, hydrogeology and potential pollution linkages, including discussing the contamination type, concentrations and lateral & vertical distribution in soils and groundwater.

4.1.1 Geology

A summary of the ground profile Plots NT02 - NT04 are included in the following **Table 4** below.

Table 4: Geology at the site

Geological unit	Description	Historically encountered thickness (m)
Made Ground	In **Plot NT02** there is a surface covering of concrete and tarmac within and outside of buildings which is typically underlain by made ground of demolition fill type material. Typically, this is a gravelly sand or sandy gravel containing whole and half bricks and chunks of concrete; gravel of brick fragments, slate, clinker, and slag. Other anthropogenic inclusions include wire, metal, glass, plastic, metal pipes and beams, clay pipes, fabric, rubber, and timber.	2.50 (m)
	In **Plot NT03** there is a surface covering of concrete and tarmac within and outside of buildings which is typically underlain by made ground of demolition fill type material.	
	The southern part of **NT04** is surfaced with a concrete slab while the remainder comprises overgrown vegetation and weeds. Made ground was generally encountered as a gravelly sand or gravelly clay containing clinker, concrete, brick, slag, slate, coal, and ceramics. Within **TP214 material suggestive of an informal domestic waste landfill was encountered** with domestic products such as food	8.40 (m)

Geological unit	Description	Historically encountered thickness (m)
	containers, plastic, clothing, rubber, rebar, and sheet metal encountered. This material appears to be limited to the immediate vicinity of TP214 and no similar material was encountered in neighbouring exploratory holes.	
Superficial deposits – River Terrace Deposits (RD) ***(Plot NT03 only)***	Encountered in **Plot NT03** at (RBH304) beneath made ground, as rounded sandy gravel of sandstone, quartzite and siltstone from a depth of 3.60 m to termination at a depth of 9.45 m. Also encountered within NR mound boreholes (RBH401 - RBH403) beneath the made ground as medium dense gravelly sand becoming silty and less gravelly in areas. It is also feasible these soils may extend further to the east into Plot NT04.	5.85 (m) not fully proven by drilling
Superficial deposits – Till (Devensian)	Underneath **Plot NT02,** the Till is often thin and sometimes comprises granular soils. Most typically Devensian Till was encountered as brown sandy gravelly clay ranging in consistency from very soft to stiff but generally becoming stiff with depth.	2.50 (m)
	Underneath **Plot NT03**, the Till was encountered as a firm to stiff slightly gravelly slightly sandy clay.	5.80 (m)
	Underneath **Plot NT04**, the Till was typically encountered as a stiff brown or blueish grey clay, slightly gravelly in places. The Till is thickening progressively from West to East.	7.80 (m)
Bedrock – Chester Formation (Lower Triassic Sandstones)	**Plot NT02** Bedrock of the Chester Formation (CHES) was encountered beneath Devensian Till deposits in all locations in NT02. The upper horizons of the Chester Formation were encountered to be significantly weathered and are effectively sand for up to the first 8.00 m. Deeper horizons of the bedrock also show weaknesses and may be affected by faulting.	15.07 (m)
	Plot NT03 Bedrock of the Chester Formation was encountered beneath Devensian Till deposits in all locations in NT03; the upper horizons of the Chester Formation are significantly weathered and are effectively sand for up to the first 6.00 m. Deeper horizons of the bedrock also show weaknesses and may be affected by faulting.	1.0 (RBH306) – 6.32 (RBH206, Plot NT04 west)
	Plot NT04 Bedrock of the Chester Formation was encountered in only one location at the western edge of NT04, RBH206. The upper horizons of the Chester Formation are significantly weathered. The Chester Formation is thinning progressively from West to East.	Absent
Bedrock – Manchester Marls Formation (Upper Permian mudstones)	**Plot NT02** Reddish brown mudstone recovered as clay when weathered, with interbedded siltstone laminated layers and layers of weak reddish brown fine grained sandstone, up to ~3.00 m thick.	Manchester Marls Formation (MM) was proven by drilling up to a depth of 25.00 mbgl.
	Plot NT03 Reddish brown mudstone and fine to medium grained reddish brown sandstone in layers up to 1.50 m thick.	

Geological unit	Description	Historically encountered thickness (m)
	Plot NT04 Reddish brown mudstone and weak reddish brown fine grained sandstone and siltstone thin layers < 1.00 m.	
Source: On-site exploratory hole records presented in RoC Phase 2 report.		

Exploratory hole locations from the previous phases of ground investigation completed by RoC are provided within **Appendix C.**

4.1.2 Hydrology

A summary of the hydrology within the site area is presented in **Table 5**.

Table 5: Summary of hydrology in site area

Condition	Description
Surface watercourses/features	The nearest surface water feature (River Irk) is indicated 21.00 m to the north. Water quality of this receptor indicates a GQA Grade of "E" (Poor) and a flow rate of less than 2.5 cumecs. The riverbed level is approximately at 26.30 mAOD and the surface water level at 26.90 mAOD in proximity of the site (as confirmed by RoC Consulting who have completed site level and earthworks appraisals). The river levels are comparable to the static groundwater elevations in the north of the site (around the time of the site levels survey in June 2023) at LK BH01 at 26.63 mAOD installed within the CHES and MM indicating that there is likely some connectivity between groundwater in the north of the site and the River Irk.
Surface water abstractions	There are no active surface water abstractions at the site or within 500 m of the site boundary. The nearest active discharge consent is indicated 73.00 m to the northwest and held by United Utilities for the release of storm sewage overflow into the River Irk.
Site drainage	Surface drainage from the site appears to discharge into a local network to an outfall point into the existing adopted sewer network. Any areas of open ground or broken hard standing across the site (or damaged drainage runs) allow surface water to infiltrate into underlying soils and likely provide inputs into the underlying groundwater table, although quantification of these inputs is not possible at time.
Preliminary flood risk assessment	The indicative floodplain map for the area, shows that the site lies within the designated floodplain of the River Irk, with a long-term flood risk classified as 'medium', according to latest info on gov.uk website, meaning that this area has a chance of flooding of between 1% and 3.3% each year.

4.1.3 Hydrogeology

Table 6 provides a summary of hydrogeology information for Plots NT02, 3 and 4 in terms of groundwater levels and flow field, hydraulic gradient, hydraulic conductivity and infiltration.

Table 6: Summary of hydrological setting

Condition	Description
Aquifer characteristics	The central-western part of the wider site (approximately Plots NT02 and 03) is underlain by the CHES principal aquifer. The eastern part of the wider site (approximately PlotNT04) is underlain by a secondary aquifer relating to the MM. Given the variability in the bedrock geology encountered beneath the site groundwater movement (vertical and lateral) via fracture flow and pore flow may be active processes beneath the site. However, it is likely that the majority of the groundwater flow is occurring in the upper weathered portion of the bedrock. The thickness of the weathered CHES is between approximately 2.60 m and 8.00 m, the thicker part is located mostly within Plot NT02 and extending into Plot NT03, among holes RBH201, RBH202 and RBH203. The thickness of MM is unproven but was found to underlie either the CHES formation or glacial till beneath the entire site, dipping roughly from east to west across the site with a low point in the south west corner of Plot NT02 (depth circa 18.30 mbgl to top of MM at BH502). When considering both Formations, the thickness weathered bedrock shows a peak (i.e., thicker weathered bedrock area) mostly within Plot NT02, and a (much larger) depression (i.e., thinner weathered bedrock area) mostly within Plot NT04, extending off-site to the south up to Bromley Street.

Condition	Description
Groundwater depth and flow	Throughout the monitoring period, covering a full hydrological year, the following can be highlighted: • A single well screened in the Made Ground deposits (WS311) was found to contain groundwater. Groundwater in this location had a hydraulic head varying between 34.64 and 34.51 mAOD over a monitoring period from April to August 2023. • The hydraulic head of the well screened in RBH304 in the River Terrace Deposits located in the centre south of Plot NT03 ranges from 27.25 (April 2023) to 27.43 mAOD (June 2023), it should be noted however that this well was largely dry and these levels may be attributable to rainfall infiltrating into the well. • The hydraulic head of the subsequently installed RBH403 ranges from 29.23 to 29.11 mAOD (November 2023). RBH401 which was also installed within the River Terrace Deposits at the same depth and with the same response zone as RBH403 was dry during all visits. The groundwater within RBH403 is therefore likely to be an isolated pocket of groundwater sitting above the low permeability clay encountered at 26.53 mAOD in this location which was not encountered at RBH401. • The hydraulic head of the wells screened both in the CHES and the MM (only two holes have screens in both formations, LKBH01 and LKBH03) ranges from 26.63 mAOD (LKBH01 nearby the river in the northwest of site, in June 2023) to 27.13 mAOD (LKBH03 in the southwest of the site, in January 2023). • The hydraulic head of the wells screened in the CHES ranges from 26.44 mAOD (RBH305 nearby the river in the centre-north of Plot NT03, in June 2023) to 27.60 mAOD (RBH302 in the southwest of Plot NT02, in November 2023). • The hydraulic head of the wells screened in the MM ranges from 25.78 mAOD (RBH205 nearby the river in the north of Plot NT04, in September 2022) to 29.74 mAOD (RBH306 in the centre-east of Plot NT03, in April 2023).
Hydraulic gradient	Results from various monitoring events across all seasons indicates a degree of variability with groundwater tables, aquifer characteristics and groundwater flows, with a mixture of highly permeable and lower permeability bedrock formations beneath the site separated by a geological fault roughly along its centre. This geology is reflected by variance in hydraulic heads between monitoring wells and increases in hydraulic gradient. Overall, the groundwater flow within the CHES formation appears to be trending from southwest to north/north east toward the River Irk and in line with local surface topographical features. Flows within the deeper MM formation appear to trend from east to west with some evidence of northern flow patterns also. The results from both rounds of investigations have been used to increase our understanding of groundwater flows and potential interactions with contaminants present on site
CHES hydraulic conductivity	The calculated geometric mean from the site data (0.82 m/day) is considered suitable for adoption within the DQRA model set up

Condition	Description
Infiltration	Approximately 95% of the site is anticipated to be hardstanding and/or covered by buildings, thus increasing runoff; as such, the overall infiltration (aquifer recharge) has been estimated to be approximately 20% of the total rainfall (~173 mm/year).

4.2 Quantitative risk assessment

4.2.1 Human health – heavy metal, PAH and VOC contamination (Linkage 1)

Exceedances of human health criteria have been observed in Made Ground soils across all plots. Primarily these comprise lead, with others such as PAHs distributed less frequently. In addition, TCE contamination was found to be concentrated within made ground soils beneath the warehouse in Plot NT02 (and a limited area of Plot NT03). Whilst only one sample of this material exhibited concentrations exceeding GACs, levels were found to be elevated within almost all samples tested in this area, The criteria used for this assessment was based on the location of the sampled soil with respect the proposed land use within the proposed development plan (following agreement with Manchester City Council of a mixed commercial/POS GAC screening criteria for the development to reflect ground floor end uses).

As the development layout is to comprise only commercial units at ground level, it was considered appropriate to screen soils collected from areas beneath proposed hard standing against commercial GACs, whereas soils beneath proposed soft landscaping were screened against GACs for public open space. It is considered future site users could be at risk of exposure to sources of contamination these proposed areas of soft landscaping. Remediation measures will be required to break the linkage between contaminants present within the shallow made ground on site and future occupants/maintenance/construction workers, in such proposed soft landscaped areas.

4.2.2 Human health - Asbestos (Linkage 2)

Asbestos in the form of loose fibres amosite, chrysotile, chrysotile and crocidolite, as well as a chrysotile fragment were identified in 18 of the 76 samples tested across the site throughout the previous site investigations undertaken by RoC. The asbestos sample concentrations were ranged between <0.001% to 0.013% by weight. A single chrysotile fragment was identified with a maximum concentration of 2.6% w/w within TP203 (1.20 mbgl) at Plot NT03. A potential linkage therefore exists between asbestos that has been identified on site for the future site users, and for construction workers and users of adjacent sites during development works.

4.2.3 Ground gas (Linkage 3)

4.2.3.1 Plot NT02

Ground gas monitoring has revealed elevated levels of Carbon Dioxide and depleted Oxygen levels in monitoring wells installed into made ground and shallow natural deposits on Plot NT02. Carbon Dioxide levels are consistently above 5% on this plot and on occasion in exceedance of 10%.

Ground gas protection will be a requirement in new buildings in accordance with a CIRA C665 CS2 scenario at this Plot. This portion of the site is also locally affected by TCE soil and groundwater contamination. The TCE contamination has the potential to release gas vapour that could pose a risk to human health that may require remedial measures in buildings in this area.

4.2.3.2 Plot NT03

The results of return ground gas monitoring at Plot NT03 recorded a peak CO_2 concentration of 8.3%, whilst flows where generally negligible. Although these values yield a worst case GSV which falls within the threshold of CS1, in line with CIRIA guidance the Plot has been characterised as CS2 (low risk) given that CO_2 levels within WS310 were frequently greater that 5%.

The origin of the Ground Gas appears to be ashes and foreign matter, wood, cloth within the made ground materials.

Ground gas protection will be a requirement in new buildings in accordance with a CIRA C665 CS2 scenario at this Plot.

4.2.3.3 Plot NT04

The ground gas monitoring results from Plot NT04 record a maximum CO_2 concentration of 4.4% at WS211 and maximum flow rate of 0.1l/hr, yielding a GSV of 0.0044/hr which falls within the threshold of CS1 (very low risk). Ground gas protection measures are not a requirement at Plot NT04.

4.2.4 Controlled waters (Linkage 4)

4.2.4.1 Groundwater

Heavy Metals, TPH & Other Inorganics

The most sensitive controlled water receptor is considered to be groundwater within the Chester Sandstone Formation (CHES - Principal aquifer) and the Manchester Marl Formation (MM - Secondary aquifer). Whilst exceedances of sulphate, manganese, and nickel where recorded when comparing soil leachate concentrations to DWS, the marginal and localised nature of these exceedances suggest that they do not pose a significant risk to wider groundwater quality (namely the CHES and MM aquifers).

Benzene

Benzene exceedances were reported in groundwater in the CHES and the MM in the north of Plot NT02 and TPH fractions aliphatic and aromatic C12-C16, and benzene are reported to exceed the DWS in the southwest of the plot. It was concluded that these contaminants are most likely to have migrated onto site from off-site sources to the west and south.

Since the majority of the benzene contamination is in the deeper marl (secondary B aquifer) and not in the overlying principal sandstone aquifer and since it is most likely due to an off-site source, benzene was not considered to be a primary risk driver for site remediation. However, consideration of this potential off site contamination source is covered within the recommendations for our Discovery Strategy (see **Section 7.8**).

VOCs

Exceedances of TCE was recorded to exceed DWS within groundwater samples collected from the CHES within the southern portion of NT02 (beneath the warehouse) and also within the western portion of NT03, close to the boundary between NT02. Several other VOC namely, carbon tetrachloride exceeded DWS, predominantly in the shallow sandstone in the south of Plot NT02, and at the western portion of NT03. TCE daughter compounds cis-1,2-dichloroethene, trans 1,2-dichloroethene, vinyl chloride were reported to exceed the DWS in the CHES in the north of Plot NT02, and in the west of NT03 supports the predicted groundwater model for the CHES which indicates a flow direction towards the north-northeast.

Some migration of chlorinated VOC into the deeper sandstone and top of the MM was also detected, however given that concentrations were significantly lower than those reported in the CHES, was considered that migration of chlorinated VOC is primarily occurring in the higher permeability CHES formation.

Based on the results of the groundwater screening assessment, the following priority contaminants of concern CoCs were taken forward to DQRA:

- TCE
- Carbon tetrachloride
- Cis and trans-1,2-dichloroethene

Based on the initial screening assessment, it was considered that groundwater table and leachate potential beneath Plot NT02 was the most significantly impacted in terms of these contaminants, and therefore would be the main focus of the DQRA. CoCs detected within the groundwater in the western portion of Plot NT03 would be addressed as part of the DQRA for NT02.

DQRA modelling indicates that the TCE detected in unsaturated soils and the existing TCE dissolved phase plume, and its daughter products pose a potential risk to the wider principal aquifer primarily. The DQRA assessment noted that the predicted levels of TCE at identified off site compliance points would pose a risk to controlled waters and a series of remedial target values for soils and groundwater were produced for inclusion within this remediation strategy (see **Section 5**).

4.2.4.2 Surface water

The nearest down gradient surface water receptor is the River Irk located approximately 21.00 m to the north of the site and is reported to be of low water quality (Grade E). A gas works is located adjacent to the northern site boundary between the site and the River Irk. There are also numerous other potentially polluting current and historic industrial sites within the vicinity of this stretch of the River Irk including a dye works and additional gas works.

The River Irk is considered a sensitive receptor to mobile contamination beneath the site, however, its proximity to the site in comparison to the underlying Principal Bedrock aquifer, makes it a secondary risk receptor. The primary risk receptor and driver for remediation works will be the underlying Sandstone aquifer and the treatment and improvement of water quality within this receptor that will arise from remedial works will also reduce risks posed by offsite contaminant flows down gradient to the River Irk.

4.2.5 Creation of potential exposure pathways as a result of piling works (Linkage 5)

Given the anticipated building loadings coupled and the presence of contaminated soils the adoption of conventional shallow foundations is not considered appropriate in this instance. The use of a piled foundation solution is recommended, with piles taken to competent rock within the Chester Formation and Manchester Marls Formations. In addition, it is proposed that a new piled retaining structure will be constructed in the southern area of NT03 to support adjacent Network Rail land to the south. It is considered that currently, a risk to controlled waters is posed by a diffuse source of TCE and daughter products) present within the unsaturated made ground in the southern area of NT02 and southwestern area of NT03, which will be remediated via source removal prior to the commencement of the development (the methods by which are detailed in later sections of this report).

The adoption of piled foundations has the potential to create preferential pathways for contaminants within the made ground on site to enter the underlying Principal and Secondary aquifers of the Chester and Manchester Marls Formation. The risk will need to be further evaluate through the completion of a piling risk assessment by the contractors at such a time when the precise nature, depth and design of piling is known.

4.3 Contaminant linkages requiring remedial action

Following the quantitative risk assessment, the following contaminant linkages were identified as still being potentially complete and requiring remediation or mitigation measures to be incorporated into the redevelopment planned for the site:

- Linkage (1) – Plausible contaminant linkage to site occupants/workers and off-site residents/workers by dermal contact/inhalation of vapours/dusts of heavy metals, PAH and VOCs
- Linkage (2) – Plausible contaminant linkage to site occupants/workers and off-site residents/workers by inhalation of airborne asbestos fibres from impacted soil
- Linkage (3) - Plausible contaminant linkage to future site workers and occupants from migration of onsite and offsite ground gasses and vapours into indoor areas via preferential pathways (such as backfill around services or compromised drainage) with subsequent risk of inhalation, asphyxiation or explosion.
- Linkage (4) – Plausible contaminant linkage to Principal and Secondary B aquifers (CHES and MM) from leachable contaminants in impacted soils in the unsaturated zone and vertical and lateral migration of leachable contaminants.
- Linkage (5) – Creation of potential exposure pathways to controlled waters as a result of piling works

4.4 Geotechnical risks

Given the size and height of the structures proposed piled foundations will be required. In respect of this solution two Geotechnical risks have been identified.

Geotechnical Risk 1 (GR1) - The site has had several phases of building and relict foundations, slabs and roadways are widespread and will potentially act as obstructions

to piling. The majority of these are concentrated within the Made Ground, with some penetration into the underlying till, and weathered marl and Chester Formation.

Geotechnical Risk 2 (GR2) - Sulphate attack on concrete. Aggressive ground conditions are present predominantly within the Made Ground. If left in-situ or replaced this will require DS2/AC2 grade concrete.

5 REMEDIAL TARGET VALUES FOR CONTROLLED WATERS

The RSK (2023) Controlled Waters DQRA (CWDQRA) reports the modelled preliminary remedial target values (RTV); these are level 2 soil remedial targets and level 3 groundwater targets. The comparison of the RTVs with the soil and groundwater results included in **Appendix F** show the following soil and groundwater exceedances, to inform the remediation of the site.

Table 7: Soil and groundwater RTV for controlled waters

COPC	Soil RTV (mg/kg)	Locations of soil RTV exceedances and max concentration (mg/kg)	Groundwater RTV (mg/l)	Locations of groundwater RTV exceedances and max concentration (mg/l)
Trichloroethene (TCE)	0.224	LK WS201 0.7m bgl (5.40) WS302 1.50 m bgl (0.602) WS304 0.50 m bgl (0.23) WS305 1.00 m bgl (0.427) WS308 0.60 & 1.00 m bgl (max 1.13)	0.0271	LKBH03 (max 0.250), RBH203 (max 0.572), RBH303 (max 0.277)
Carbon tetrachloride	0.116	NR	0.149	RBH203 (max 0.265), RBH302 (max 0.207)
Cis and trans-1,2-dichloroethene	NA	NA	0.0902	LKBH01 (max 0.602) RBH301 (0.102) RBH503 (0.100) RBH504 (0.151)
Vinyl chloride	NA	NA	0.00425	LKBH01 (max 0.016) RBH503 (0.044)
Notes: NR – no RTV exceedances recorded NA – DCE and VC not included in the leaching pathway model				

6 REMEDIAL AND DEVELOPMENT OBJECTIVES

6.1 General

The following remediation strategy has been completed following on from completion of the site investigation works as presented below.

6.1.1 Remediation Objectives

In preparing the Remediation Strategy, several key objectives will be taken into consideration. These can be split between management objectives and technical objectives as follows:

6.1.1.1 Site Specific Technical Objectives

The assessments have identified that the key risk to the future development, which require addressing within the Remediation Strategy are:

- **Human Health Risk** to development and maintenance workers, future users from direct contact (dermal contact, ingestion and inhalation) with contaminated soil and (inhalation via dust) site neighbours. **(Linkage 1)**
- **Human Health Risk** to development and maintenance workers, future users from (inhalation) of loose asbestos fibres. **(Linkage 2)**
- Risk to maintenance and development workers (excavations and confined spaces), future end users, future building structures (CS2 Levels of protection required at Plot NT03 only) from Elevated Levels of Carbon Dioxide **(Linkage 3)**
- **Risk to the underlying Principal and Secondary B aquifers (CHES and MM)** from leachable contaminants in impacted soils in the unsaturated zone and vertical and lateral migration of leachable contaminants **(Linkage 4)**
- Risk of potential exposure pathways to underlying Principal aquifer within the Chester Formation and Secondary aquifer within the Manchester Marls Formation and as a result of piling works **(Linkage 5)**

6.1.2 Technical objectives

General technical objectives to be achieved;

- Following the remediation work the Site will not be considered ‘Contaminated Land’ as defined by Part 2a of the Environmental Protection Act 1990 and as such there will be no residual liability for future land owners;
- the remediation options employed must be effective in reducing or controlling the identified contamination risks to the future development to an acceptable level;
- the remediation options must be feasible and practical taking into consideration factors such as the ground conditions, environmental setting, ecological issues and the phasing of the development and not involve excessive cost;

- sustainability of the strategy in terms of how it fits other environmental objectives e.g., habitat enhancement, use of natural resources and avoiding or minimising adverse environmental impacts e.g., transportation, water, environment, air and off -site landfill disposal
- to integrate remediation design with geotechnical design, and
- to consider the additional benefits of the strategy in terms of enhancement of amenity and ecological value.

6.1.3 Management objectives

- To produce a Remediation Strategy that will permit the construction of the residential development and associated landscaping.
- To produce a remediation strategy that can be agreed with all key regulatory stakeholders.
- To meet all regulatory requirements applicable to the development of contaminated land and to consider the views of stakeholders on how significant risks should be managed.
- To meet all regulatory requirements during the implementation of the remediation.
- To comply with all current UK guidance where appropriate, to avoid unacceptable health and safety and environmental impacts during the remediation.
- To carry out the remediation in accordance with good technical practice.
- To give due consideration to the management and mitigation of potential unforeseen sources of contamination that may be revealed during either remediation or main construction phases.
- To provide commentary and guidance on the retention of groundwater monitoring wells required to support remediation works including the protection of infrastructure, frequency of monitoring/sampling and their subsequent decommissioning.
- To provide commentary on short term contingency measures that are to be employed during site construction or remediation works to prevent the unintentional mobilisation of contamination present beneath the site.
- To achieve successful phased remediation within the timescales and budgets required by the development.
- To mitigate as far as reasonably practical the nuisance and inconvenience to the wider community.

7 REMEDIATION STRATEGY

7.1 Introduction

This section outlines the general principles underpinning the proposed remediation. This report should be used by contractors to collate a Remediation Method Statement for the works within which further details and elaboration on the implementation of remediation requirements outlined below are provided, along with details of associated control measures and validation/monitoring requirements.

7.2 Primary and secondary contamination source removal

7.2.1 Excavation, on-site processing and off-site treatment/disposal of TCE impacted unsaturated soils

TCE and its breakdown products DCE, VC and carbon tetrachloride, have been detected as a diffuse source within the unsaturated made ground soils on site on site. Much of the soil contamination is concentrated within the southern portion of Plot NT02 and southwest of NT03. Whilst only a single exceedance of TCE against commercial GACs was recorded as part of the screening assessment for human health (though it should be noted that elevated concentrations of TCE were detected in the majority of exploratory hole locations in this area), the risk to controlled waters posed by the presence of the TCE impacted soils has been proven by the prevalence of VOC contamination within the groundwater of the CHES (principal aquifer) in this area. Thus, the risk to controlled waters is considered the main driver for the remediation of this material.

The general area of VOC impacted unsaturated made ground soils has been proven during previous ground investigation by virtue of visual and olfactory evidence of contamination and laboratory testing. The area generally encompasses the southern portion of NT02 and southwestern portion of NT03 within the footprint of the former bolt works as shown in Figure 4328-ROC-ZZ-XX-DR-ES-ES208 and extends to a depth of c. 2.00mbgl (which encroaches into the underlying Till and weathered CHES).

Remediation works will require excavation and treatment/removal of TCE impacted soils in this area.

This method would involve the selective excavation of contaminated soils, on site processing (screening, handpicking, testing) to recover an acceptable fraction and off-site disposal of the heavily impacted soils for either further treatment at an offsite recovery centre or disposal to landfill.

The DQRA model and associated assessment assumes a more conservative primary soil source area of being the entire footprint of the former Nut & Bolt works that was historically located in this area of the site. In order to confirm the precise extent of the affected area, the contractor shall complete a program of soil sampling and inspection across this area on a 5.00 x 5.00 m grid. The sampling and inspection shall comprise the formation of machine excavated trial pits to depths circa 2.00 -3.00 m with a visual inspection of soils completed, PID screening and sampling of chemical analysis at an accredited testing facility to check for levels of TCE and its daughter products.

This sampling will allow confirmation of the area of soil removal as well as its likely depth. The results from this plume confirmation exercise should be recorded for inclusion within the site validation report.

This approach to final soil plume delineation and removal would serve to:

- Remediate risks relating to soil contamination in the area (contaminant linkages 1, 2, 3 ,4, and 5) as well as geotechnical risks GR1 (buried obstructions & foreign matter) and possibly GR2 (requirement for sulphate resistant concrete dependent on the acceptability criteria selected for re-use of soils on the site).
- Allow the recovery of coarse granular material, suitable for use within piling mats, which may offset the requirement to import material.
- Reduce the risk of exposure from soil borne contaminants in the area to construction workers.
- May negate the need for a cover layer in proposed soft landscaped areas provided backfill material meets the import/reuse criteria set in this strategy
- Reduce or remove the secondary risks of soil vapour ingress into new structures associated with TCE and other VOC contaminants.

Current earthworks models for the development predict significant cut of the made ground material across the site (net cut of c. 37,500 m^3) will be required to achieve formation levels. This includes a cut of c. 1.00 - 2.00 m across the southern area of NT02 and southwestern NT03. While this will remove a significant portion of the impacted made ground material, additional excavation will likely be required beneath the existing enabling works cut/fill level to ensure all contaminated material is sufficiently remediated. This may lead to an increase in the proposed excavation and filling volumes.

Processing of the excavated material will likely significantly reduce off-site disposal volumes. Further details on the requirements for material reuse is included within **Section 7.8**.

Soils containing elevated levels of VOCs are unlikely to be acceptable for re-use on site without further treatment. Soils contaminated with high levels of entrained loose asbestos fibres may require offsite disposal to landfill. Further details on off-site disposal requirements are included in **Section 7.9**.

7.2.2 Removal of domestic landfill material identified at Plot NT04

During the October 2022 RoC site investigation works, material suggestive of an informal domestic waste landfill was encountered with domestic products such as food containers, plastic, clothing, rubber, rebar, and sheet metal. This material was encountered within TP214 at Plot NT04. No similar material was encountered in neighbouring exploratory holes, suggesting that this material appeared to be limited to the immediate vicinity of TP214. There will be a requirement for all such landfill waste material encountered in this location to be chased out during the enabling works, excavated and removed off site to an appropriately licensed treatment or disposal facility. Further details on off-site disposal requirements are included in **Section 7.9**.

7.2.3 Management of previously unidentified contamination

Other sources of contamination (e.g. below ground storage tanks, significantly contaminated soils, immediate risks to controlled waters) and secondary sources (e.g., lower-level soil contamination, minor or localised hydrocarbon impacted material) requiring removal have not been identified at the site. An initial strategy for the management of unanticipated contamination has been collated and is provided within **Section 7.**

7.3 Remediation of contaminant linkage 1 (Human Health – heavy metal, PAH and VOC contamination)

7.3.1 Use of an imported clean soil cover layer

On completion of the development, the majority of the site will comprise of surface hard cover (buildings and car parking) and, where present, this will be sufficient to provide a physical breakage in the contaminant linkage toward end-users of the site, however there are several communal green planting and green paving/soil cell areas proposed (shown as orange and green areas respectively on **Image 1**).

Given the incidence of contamination observed within the shallow made ground soils across Plots NT02, NT03 and NT04, site-derived “topsoil” or made ground will not to be suitable to remain within 600 mm of soft cover finish level and imported natural sub and topsoil’s will be required to be used as fill in these areas.

A minimum 600 mm capping layer will be required in proposed soft landscaping zones with 600 mm taken as the depth below final finished floor levels. Site won soils excavated from these soft standing areas will need to be either retained on site (where possible) beneath areas of hard standing; or disposed of from site to a suitably licensed facility.

Any imported soils used in these areas should be subject to chemical validation testing of material imported and compared against the range of determinants and requirements for a simple soil cover system presented in **Section 7.3** (and in accordance with validation requirements outlined in **Section 8**). In addition, any material used as capping in these soft landscaped areas will need to possess sufficient infiltration characteristics to allow site drainage networks to function.

Photographs recording that the soil capping depth has been achieved will be required once completed along with information on the source for any imported clean soils. Photographs should include a survey staff for measurement as evidence the 600 mm capping requirements have been achieved. This information will be required for completion of the Phase 3b Site Validation Report for the project.

7.4 Remediation of contaminant linkage 2 (Human Health – Asbestos)

Asbestos in the form of loose fibres (chrysotile, amosite, anthophyllite and crocidolite) and fragment (chrysotile) have been identified in 18 of the 83 samples of made ground scheduled for analysis throughout previous investigations by RoC. 11 of the 18 samples subjected to quantification analysis recorded asbestos concentrations above the laboratory lower limit of detection of 0.001%.

The distribution of asbestos in soil detected during previous site investigation suggests that the asbestos is likely to be consistently present throughout all plots. As such it will be necessary to employ asbestos mitigation measures during the redevelopment work to safeguard the health and safety of site staff and users of adjacent sites (further details of which are provided in this section).

7.4.1 Use of a clean soil cover layer

Where hardstanding is proposed as part of the development, this will serve as a physical breakage to prevent the exposure of future end users to asbestos within the made ground. Where soft standing is proposed, there will remain a contaminant linkage between the made ground soils and site end users. Remediation measures will be required in these areas via the implementation of a clean cover system, the specification of which should be as per **Section 7.3.1** in order to sever the pathway of contamination to future users.

7.4.2 Safety of construction workers during ground works

Asbestos fibres are released more readily from granular soil. Exploratory hole records for previous investigations at the site indicate that the large majority of made ground underlying the site. Fibres are also released more readily during dry and windy conditions with fibre release reduced when soil moisture contents are maintained greater than 10%. Asbestos fibre concentrations in the soil range between <0.001% and 0.013%. To prevent, where practicable, exposure and spreading of asbestos fibres in line with the Control of Asbestos Regulations (2012) mitigation measures are recommended (see **Section 7.4**).

7.4.3 Users of adjacent sites during the earthworks

The site generally lies within a commercial/industrial setting, with a viaduct to the north, various works to the north and discussed Plot NT02 to the west. However adjacent to the east of Plot NT04 are residential dwellings, as well as an active caravan site to the northwest of Plot NT03. Immediately adjacent to the west of Plot NT02, is the Victoria Riverside Project, which is currently undergoing construction. Given the potential close proximity of the general public to the proposed works, this linkage will require mitigation measures to prevent, where practicable, exposure to adjacent occupants in line with the Control of Asbestos Regulations (2012) (see **Section 7.4**).

7.4.4 Mitigation measures for dealing with asbestos

It is likely that the identified asbestos in soil relates to asbestos containing materials (ACMs) historically contained within the building fabric of demolished former structures (such as the former screw and bolt works, foundry and asphalt and tripe works at Plot NT02, the unspecified works, demolished in the mid-20th century at Plot NT03, and Dalton Print Works demolished c. 2013 at Plot NT04) that have become mixed during the various phases of redevelopment at the site. From onsite testing, granular made ground, which is present across the majority of both Plots has been found to contain asbestos fibres and chrysotile cement. Therefore, asbestos mitigation measures should be implemented site wide.

It will be necessary to control the release of nuisance dust from the site during the works and such control will also limit the release of asbestos. RSK considers the works are not licensable and that notification of the works to HSE is not required.

To manage spreading and exposure risks RSK recommends:

- Excavations within the granular made ground and stockpiles comprising granular made ground (incorporating rubble waste) be dampened down.
- Stockpiles of granular made ground (incorporating rubble waste) to be covered.
- All site staff to receive training on the identification of ACM and an understanding of actions to be implemented if ACM is identified.
- A watching brief should be implemented during the excavation of all granular made ground to identify the presence of ACM.
- Implement stop work procedures if potential unforeseen ACM is identified.

To demonstrate these mitigation works are adequate and because of the potentially close proximity of general public, RSK recommends boundary monitoring be undertaken during periods when excavating, handling and transporting the rubble waste. Further details of the boundary monitoring are provided in the following subsections.

7.4.5 Mitigation measures to manage spreading and exposure

The asbestos contamination within the granular made ground presents a potential risk to site personnel and the general public during the development of the site. Disturbance of the made ground on site by vehicles and excavation activity has the potential to cause airborne fibre release. Fibre release is generally considered to be greatest from granular material with a low moisture content. This type of material is potentially present across the majority of the site. This shall be minimised by the implementation of the following control measures:

- The exposed made ground soil should be dampened down to reduce the potential for asbestos fibre release. The moisture content at the surface of the area being excavated and in any uncovered stockpiles of excavated made ground material should be maintained at >10%.
- To prevent spreading of potential asbestos contamination to ‘clean’ soils, where excavated granular made ground should, if possible, be stored on impacted areas that are later to be excavated and removed or on hard standing. If this is not possible, stockpiles should be placed on plastic sheeting.
- If stockpiles are to be left in place for more than 12 hours, leading to possible drying out (or sooner if the weather conditions dictate), they shall be covered to prevent the possible release of fibres.
- When impacted soils are required to remain on site outside of working hours then appropriate fencing and signage should be present to secure the area.
- Vehicle movements need to be managed to avoid spreading of asbestos fibres. To minimise the potential for affecting natural soils within the site, vehicular movement routes should be signed and where possible loading areas will be restricted either to hard standing, or to haul roads constructed of ‘clean’ imported fill or natural clean soils from site.

- Should the exterior or wheels of any tipper lorry be affected by potentially contaminated material, a vehicle jet-wash will be used to clean the vehicle, with the wash water directed into the contaminated area.

7.4.6 Health and safety of site personnel

It is the responsibility of the principal contractor and any appointed sub-contractors to enforce an appropriate health and safety regime for all site personnel. Full details regarding the proposed working practices in connection with the remediation works shall be agreed in advance of the commencement of the works with the Principal Designer.

A project health and safety plan will be produced before site works commence. This will detail the anticipated hazards associated with the site work, for example asbestos, machinery and open excavation. It will also detail the control measures that will be put in place to reduce these risks to an acceptable level. This plan will also document emergency procedures and include the address and location of the nearest hospital with an A & E department. A copy of this will be made available to principal contractor before commencement and also kept on site and made available on request.

RSK engineers carry their own personal protective equipment, as detailed in RSK's in house procedures. This includes respiratory protection and protective clothing where it is considered necessary. Measures will be necessary to protect the health and safety of site workers during the site works. The contractors will be under a statutory obligation to take reasonable care to protect the health and safety of their employees. The following measures are suggested to provide a minimum level of protection.

- All site staff should undergo asbestos awareness training as part of the site induction.
- All ground workers on-site should be issued with protective clothing, respiratory protective equipment to FFP3 standard, footwear and gloves. These should not be removed from site, and advice should be given on when and how they are to be used.
- Care should be taken to minimise the amount of dust and mud generated on-site.
- Good practices relating to personal hygiene should be adhered to on-site, i.e., food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.

Reference should also be made to the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

7.4.7 Mitigation measures to manage unforeseen ACM

Owing to the potential for previously unidentified concentrations of ACM throughout excavation of granular made ground, RSK recommends a watching brief be maintained by a suitably experienced engineer. The engineer should carefully inspect the soil for the presence of previously unidentified ACM, such as clumps of fibrous asbestos, material that may contain asbestos such as board, rope, textile, vinyl or ceramics. Should the engineer suspect ACM from their visual observations, works should cease, and the situation re-evaluated. The duration and frequency of the watching brief can be reviewed during the works to allow certainty that an engineer is present during the higher risk operations.

Re-evaluation may require wetting of soil, additional monitoring, risk assessment and personal protective equipment to be adopted. Should it be necessary to obtain samples for bulk analysis or quantification of asbestos, samples will be taken in a controlled manner and utilising appropriate dust suppression techniques. Samples will be double bagged at the sampling location and uniquely labelled. The approximate location will be recorded on the site plan for future reference.

7.4.8 Air monitoring and analysis

Upon commencement of excavation works air sampling and counting of asbestos fibres should be undertaken.

The air monitoring should be undertaken during the first week of the excavation works only and reviewed after this time. If the fibre levels are above the limit of quantification (0.01 fibres/ml (f/ml)), additional air monitoring should be undertaken until the clearance levels are satisfied (0.01 f/ml).

The specific location of air monitoring will depend upon wind direction and the extent of the excavation works. Therefore, it will be determined upon arrival at the site on the day of monitoring. The monitoring location will be recorded by the engineer undertaking the 'watching brief'.

Where power is available on site, the results of air sampling will be determined on site following completion of the tests. Should power not be available, then fibre levels would need to be determined back at RSK's laboratories with results reported later the same day or first thing on the following day.

7.5 Remediation of contaminant linkage 3 (Ground Gas)

The results of ground gas monitoring undertaken by RoC during previous site investigations at Plot NT02 revealed a peak CO2 concentration of 13.4%, and negligible flow rate. Although these values yield a worst case GSV which falls within the threshold of CS1, in line with CIRIA guidance the Plot has been characterised as CS2 (low risk) given that CO_2 levels within several wells were frequently greater that 5%, **Ground gas protection measures protective of carbon dioxide will be required Plot NT03.**

Similarly, while Plot NT03 revealed a peak CO2 concentration of 8.3%, and negligible flow rate, CO_2 levels within WS310 were frequently greater that 5% which warranted a characterisation of CS2. **Ground gas protection measures protective of carbon dioxide will be required at Plot NT03.**

Based on the results of the return ground gas monitoring data obtained during the RoC site investigation, **Plot NT04 has been characterised as CS1 (very low risk) and therefore no ground gas protection measures are required at this Plot.**

The risks to development from ground gases have been assessed in accordance with BS8485:2015+A1:2019 (BS8485), which provides guidance on ground gas (methane and carbon dioxide) characterisation and hazard assessment, as well as providing a framework for the prescription of protection measures within new buildings.

Gas protection measures within new buildings are prescribed using a point scoring system, taking into consideration the CS and the proposed building type.

It should be noted that for membranes to achieve a point score greater than zero they should be:

- Sufficiently impervious to methane and carbon dioxide.
- Capable after installation of providing a complete barrier to the entry of the relevant gas.
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions.
- Sufficiently strong to withstand in service stresses (e.g., due to ground settlement if placed below a floor slab).
- Sufficiently strong to withstand the installation process and following construction activities until covered (e.g., penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools).
- Chemically resistant to degradation by other contaminants that might be present.
- Verified in accordance with CIRIA C735.

Verification of correct installation should be collected (including site photographs) for documenting in the site verification report.

7.5.1 Gas protection measures in buildings

Considering the CS determined for Plots NT02 and NT03 (CS2) and the proposed building type (Type B) a minimum point score of 3.5 will be required to achieve an adequate level of protection at this Plot. Solution scores are awarded for different of gas protection measures. BS8485 indicates the gas protection system should consist of at least two different elements from the list below to achieve the required gas protection score for a Type B building:

- structural barrier (floor slab/basement);
- ventilation measures;
- gas resistant membrane.

In order to achieve a score of 3.5, the recommended ground gas protection measures and method of construction is summarised in **Table 8** below.

Table 8: Recommended gas protection measures at Plots NT02 and NT03

Type of Gas Protection	Score
Cast in-situ monolithic reinforced ground bearing raft or reinforced cast in-situ suspended floor slab with minimal penetrations	1.5
Methane and carbon dioxide resistant membrane installed as per manufacturer's instructions	2
Total	**3.5**

The site developers will be responsible for the detailed design of the proposed gas protection, including installation and verification proposals. The gas protection membrane

should be selected specifically to mitigate vapour ingress to buildings as well as from ground gases.

7.5.1.1 *Cast in-situ monolithic reinforced ground bearing raft or reinforced cast in situ suspected floor slab with minimal penetrations*

Contrary to segmental floor construction methods, well-constructed cast in-situ reinforced concrete raft foundations, which are monolithic with few joints can provide resistance for ground gas ingress into buildings. In order to achieve the required point score of 1.5, the following floor structures would be considered suitable:

- Cast in-situ ground bearing monolithic reinforced industrial floor slab with minimal services entering the slab and few perforations.
- Suspended or semi suspended floor slab constructed from reinforced dense cast in-situ reinforced structural concrete, with minimal perforations.

7.5.1.2 *Gas resistant membrane*

A suitably designed and installed gas resistant membrane would achieve a point score of 2. To achieve a point score greater than zero they should be:

- Sufficiently impervious to methane and carbon dioxide;
- capable after installation of providing a complete barrier to the entry of the relevant gas;
- sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- sufficiently strong to withstand in service stresses (e.g., due to ground settlement if placed below a floor slab);
- sufficiently strong to withstand the installation process and following construction activities until covered (e.g., penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools);
- chemically resistant to degradation by other contaminants that might be present, and
- verified in accordance with CIRIA C735.

It is recommended that membrane specification data sheets be provided to RSK for comment prior to installation of the membrane on site.

All joints and penetrations of the membrane (notably utility services) should be lapped and sealed in accordance with the membrane manufacturers' recommendations. The membrane should be placed continuously across the slab construction and lapped onto/extended through the cavity wall construction. The membrane should be placed onto a clean surface, which is free of any debris that could puncture the membrane.

The final performance requirements of the ground gas protection measures necessary should be confirmed as part of detailed design in consultation with a specialist contractor and in agreement with Building Control. All ground gas protection measures incorporated into the design of the buildings will need to be documented on-site by the Contractor in accordance with verification procedures outlined in CIRIA C7358 and C7489.

Visual inspection and photographic evidence prior to concrete pours of the general installation, taping and sealing of a membrane will be required, this may be carried out by RSK or another suitably qualified third party to provide documented evidence confirming robust installation for inclusion in the verification report.

A detailed design report (which this report is not) should be prepared for the proposed mitigation measures and should be provided to and agreed with the local authority and relevant warranty providers prior to construction works commencing. The design report should include a combination of the following:

- Gas conceptualisation (severity of gas regime and sensitivity of land use).
- Building and construction related details such as floor slab, wall construction, ground conditions and any complex detailing.
- Gas protection design sufficient to mitigate the gas risk and be practically installed given the building and construction related details. Likely to include venting calculations, product specifications, installation methodology and installer qualifications/experience.

Verification plan (prepared in accordance with CIRIA C735) to identify the verification tasks, frequency of such tasks and by whom they should be undertaken, regulatory requirement and contingency plans. The verification measures required will be dependent on a number of factors including the gas regime, the qualifications of the installers, the complexity of the design and the number of Plots.

7.5.1.3 Soil Gas Vapour

As previously mentioned, the TCE contamination area beneath the Plot NT02 portion of the site has the potential to generate volumes of SVOC and VOC vapour that could pose a risk to human health during the construction and operational phases of the development. The soil contamination zone affected by TCE and its daughter products will be subject to screening and removal in accordance with the re-use criteria outlined in this strategy for the protection of controlled waters.

It is considered the reduction or removal of VOC contaminants in soils will also significantly reduce the potential for soil gas vapour generation and ingress post completion of remediation works (and into the new structures on this part of the site). As such, the use of specific gas vapour resistant barriers within new buildings is not considered necessary. However, it will be necessary for contractors completing TCE remediation works to undertake validation gas monitoring on conclusion of soil treatment works. This monitoring should confirm what, if any, residual VOC vapour contamination may be present in site soils and confirm that there is still no requirement for gas vapour membranes within buildings.

There will be risks posed to construction workers during the primary TCE soil source removal phase. Due consideration should be given to the range of mitigation measures required for site operatives engaged in these works to reduce risk of chronic exposure to airborne VOC contaminants. This could include the use of disposable overalls, certified face masks or exclusion zones around the most grossly impacted soils reported during

the remediation process. Regular PID monitoring of soils would also be prudent to check levels of vapour release.

7.6 Remediation of Groundwater – contaminant linkage 4

Based on the results of previous site investigation works and the controlled waters DQRA model produced for Plot NT02 (ref. 11847 R01), a pollutant linkage is considered to exist between the TCE, DCE, VC and carbon tetrachloride soil source and dissolved phase plume extending beneath Plot NT02 and controlled waters via leaching/vertical migration through the unsaturated zone and/or lateral migration through dissolved phase to the wider principal aquifer of the CHES. The high density and low solubility of TCE can mean that the compound can often manifest as dense non-aqueous phase liquid (DNAPL) within the groundwater environment, however previous monitoring rounds completed as part of previous site investigation have not encountered any measurable DNAPL thickness. Due to the more cohesive nature of the MM mudstone underlying the CHES, it is likely that any DNAPL present would accumulate on the surface of the MM, though monitoring of the predicted lowest elevation point of the MM (based on estimated dip direction) at RBH502 did not detect any DNAPL.

In the absence of DNAPL and following removal of the soil source as detailed in **Section 7.2.1**, direct treatment of the groundwater within underlying soils and bedrock will be required across the southern area of NT02 and southwestern NT03 within the area of TCE contamination. The Remedial Target Values that groundwater should be monitored and tested against during any treatment process are provided in **Section 5** of the current strategy and should be used to support the design of remediation treatment works.

7.6.1 In-situ chemical oxidation/reduction

An initial appraisal of the remediation options for the treatment of TCE impacted groundwater was presented within the RSK Outline Remediation and Options Appraisal for the site (ref. 11834 R01 (00), dated August 2023). The appraisal considered in-situ chemical oxidation/reduction (ISCR) a viable treatment option for the VOC contaminated groundwater in the underlying principal aquifer of the CHES due to its successful operation at targeting chlorinated solvents, the minimal need for significant remedial plant and no requirement to quarantine areas of the site allowing other site activities to be undertaken around the remedial works. As a result of additional site investigation to increase confidence in the groundwater model and characterise the contamination plume, and production of the DQRA model, ISCR is now considered the preferred groundwater treatment option.

This technique involves the injection of oxidant (or reducing) chemicals into the contaminated groundwater to produce a strongly oxidising/reducing environment within the groundwater body, such that residual contaminants of concern are reduced to their ultimate daughter compounds through a combination of direct chemical reduction and aerobic/anaerobic degradation.

The spacing, frequency and ultimate depth of the treatment and monitoring wells should be designed by a specialist remediation contractor based on the estimated contamination plume dimensions and take into account of the topography of the underlying geological strata,

It is considered that use of reducing chemicals across the affected area would produce a strongly reducing environment within the groundwater body resulting in VOC compounds being reduced to their ultimate daughter compounds through a combination of direct chemical reduction and anaerobic degradation. The existing groundwater data and aquifer parameters indicates that the groundwater environment is currently aerobic within the plume and anaerobic on the edges of plume. This process would therefore force anaerobic conditions increasing the capability of biodegradation and faster reduction in concentrations within the aquifer and reduce the spread to the wider aquifers. The required injection frequency and dose concentration should be calculated by a specialist remediation contractor, relative to contaminant concentration and persistence.

Timescales for remediation are based on the on the size of the source area and will be estimated by the remediation specialist. It should be noted that treatment process can be slowed if contaminants are trapped in hard-to-reach areas such as rock fractures which is potentially the case within the CHES. There is also potential for contaminants to rebound following treatment, requiring further injection, this would be determined by ongoing groundwater monitoring and sampling. Once contaminant have decreased sufficiently, in cases where and the aquifer conditions allow, continued remediation of the plume could be implemented through monitored natural attenuation MNA.

7.6.2 Monitored natural attenuation

While it is common for MNA to be used in conjunction with other methods (such as ISCR) in to remediate the remnant lower contaminant concentrations, initial discussions with remediation specialists have indicated that there may be some potential to explore MNA (following soil source removal) as an alternative to ISCR to resolve VOC contamination within the groundwater. Whilst this alternative has not been explored in detail in this report, it may be worth further consideration during the detailed design of remediation work and collation of the remediation method statement (RMS).

7.7 Piling Risk Assessment – contaminant linkage 5

Given the proposed development loadings and existing ground conditions on site, it is anticipated that a piled foundation solution will be adopted for the proposed structures. The use of pile foundations for the new development will require completion of a Piling Risk Assessment in accordance with the Environment Agency guidance note on piling into contaminated sites. This assessment will require pile design information included the selected pile method, diameter, termination depth and strata. The piling risk assessment should also consider the nature of remediation works proposed (once agreed with the regulatory authorities) and should form part of the Remediation Method Statement document.

7.8 Management of unforeseen contamination (Discovery Strategy)

The site has been subject to multiple rounds of ground investigation works such that the characterisation and identification of the principal contaminants of concern and associated risk drivers for remediation process are well defined. However, it is also noted ground investigation works, by their very nature, can only provide a limited insight into the overall

ground model beneath the site, and that the presence of as yet unreported sources of contamination cannot be precluded as a result. Such issues may occur in areas where access for previous ground investigation works were limited, e.g. within occupied buildings, along site boundaries, in areas of dense vegetation or beneath/adjacent retaining structures.

With reference to the aforementioned planning consent for the development, and specifically Condition 17, Part 11, it is noted obligations are placed on the client and contractors with respect to the management of unforeseen contamination (henceforth known as the Discovery Strategy). This section provides an initial framework for the management of unexpected contamination via the adoption of a Discovery Strategy, further detail will be required regarding prior to the strategy being implemented by contractors. We encourage this is developed with EA consultation to avoid delay.

In order to comply with the requirements of this condition all contractors should adopt the following measures in all aspects of work that require below ground excavations, or that may break ground.

1) The briefing for all site operatives (aka toolbox talk) shall include commentary and advice on identifying potential sources of contamination that may be uncovered during earthworks. We have included a briefing note with examples of types of contamination within **Appendix G** of our current report as a guide.

2) During site works, in the event a new area of potential contamination is uncovered, it is recommended the following actions are taken.

   - All works within the affected area should cease with immediate effect. Any site operatives who have come into contact with contaminants should report to the site manager and any injuries, exposure or adverse effects recorded and appropriate medical treatment sought.
   - Excavations should be backfilled with arisings (including any contaminated spoil) and should be placed at the depth in which it was encountered. Photographic records should be obtained at this stage and the location of the affected area surveyed. An exclusion zone should then be set up around the area and site works re-programmed to accommodate.
   - As soon as safely and practicably possible, the site manager should contact the Environmental Consultant responsible for the verification of remediation works. The consultant should then attend site no later than 24hrs after the initial recorded incident to consider the issue further and next steps with respect to remediation. The Environmental Consultant shall also, following an initial inspection of the issue identified on site, notify Manchester City Council contaminated land officers and the Environment Agency of the occurrence and their preliminary findings.
   - This assessment should be completed in the context of the findings of all previous rounds of ground investigations work as well as the requirements of any remediation works that are currently being undertaken, to be undertaken, or previously undertaken across the site.

- Further investigation, sampling and chemical assessment of affected area will be required under the instruction of the environmental consultant to assess the issue. Any works will need to consider potential H&S implications of excavating contaminated spoil with appropriate mitigation measures (e.g. air monitoring, Visqueen sheeting, water dust suppression, additional PPE) employed.
- Once investigations have been completed the Environmental Consultant shall revisit the site conceptual model and consider the implications of the new source (or sources) of contamination in the context of the proposed remediation works. Depending on the results of this assessment the scope of this remediation strategy may need to be revised and updated to include any additional treatment or management requirements.
- For expedience, and once agreed with the client and contractors, the Environmental Consultant shall issue an addendum report to this strategy outlining details of new sources of contamination uncovered and modification or additional remedial treatment measures required. This report should be provided to the regulatory authorities (Manchester City Council and the Environment Agency) as soon as practicable for their consideration and comment, noting any remediation works completed with respect to the recently discovered contamination would be at risk until these authorities have reviewed and agree with the treatment proposals.

3) Any new sources of contamination that are reported and covered by the above Discovery Strategy should be subject to the same validation requirements of the wider remediation process, noting these validation works may require additional treatment measures or recording (over and above those described in this report) that should also be captured.

4) The validation should be included and referenced within the Phase 3b Site Validation report on conclusion of site works.

With reference to the findings of ground investigation works it is noted some anecdotal evidence relating to potential on site migration of Benzene and TPH was noted toward the sites southern and eastern boundaries. As such it would be prudent to give specific consideration as part of any watching brief or risk register to the potential presence of these contaminants. Similarly, the area of suspected TCE contamination should also be defined on site plans and risk registers as a location where grossly contaminated soils, vapour or groundwater may be reported (see Image 2 overleaf for further information).

It should be noted that the Discovery Strategy is applicable to all types of contamination, be it soil, or groundwater borne or in the event of the release of malodorous airborne contamination such as methane, carbon dioxide or SVOC/VOC vapour ingress. An abridged flow chart style version of this strategy has been provided within **Appendix G** of this report to further illustrate requirements.

A soil vapour ingress issue was noted during the formation of a borehole within the TCE plume area during previous investigation works, as such the use of PID equipment would be prudent during excavation works as a safety measure to confirm any gas release and potential risks to site operatives.

The Discovery Strategy may require revision and update following input from remediation contractors to suite specific remediation treatment methods. Any such modifications or updates should be outlined within the Remediation Method Statement to be provided prior to commencement of site works for the consideration and approval by regulatory authorities. The Remediation Method Statement should also include reference to, and an obligation upon, the implementation of the Discovery Strategy during site works and the strategy should also be applied to all earthworks operations by the Principal Contractors out with of remediation zones.

7.9 Contamination Contingency Plan

It is noted that sources of mobile contamination (principally TCE and its daughter products) have been identified beneath the Plot NT02 and parts of the Plot NT03 development sites, as denoted by the orange dashed line in **Image 2**. At present, the mobility of these contaminants within the primary soil source area is being impeded by the presence of building or concrete hard standing coverage, however in order to remediate soils and groundwater in this area, as well as across the wider site, this hard standing coverage will require removal.

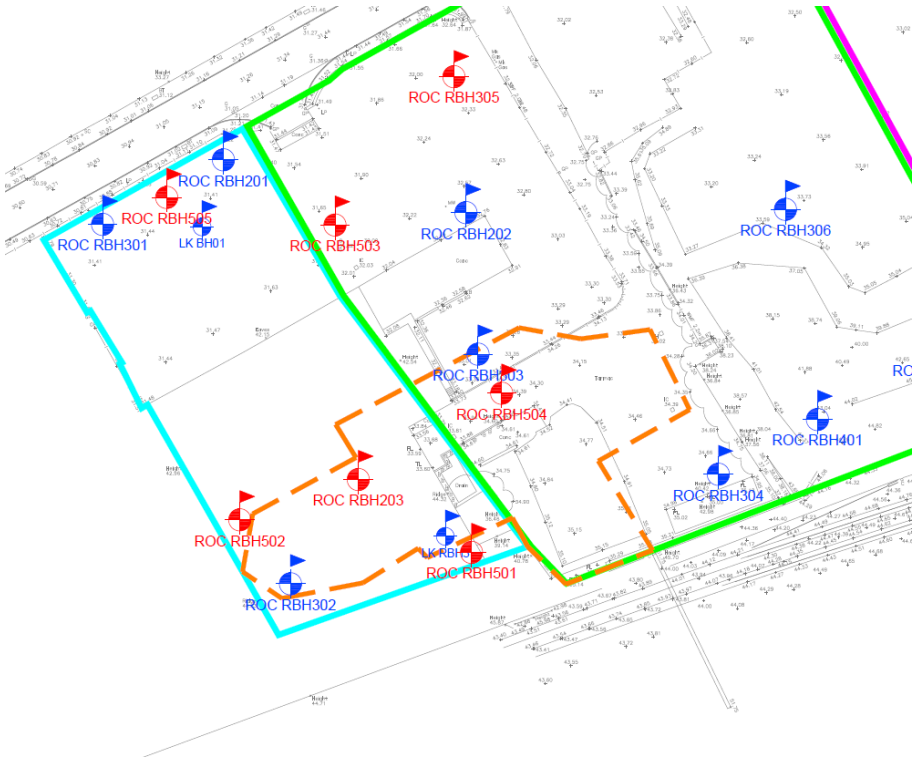


Image 2: Primary TCE contamination source area (denoted by orange dashed zone)

Similarly, the area in question, as noted on **Image 2** above, has a program of demolition proposed to remove existing warehouse buildings.

In order to mitigate against the risks posed by increased contaminant mobility during site clearance and remediation works it is recommended the following precautions are taken:

1) During building works, all hard standing and building floor slabs should be retained until such time as the soil remediation phases can be commenced. Similarly, care should be taken during the demolition process to prevent damage to existing site drainage networks (where possible).
2) Ideally the soil remediation works should be completed in a single phase, with hard standing and floor slabs left in place for as long as practicable during this process. Where possible, soils in the affected areas should be uncovered, assessed, removed and replaced (where required) in strips across the affected area so that the slabs can be left in situ for as long as practicable.
3) If this approach is not possible, the use of Visqueen sheeting should be employed across areas of un-remediated soils following slab removal. The sheeting should be laid and held in place using stockpiled clean uncontaminated soil with consideration given to drainage such that any surface water run off does not pass through the affected area.
4) It should also be noted that such measures can only be considered as a temporary mitigation to protect soils and that if works on site are delayed or reprogramed, more robust measures may be required to prevent rainfall or surface water infiltration into the primary soil source area.

The movement of surface water should be appropriately managed throughout all phases of the construction works, particularly in the area of the primary soil source, to prevent overland flow and infiltration into site soils.

Stockpiled contaminated soil that is awaiting removal or treatment on site should be located (ideally) on areas of hardstanding away from drainage networks on top of chemically resistant Visqueen sheeting, with mounds also covered with sheeting that is secured at ground level.

7.10 On going monitoring

A number of groundwater monitoring wells are present across the site; the locations of which are indicated in the RoC Consulting drawing 4328-ROC-ZZ-XX-DR-ES-ES214 provided within **Appendix H**. These wells are sealed into various strata beneath the site and have the potential to act as a pathway between any near surface sources of contamination and the underlying natural soils and bedrock.

It is noted that on going monitoring of selected wells will be required to further refine the design of groundwater remediation works, and that further testing of groundwater and level monitoring will be required to support the collation of the Remediation Method Statement. The formation of further monitoring wells may also be required by remediation specialists to either support the design of remediation works or completed compliance monitoring during and following on from the remediation process.

At the time of writing, the specific details of these monitoring requirements are still to be confirmed and will be further outlined in the Remediation Method Statement. However, as an interim measure we would propose the following on going monitoring regime.

Part 1 : Well Removal Works

1) With reference to drawing 4328-ROC-ZZ-XX-DR-ES-ES214 provided within **Appendix H**, all monitoring wells shown in Blue should be removed and treated in accordance with the Environment Agency guidance Science Report SC020093.
2) The removal of these wells should be completed by appropriately qualified contractors and documented with a validation note provided with (inc photographical evidence) of the well removal process.
3) If these wells are to be retained in the short to medium term it is recommended that quarterly inspection visits are completed to confirm their current condition and that no damage has occurred that could compromise their integrity. As with the well removal works, these validation inspections should be documented, and a Well Condition survey report provided following each visit. This information, along with the documentation of well removal works, should be provided within the Phase 3b Site validation pack and may also be required in advance of remediation works by the regulatory authorities.
4) It is noted a number of the monitoring wells were buried during site operations that had taken place across the site. It is recommended the location of these wells are confirmed during any inspection or removal works and recorded in accompanying reports.

Part 2 : Well retention and monitoring works

The following RoC Consulting monitoring wells are to be retained to support the design and validation of remediation works:

- BH501
- BH502
- BH203
- BH503
- BH504
- BH505
- BH305
- LKBH1

The locations of these wells are known and accompanying coordinates have been surveyed in (and are included on accompanying log sheets). On going groundwater level gauging should be completed on these wells at monthly intervals up to issue of the Remediation Method Statement. The information obtained from these monitoring works should be documented in a brief letter report for distribution.

In addition to the monthly groundwater level gauging visits on these wells, it is recommended that water quality samples are obtained on a quarterly basis to support the design of groundwater remediation works prior to commencement of site construction works. This sampling should include for the analysis of the following determinands.

- Heavy Metals

- Poly Aromatic Hydrocarbons
- SVOC & VOC's
- TPHCWG
- Hardness, Dissolved Oxygen and pH values

Samples should be collected and dispatched to a suitably accredited UKAS testing facility with the results reported in a brief letter report. This report should also include a Tier 1 screen of water quality testing results against published UK DWS and EQS screening criteria, in line with assessment of water quality during previous investigation works. In the event the results of this sampling indicate a deterioration of water quality, it will be necessary to further consider the implications of this issue in the context of proposed remediation works.

The frequency of water quality sampling will likely increase during the course of soil and groundwater remediation works the scope of which should be further elaborated upon within the Remediation Method Statement. Of particular note in this regard will be the results from water quality testing data during the demolition and soil remediation phase, or following the removal of any hard standing, as it may indicate an increased mobility of contamination into the groundwater table that could require action.

Similarly, the monitoring wells indicated for retention and further monitoring/sampling have been agreed with the Environment Agency as part of the collation of this strategy. In the event that any of these wells are lost or damaged the contractor will be required to advise the EA of the damage and make good any associated repair or replacement.

Part 3 : Protection of monitoring wells

As previously discussed, additional monitoring wells (or the removal of those currently proposed for retention) may be required during the remediation process. The location and design of any additional monitoring wells should be described in the Remediation Method Statement and any wells that require removal subject to the same requirements of those outlined in Part 1 of this section.

The protection of monitoring wells during the course of remediation works, and following on from its conclusion, will be an essential requirement of the Principal Contractor. As such, we would recommend the following measures are adopted as part of the wider construction management plan.

1) The location of all monitoring wells should be displayed on notice boards in site cabins and other appropriate areas to increase awareness. Reference should be made to the presence of these wells during toolbox talks with an emphasis on their importance.
2) Wells currently comprise flush style covers; it is recommended that the well head gear be replaced with "top hat" style raised covers prior to commencement of demolition works on site to improve their visibility on site. Raised covers should be painted in bright colours to make them easy to identify when working on site.
3) Protective measures should also be employed around each well location to protect them from site works. A number of examples of such measures are provided within **Appendix H** for information.

It should be emphasized that the retained monitoring wells form a critical part of the overall remediation validation process and that failure to ensure their protection may result in the groundwater treatment process not being approved by regulatory authorities.

As such, any damaged wells will need to be repaired or, in the worst case, replaced. It is also important to note the validation monitoring period for the groundwater will extend beyond the physical treatment phase and could encroach into subsequent construction phases of the development process (further details of which will be outlined in the Remediation Method Statement).

7.11 Re-use of materials & Importation Requirements

At this stage it is estimated that the development is likely to produce moderate volumes of civils arisings (c. 37,537 m³) during earthworks associated with piled foundations, excavation of utility corridors, construction of a new piled retaining structure supporting adjacent Network Rail land to the south, and general cut to achieve formation levels (significantly the new under croft plant and carparking space). It is understood that the intention is to reuse a portion of this site generated material elsewhere on site. Site generated material retained on site for re-use will be subject to additional chemical testing to confirm suitability for re-use.

Soils that are excavated are anticipated to be screened and sorted, and temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use:

- Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials.
- Material suitable for inclusion within 600 mm of surface in landscaped areas (highly unlikely to be recovered in significant volumes on site).
- Material suitable for placing beneath single storey, overground car parks (i.e., not situated beneath building) and roadways.

Soils found unsuitable for any of the above purposes will be consigned for offsite disposal. It is possible that soils will be disposed off-site despite suitability for re-use if stockpiling is impracticable or a surplus volume of material is present. In addition to general excavations, aggregate may also be generated from processing of concrete slabs and old foundations to a suitable granular fill material.

The volume of imported material required as part of the development process will be relatively modest (excluding construction materials required in building and hard standing), relating primarily to clean natural subsoil and topsoil required as capping in the 600mm landscaping zones. The approximate volume of imported soils for use in these zones will be of the order of 2,000m^3 divided between a mixture of discrete landscaping planters and larger more formal landscaping zones (such as the public realm space between Plots NT03 & 04) across the site.

Re-use of materials on site shall be subject to the provisions of a materials management plan (MMP).

7.12 Off-site disposal

It is likely that excess soils or soils unsuitable to remain on site (including landfill waste material within the vicinity of TP214 and soils heavily impacted by VOC contamination within the southern portion of NT02 and southwester portion of NT03) will be generated during the development.

Where this occurs, chemical testing to inform waste classification of the material may be undertaken although chemical test data is already available from the RoC site investigation, and this includes data from waste acceptance criteria (WAC) testing.

Waste soils will be taken to an appropriately licensed treatment or disposal facility and transported by an appropriately licensed carrier. Duty of care information to demonstrate this will be collected and maintained on site for inspection.

8 REQUIREMENTS FOR REMEDIATION VERIFICATION

8.1 Introduction

This section identifies the proposed form of verification and reporting that will be undertaken to demonstrate that the mitigation measures that are considered necessary have been implemented on site.

8.2 Site records

Site records will be maintained so that sufficient data are available for the purpose of compiling a robust verification report. In addition, where any contamination is being further investigated or where any proposed mitigation is required, details of this will be retained for inclusion in the site health and safety file as previously discussed. Records of any environmental monitoring (for asbestos, dust etc.) undertaken during the remediation programme shall also be retained so they can be included in the final verification report.

Chemical test data and visual confirmation of suitability will be recorded prior to confirming the imported soils as being suitable. As detailed in earlier sections of this RS, verification records of the remedial works will be collated in a verification report on completion of all site-works.

A record of all soil imports to site for will be maintained. This will include:

- Certificates of quality - material imported under the WRAP protocol will be accompanied by certificates of conformity that are less than two months old and relating to the material being imported.
- Invoices and lorry tickets – importation tickets should be completed in full and legible so the origin of the soil can be traced to the specific donor site.
- Chemical test data – all data obtained from the donor site or from site initiated chemical testing.
- Storage – the location of temporary storage or quarantine areas will be identified, and plans/photographs retained to show where the position and movement of stockpile at the site.
- Verification reports – reports that are generated following visits for the purpose of verification will be retained on site.

It is recommended that gas membrane specification data sheets be provided to the environmental consultant for comment prior to installation of the membrane on site. It is proposed that the principal contractor will undertake installation of the membrane and provide both the Site Manager and the environmental consultant with photographic evidence of the membrane installation to demonstrate that the level of workmanship is in accordance with the manufacturers specification.

The environmental consultant shall undertake ‘spot checks’ of the membrane installation at a frequency not less than 1 per Plot to verify the records provided by the contractor and confirm that the level of workmanship is to an acceptable standard.

8.3 Soil Sampling frequency

The type and frequency of confirmatory soil analysis will be in line with that in **Table 9** Where appropriate chemical test data is not available, additional sampling will be undertaken once the material is received at site.

Imported soil material will either be quarantined in a temporary storage area where its use will await confirmation of chemical test data, or it will be placed directly into the final place of use. There is a risk that soils may need to be removed from site if the chemical test data shows it is not suitable. Any imported soils will be clearly demarked as awaiting clearance until suitable data confirms its acceptance.

Material arriving at the site will be visually assessed for suitability before it is either placed in quarantine or directly in the final location.

Table 9: Sampling and Testing Requirements

	Number of samples*	Testing schedule
Natural imported top soil (for use within below 600 mm clean cover system)	Minimum 3, or 1 per 200 m^3 (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), asbestos
Brownfield/screened soils (for use as general fill across the site or below any 600 mm landscape cover system)	Minimum 3 or 1 per 200 m^3 (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), SVOC, VOC, TPH (CWG banded), asbestos and any additional analysis depending on the history of the donor site
First generation i.e. quarried sand or stone to be used in subsoil/breaker layer	No testing required. Certification of material source is required.	
Recycled Stone (6F2 or similar, for use as general fill across the site or below any 600 mm landscape cover system)	Minimum 3 or 1 per 200 m^3 (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), TPH (CWG banded), asbestos and any additional analysis depending on the history of the donor site

*Sample frequencies stated are based on requirements from Manchester City Council document *"Planning & Contaminated Land Technical Guidance"* (2021), Section 6.3, Table 2

In addition to assessing the chemical suitability of the imported material, measurements of the subsoil and topsoil thickness will also be confirmed by a third party. At least two verification locations will be selected in each area where soft landscaping is proposed, and the relevant measurements recorded; photographic evidence will also be obtained.

A drawing showing the layout of the buildings' footprints, the hard surfaced areas and the soft landscaping areas, together with the locations where the soils in the landscaped areas have been removed and replaced by imported material will be documented in the verification report.

8.4 Remedial criteria

As the proposed development is to comprise commercial units at ground level, with high rise residential units above, with external area predominantly surfaced with hardstanding and some communal soft landscaping, the remedial criteria for material reuse as general fill have typically been derived from RSK's GAC designed to be protective human health for a commercial end use (see **Table 10**). This approach has been discussed and agreed with Manchester City Council contaminated land department (a copy of the associated correspondence for which is provided within Appendix I.

Across Plots NT02 & NT03 testing of and screening for Trichloroethene (TCE), Carbon tetrachloride, Cis and trans-1,2-dichloroethene and Vinyl chloride will also be required on all site-won fill material to be used below buildings, hard stand or landscaped zones in accordance with the RTV values outlined in the DQRA (as noted in **Table 7**, in **Section 5**).

A copy of the proposed remedial criteria for site won material is described further in **Section 8.4.1** and **Table 10** below.

8.4.1 Re-use of material as general fill

The criteria in **Table 10** will be applicable to soils used as general engineered backfill to achieve final development contours but placed >600 mm below the final restoration level in soft cover areas or below hard surfacing (buildings, hardstanding etc.). The remedial criteria are based on the vapour inhalation pathway from GAC provided in **Appendix E.**

Table 10: Criteria for re-use of material as general fill beneath buildings & hardstanding

Compound	SSTL for Soil		
	SOM 1% (mg/kg)	SOM 2.5% (mg/kg)	SOM 6% (mg/kg)
Semi-volatile organic compounds			
Naphthalene	1,800	3,900	7,800
Trichloroethene (TCE)*	0.224	0.224	0.224
Carbon tetrachloride *	0.116	0.116	0.116
BTEX			
Benzene	27	50	98
Toluene	56,000	107,000	184,000
Ethylbenzene	6,000	13,000	27,000
Xylene - m	6,200	14,100	31,200
Xylene - o	6,600	15,000	33,000
Xylene - p	5,900	13,600	30,000
Total xylene	5,900	13,600	30,000

Compound	SSTL for Soil		
	SOM 1% (mg/kg)	SOM 2.5% (mg/kg)	SOM 6% (mg/kg)
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons (C_5-C_6)	3,200	5,900	12,100
Aliphatic hydrocarbons (>C_6-C_8)	7,800	17,400	39,600
Aliphatic hydrocarbons (>C_8-C_{10})	2,000	4,800	11,300
Aliphatic hydrocarbons (>C_{10}-C_{12})	9,700	22,900	47,300
Aliphatic hydrocarbons (>C_{12}-C_{16})	59,000	82,000	90,000
Aliphatic hydrocarbons (>C_{16}-C_{35})	-	-	-
Aliphatic hydrocarbons (>C_{35}-C_{44})	-	-	-
Aromatic hydrocarbons (>C_8-C_{10})	3,500	8,100	17,000
Aromatic hydrocarbons (>C_{10}-C_{12})	16,000	28,000	34,000
Aromatic hydrocarbons (>C_{12}-C_{16})	36,000	37,000	34,000
Aromatic hydrocarbons (>C_{16}-C_{21})	-	-	-
Aromatic hydrocarbons (>C_{21}-C_{35})	-	-	-
Aromatic hydrocarbons (>C_{35}-C_{44})	-	-	-

* Screening and testing required for protection of controlled waters for soils being left in situ beneath plots NT02 and NT03

By design, placement of soil >600 mm below the final restoration level in soft cover areas or below hard surfacing (buildings, hardstanding etc.) is sufficient to protect end-users from direct contact with soil contaminants. Thus, a remedial criterion for asbestos in soil is not applicable to soils destined for re-use as general fill.

8.4.2 Within 600 mm of soft landscaping cover level

A clean imported natural soil cover system is required for landscaping areas situated within made ground across the site. The cover system shall be a minimum of 600 mm thick and comprise a 150 mm minimum thickness of topsoil, overlying 450 mm of sub soil. A Terram marker layer should be placed between the cover system and any underlying made ground.

Given the longstanding history of the site and the fact that no significant deep excavations are proposed, it is likely that the quantity of clean natural site won material for use as clean cover will be limited. As such, it will be necessary to import clean natural sub and topsoil will be required to make up the clean cover area, provided it is tested and complies with the criteria set out in **Appendix E**. Imported sub and topsoil for use in landscaping should be from commercial merchants only and should not be sourced via CL:AIRE DoW CoP or other associated site to site material transfer protocols.

Where undisturbed (i.e., in situ) natural soil is present within 600 mm of the final surface of soft landscaping then as long as they comply with the criteria set out in **Appendix E** a Terram marker is not required.

The balance of material making up the level (be it site won natural re-used soils, or imported subsoil, and topsoil) should be compliant with the criteria in **Appendix E**. In addition, topsoil acceptability is subject to analyses and subsequent declaration as acceptable as multipurpose topsoil in accordance with the provisions of BS3882: 2015. Values indicated in **Appendix E** are based on RSK GAC values for soil placement under a" residential without home grown produce" end use scenario.

The following remedial criteria apply as the maximum concentrations allowable for cover system soils placed within areas of soft landscaping within 600 mm of the final ground level.

8.4.3 Site Validation Reporting Requirements

It will be necessary to produce a Phase 3b Site Validation report upon completion of site construction works. This report should include evidence of the completion of all remedial objectives as well as supporting site records, testing information, photographs etc. Gas membrane specification sheets and evidence of Asbestos mitigation and monitoring measures should also be provided for inclusion within this report.

Details of any additional remedial requirements (arising as a result of unexpected sources of contamination being discovered during site works), or deviations from the current strategy should also be provide for inclusion with this report.

The report will be required to be submitted to the Local Planning Authority (Manchester City Council) in order to discharge the associated pre-occupation planning conditions attached to the consent. As such it is essential construction contractors provide information required to collate the Validation Report in advanced on practical completion so that these final planning obligations can be resolved.

This is of particular importance where earthworks or enabling works may be phased or completed by different contractors. In such instance it is the responsibility of each contractor to record evidence of all aspects of the above testing and validation works, to be presented as a stand-alone report for incorporation into the "final" Phase 3b Site validation report for the entire site. Copies of all drawings, photographs, material movement records and chemical validation testing should be provided both bound in a PDF report and also as individual files and documents to the consultants preparing the final Phase 3b report for ease of inclusion.

8.4.4 Recommendations for further works

The current remediation strategy has been collared to provide details and specifications for the treatment and management of soil, groundwater and ground gas issues across the site. It should be provided to the local planning authority and Environment Agency for consideration and to support the discharge of associated pre-commencement planning conditions (with any comments fed back to RSK Geosciences for review and response).

Given the specialist nature of aspects of the remediation works it would be prudent to engage with remediation specialists to further develop the practical aspects of soil and groundwater treatment works.

This assessment may require the further sampling and testing of site soils and groundwater to confirm the remediation design and should be presented as a detailed design for the treatment works within a Remediation Method Statement. Input from the Principal Contractors into this design process would also be prudent so that the requirements for remediation works can be captured in the overall construction phase plan.

This Remediation Method Statement should be provided to the aforementioned regulatory authorities for review and to support the remaining pre-commencement conditions relating to ground contamination. Due consideration of any proposed site phasing, demolition or enabling works should also be considered and its implications discussed within the Remediation Method Statement.

A piling risk assessment should also be completed for the development in accordance with Environmental Agency guidance at such a time when the pile design, depth and extents are known. This assessment should consider the proposed remediation works and consider any potential interactions or implications of piling works on the overall effectiveness of soil and groundwater treatment methods.

As previously discussed in **Section 7.10**, the ongoing monitoring and sampling of retained groundwater monitoring wells should be continued to increase the baseline understanding of the hydrogeological regime beneath the site with any wells no longer required treated and removed in accordance with EA guidance. The monitoring program should remain as outlined in this strategy until such time as the remediation contractor is appointed, owing to the fact they may wish to amend or adjust sampling or groundwater level logging requirements.

9 REFERENCES

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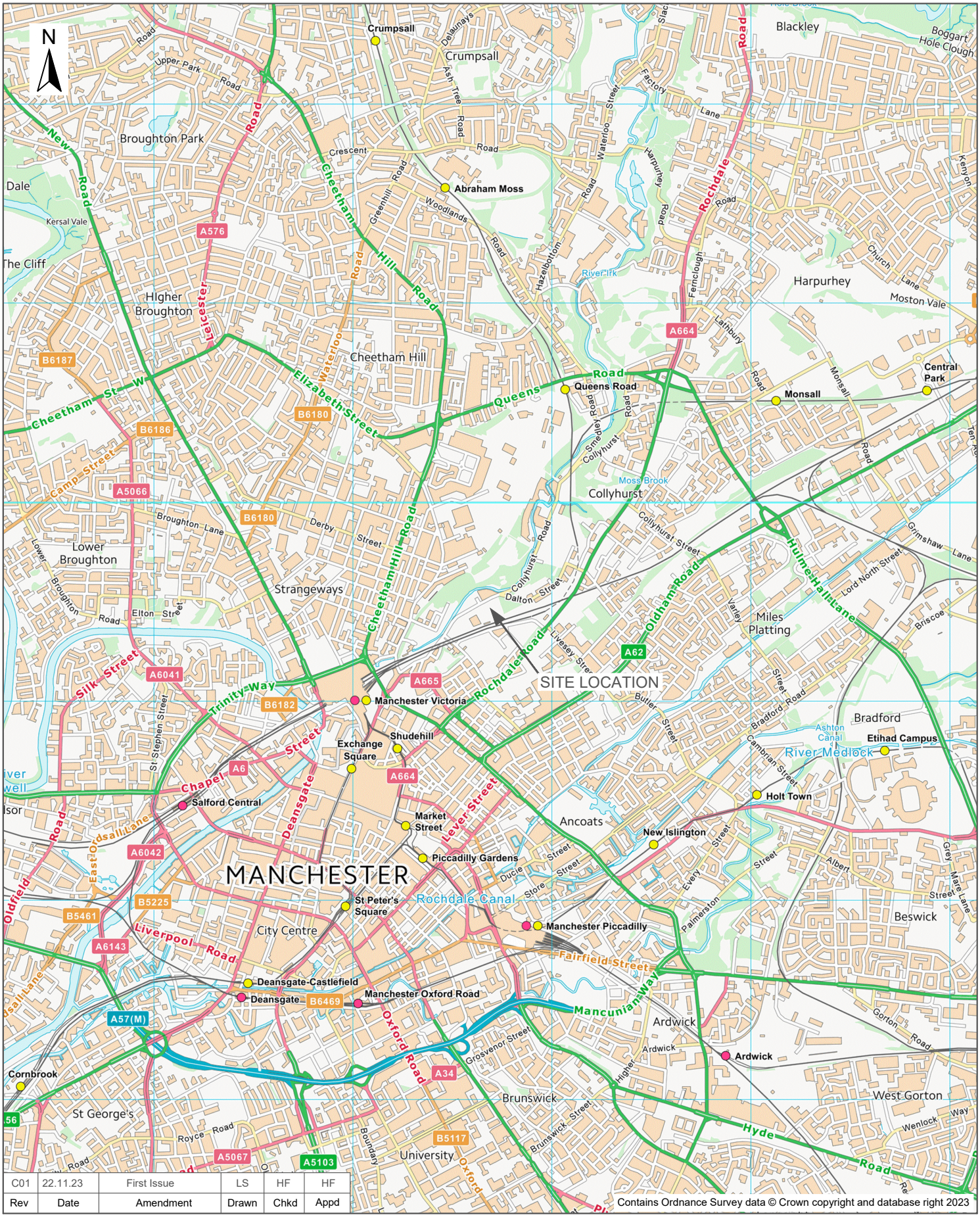
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FIGURES



Rev	Date	Amendment	Drawn	Chkd	Appd
C01	22.11.23	First Issue	LS	HF	HF

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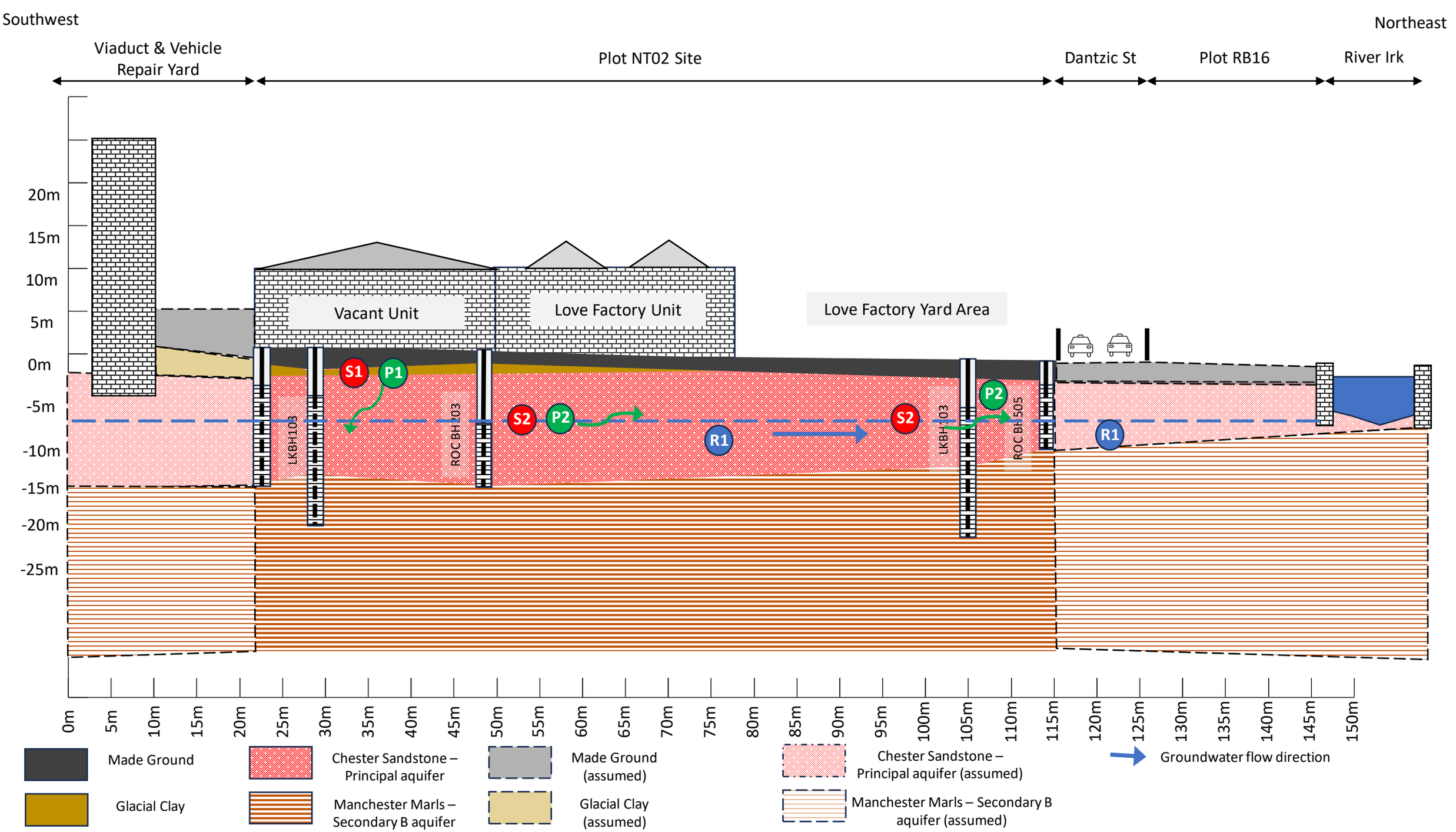
Client: Far East International Consortium

Project Name: Plots NT02, NT03, NT04 - Northern Gateway

Description: Site Location Plan

Dimension	Size	Scale	Geolocation	Project ID	Drawing no.	Rev	File name
m	A4	1:25,000	384690,399470	11834	11101	C01	11834-MA-111-SS-D-C-11101-C01

FIGURE 1 SITE LOCATION PLAN



Sources

S1 Chlorinated VOC including TCE in unsaturated soils

S2 Chlorinated VOC including TCE and daughter products (DCE, VC) in dissolved phase in the Chester Sandstone

Pathways

P1 Leaching / remobilisation of contamination from unsaturated soils

P2 Lateral migration of dissolved phase contamination within the Chester Sandstone (CHES)

Receptors

R1 Groundwater within the Chester Sandstone – Principal aquifer

Complete / Potentially Complete Pollution Linkages

- On-site chlorinated VOC including TCE contamination in unsaturated soils from historic bolt works – Principal aquifer via leaching/remobilization of contamination
- On-site dissolved phase chlorinated VOC plume including TCE and daughter products (DCE, VC) – Wider principal and secondary aquifers via vertical and lateral migration of dissolved phase

RSK GEOSCIENCES

JOB NO	11847	SKETCH NO	ESK100	DRAWN BY : AS & LA 06/12/2023
PROJECT TITLE	Plot NT02 DQRA	SKETCH TITLE	Conceptual Site Cross Section, Plot NT02	

FIGURE 2 CSM CROSS SECTION

APPENDICES

APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for RSK Environment Limited (RSK) for RoC Consulting (the "Client") in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] between RSK and the Client. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.

12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B
PROPOSED DEVELOPMENT DRAWING

RIVER IRK

DALTON ST.

DANTZIC ST.

NT04
Midrise
4

NT04
Tower 4

NT04
Tower 5

TRAVIS
SQUARE

NT04
Tail 5

NT03
Tail 3

NT03
Tower 2

NT04
Tail 4

TRAVIS
CORNER

NT03
Tower 3

DULWICH ST.

NT02
Clubhouse

NT03
Midrise 3

NT02
Tower 1

DULWICH ST.

© Maccreanor Lavington Ltd.

Do not scale from this drawing. Verify all dimensions on site. Drawing should be read in conjunction with information from all other design consultants and contractors. All drawings in digital format are for reference only, paper copies are available on request.

0 10 30m

Legend

Application boundary

Land owned or controlled by the applicant

Rev	Details	Date
P10.01	S0-Initial Status	02/06/2023
P09.04	S0-Initial Status	13/04/2023
P09.01	S0-Initial Status	31/03/2023
P08.01	S0-Initial Status	16/03/2023
P07.04	S0-Initial Status	14/03/2023

MACCREANOR LAVINGTON
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The Netherlands
+31(0)10 443 90 60

Proj. No. RDB
Project Red Bank NT04
Status S0-Initial Status
Sheet Name Site Plan
Client FEC
CDE ID RDB-MLA-00-XX-DR-AR-01110000
Scale 1:500
Size A1
Rev. P10.01


Adopted highway boundary
DALTON STREET
WARFORD STREET
BROMLEY STREET
Network Rail Land
Building Footprint
Hard paving
Green Planting
Green paving/soil cells

APPENDIX C
SITE INVESTIGATION PLANS – ROC

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NOTES

SITE FEATURES

RIVER IRK

APPROX PLOT NT02 BOUNDARY

APPROX PLOT NT03 BOUNDARY

APPROX PLOT NT04 BOUNDARY

DRAWING NOTES

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DRAWING TITLE
SITE LOCATION PLAN

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- LK RBHX — LK CONSULT ROTARY BOREHOLE
- ROC RBH2XX — ROC 2022 ROTARY BOREHOLE WITH INSTALL
- ROC WS2XX — ROC 2022 WINDOW SAMPLE BOREHOLE WITH INSTALL
- ROC WS2XX — ROC 2022 WINDOW SAMPLE BOREHOLE
- ROC TP2XX — ROC 2022 TRIAL PIT
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (ENVIRONMENTAL OR COMBINED) WITH INSTALL
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (GEOTECHNICAL ONLY) WITH INSTALL
- ROC WS3XX — ROC 2023 WINDOW SAMPLE BOREHOLE
- ROC WS3XX — ROC 2023 WINDOW SAMPLE BOREHOLE
- ROC TP3XX — ROC 2023 TRIAL PIT
- ROC SS3XX — ROC 2023 SURFACE WATER SAMPLE
- ROC HP3XX — ROC 2023 MOUND HANDPIT
- ROC RBH4XX — ROC 2023 NR MOUND BOREHOLE
- ROC RBH5XX — ROC 2023 ADDITIONAL TCE BOREHOLES
- APPROX PLOT NT02 BOUNDARY
- APPROX PLOT NT03 BOUNDARY
- APPROX PLOT NT04 BOUNDARY

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DRAWING TITLE: ALL EXPLORATORY HOLE LOCATIONS

DRAWING No.: 4328-ROC-ZZ-XX-DR-ES-ES201D

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- ROC RBH2XX — ROC 2022 WINDOW SAMPLE BOREHOLE WITH INSTALL
- ROC RBH2XX — ROC 2022 WINDOW SAMPLE BOREHOLE
- ROC TP2XX — ROC 2022 TRIAL PIT
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (ENVIRONMENTAL OR COMBINED) WITH INSTALL
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (GEOTECHNICAL ONLY) WITH INSTALL
- ROC WS3XX — ROC 2023 WINDOW SAMPLE BOREHOLE
- ROC WS3XX — ROC 2023 WINDOW SAMPLE BOREHOLE
- ROC TP3XX — ROC 2023 TRIAL PIT
- ROC SS3XX — ROC 2023 SURFACE WATER SAMPLE
- ROC HP3XX — ROC 2023 MOUND HANDPIT
- ROC RBH4XX — ROC 2023 NR MOUND BOREHOLE
- ROC RBH5XX — ROC 2023 ADDITIONAL TCE BOREHOLES
- APPROX PLOT NT02 BOUNDARY
- APPROX PLOT NT03 BOUNDARY
- APPROX PLOT NT04 BOUNDARY

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PLOTS NTO2, NTO3 & NTO4 NORTHERN GATEWAY

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- ROC TP2XX — ROC 2022 TRIAL PIT
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (ENVIRONMENTAL OR COMBINED)
- ROC RBH3XX — ROC 2023 ROTARY BOREHOLE (GEOTECHNICAL ONLY)
- ROC WS3XX — ROC 2023 WINDOW SAMPLE BOREHOLE
- ROC TP3XX — ROC 2023 TRIAL PIT
- ROC HP301 — ROC 2023 HAND PIT (MOUND)
- ROC RBH4XX — ROC 2023 NR MOUND BOREHOLE
- ROC RBH5XX — ROC 2023 ADDITIONAL TCE BOREHOLES
- SOIL ASSESSMENT AREA 1
- SOIL ASSESSMENT AREA 2
- SOIL ASSESSMENT AREA 3
- SOIL ASSESSMENT AREA 4
- SOIL ASSESSMENT AREA 5

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- ROC RBH2XX — ROC 2022 WINDOW SAMPLE BOREHOLE
- ROC TP2XX — ROC 2022 TRIAL PIT
- LK WSX — LK AS DUG WINDOW SAMPLE BOREHOLE
- LK RBHX — LK CONSULT AS DUG ROTARY BOREHOLE

SITE FEATURES

- SCREENED FOR GAC VALUES "RESIDENTIAL WITHOUT PLANT UPTAKE"
- SCREENED FOR GAC VALUES "COMMERCIAL/INDUSTRIAL" TO SUIT RETAINING WALL END USE
- SCREENED FOR GAC VALUES "RESIDENTIAL WITHOUT PLANT UPTAKE" EXCEPT FOR CONTAMINANTS OF CONCERN WHICH ARE REPORTED IN THE PHASE 3A REMEDIATION STRATEGY COMPLETED BY RSK GEOSCIENCES

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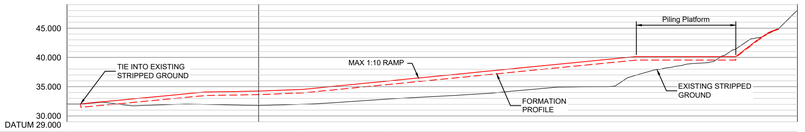
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APPENDIX D
EARTHWORKS DRAWINGS – ROC CONSULTING



CHAINAGE	0.000	2.308	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	70.000	75.000	80.000	85.000	90.000	95.000	100.000	105.000	110.000	115.000	120.000	127.451	124.821
EXISTING GROUND LEVEL MINUS 100mm STRIP	32.042		32.265	31.872	31.870	32.025	31.945	31.834	31.853	31.998	32.227	32.563	32.898	33.173	33.434	33.747	34.133	34.580	34.929	34.987	35.984	37.751	38.616	39.223	41.909	44.127		48.077
PROPOSED FINISHED LEVEL		32.065	32.323	32.795	33.270	33.745	34.119	34.203	34.332	34.527	35.004	35.494	35.986	36.478	36.971	37.463	37.955	38.447	38.939	39.430	39.923	40.150	40.150	40.150	40.889	44.307	44.870	

1-1 RAMP/ PLATFORM LONG SECTION

PROPOSED FINISHED LEVELS

SCALE 1:250

CONTOURS SHOWN REPRESENT THE FINISHED SURFACE LEVELS I.E. FORMATION LEVEL PLUS BUILD UP DEPTHS AS DETAILED IN TABLE BELOW

APPROXIMATE ALIGNMENT OF EXISTING GAS MAIN. TO BE DIVERTED

EXISTING PUBLIC COMBINED SEWER TO BE ABANDONED AND REMOVED. SUBJECT TO S116 APPLICATION TO UNITED UTILITIES

EXISTING PUBLIC COMBINED SEWER TO BE ABANDONED AND REMOVED. SUBJECT TO S116 APPLICATION TO UNITED UTILITIES

6407
CL 32.00
IL 28.20

MAX 1:10 RAMP TO PROPOSED PILING PLATFORM LEVEL

MAX 1:3 EARTHWORKS EMBANKMENT TO EXISTING GROUND (STRIPPED)

APPROXIMATE EXTENT OF EXISTING MOUND.

PILING PLATFORM
40.15m

MAX 1:1 EARTHWORKS EMBANKMENT TO EXISTING BOUNDARY FENCE

REFER TO ROC DRAWINGS RBD-ROC-ZZ-ZZ-DR-S-NR040 TO 046 FOR DETAILS OF PROPOSED RETAINING WALL

7501
CL 31.57
IL 29.36

7401
CL (TBC)
IL (TBC)

375ø CO CWS

375x475 CWS

CUT-FILL ANALYSIS

SCALE 1:250

BANDS INDICATE THE DEPTHS OF CUT & FILL BETWEEN THE PROPOSED FORMATION AND THE EXISTING SITE FOLLOWING SITE STRIP.

SITE STRIP (100mm)	
2D AREA	VOLUME
5,322m²	532m³

SITE STRIP BENEATH RAMP/PLATFORM FOOTPRINT ONLY. IT IS ASSUMED THAT THE MATERIAL CANNOT BE RE-USED AND IS TO BE REMOVED OFF-SITE.

SITE WIDE CUT AND FILL SUMMARY
(EXCLUDING SITE STRIP VOLUME & MATERIAL MOUND)

AREA	2D AREA	GROSS CUT	GROSS FILL	NET CUT/FILL
FULL	5,322m²	2,506m³	8,316m³	5,810m³ FILL

CUT & FILL VOLUMES ABOVE ARE BASED ON A REDUCED LEVEL DIG BETWEEN PROPOSED FORMATION (USING THE FOLLOWING CONSTRUCTION BUILD UPS) AND THE EXISTING GROUND (FOLLOWING SITE STRIP). IT IS ASSUMED THAT THE FILL VOLUME ABOVE REQUIRED TO ACHIEVE FORMATION LEVEL WILL COMPRISE EXISTING SITE-WON MATERIAL THE SUITABILITY OF SITE WON MATERIAL TO BE USED WITHIN THE BULK EARTHWORKS EXERCISE IS TO BE CONFIRMED.

BUILD UP DEPTHS	
RAMP/ PLATFORM FOOTPRINT	600mm
EMBANKMENT AREAS	100mm

BUILD UP DEPTHS ARE INDICATIVE ONLY AND TO BE CONFIRMED BY PILING CONTRACTOR. MATERIAL ASSUMED TO COMPRISE IMPORTED GRANULAR MATERIAL TO CONTRACTOR SPECIFICATION/ REQUIREMENTS.

APPROXIMATE EXTENT OF EXISTING MOUND.
VOL MAX: 5,655 m³

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CUT / FILL BANDS

CUT	FILL
0.00 - 0.50m	0.00 - 0.50m
0.50 - 1.00m	0.50 - 1.00m
1.00 - 1.50m	1.00 - 1.50m
1.50 - 2.00m	1.50 - 2.00m
2.00 - 2.50m	2.00 - 2.50m
2.50 - 3.00m	2.50 - 3.00m
3.00 - 3.50m	3.00 - 3.50m
3.50 - 4.00m	3.50 - 4.00m
4.00 - 5.00m	4.00 - 5.00m
5.00 - 6.00m	5.00 - 6.00m

BANDS INDICATE THE DEPTHS OF CUT & FILL BETWEEN THE PROPOSED FORMATION AND THE EXISTING SITE FOLLOWING SITE STRIP.

THE SITE STRIP MATERIAL IS NOT CONSIDERED SUITABLE FOR RE-USE WITHIN THE BULK EARTHWORKS AND IS TO BE REMOVED FROM SITE.

THE SUITABILITY OF SITE WON MATERIAL TO BE USED WITHIN THE BULK EARTHWORKS EXERCISE IS TO BE CONFIRMED.

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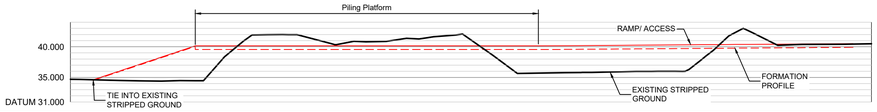
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NETWORK RAIL VIADUCT
PILING PLATFORM OPTION 1
LEVEL & CUT-FILL ANALYSIS

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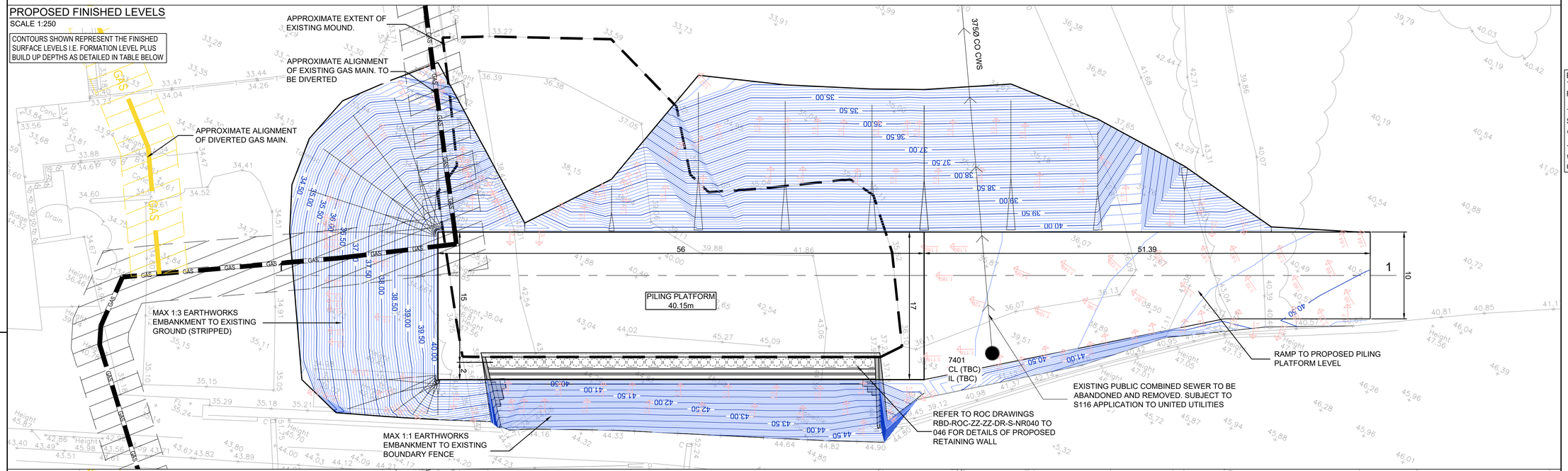
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PROPOSED FINISHED LEVEL		34.617	35.047	36.707	38.366	40.026	40.150	40.150	40.150	40.150	40.150	40.150	40.150	40.150	40.150	40.150	40.150	40.170	40.206	40.237	40.272	40.309	40.347	40.388	40.419	40.454	40.491	40.510	
PROPOSED FORMATION LEVEL		34.517	34.947	36.607	38.266	39.926	39.550	39.550	39.550	39.550	39.550	39.550	39.550	39.550	39.550	39.550	39.550	39.570	39.606	39.637	39.672	39.709	39.747	39.788	39.819	39.854	39.891	39.910	
EXISTING GROUND LEVEL MINUS 100mm STRIP	34.693	34.582	34.464	34.406	34.472	38.180	41.935	41.986	41.191	40.655	40.849	41.369	41.689	41.386	37.828	35.672	35.757	35.821	35.927	35.995	35.992	39.461	42.932	40.473	40.391	40.407	40.481		

1-1 RAMP/ PLATFORM LONG SECTION

PROPOSED FINISHED LEVELS

SCALE 1:250

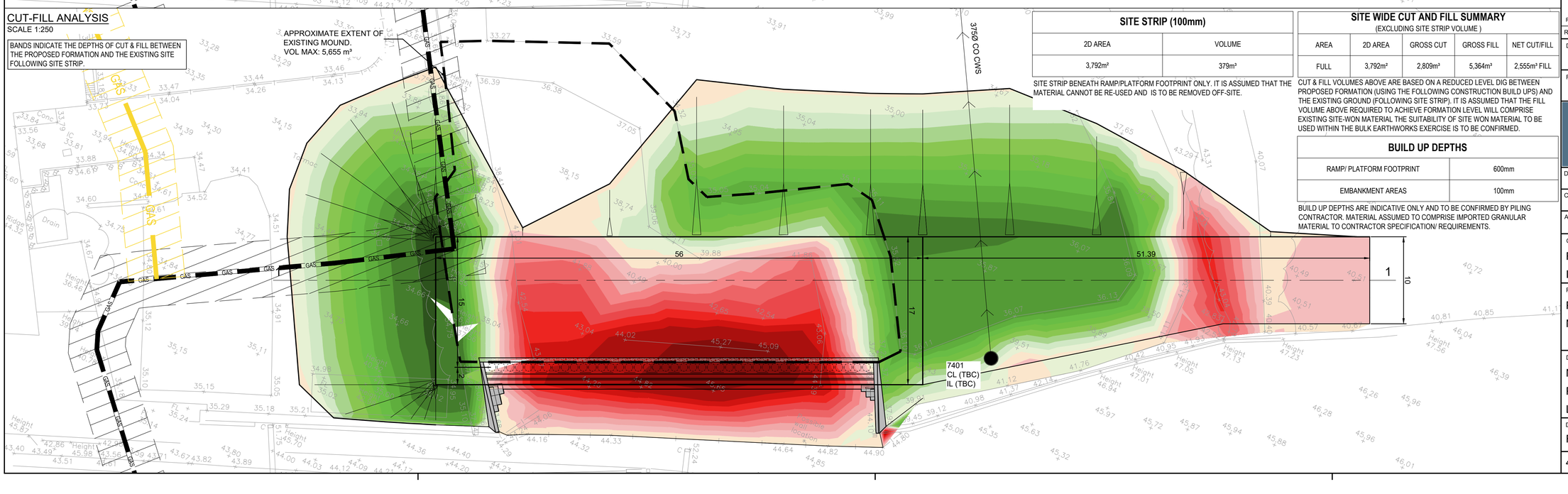
CONTOURS SHOWN REPRESENT THE FINISHED SURFACE LEVELS I.E. FORMATION LEVEL PLUS BUILD UP DEPTHS AS DETAILED IN TABLE BELOW



CUT-FILL ANALYSIS

SCALE 1:250

BANDS INDICATE THE DEPTHS OF CUT & FILL BETWEEN THE PROPOSED FORMATION AND THE EXISTING SITE FOLLOWING SITE STRIP.



SITE STRIP (100mm)	
2D AREA	VOLUME
3,792m²	379m³

SITE STRIP BENEATH RAMP/PLATFORM FOOTPRINT ONLY. IT IS ASSUMED THAT THE MATERIAL CANNOT BE RE-USED AND IS TO BE REMOVED OFF-SITE.

SITE WIDE CUT AND FILL SUMMARY (EXCLUDING SITE STRIP VOLUME)				
AREA	2D AREA	GROSS CUT	GROSS FILL	NET CUT/FILL
FULL	3,792m²	2,809m³	5,364m³	2,555m³ FILL

CUT & FILL VOLUMES ABOVE ARE BASED ON A REDUCED LEVEL DIG BETWEEN PROPOSED FORMATION (USING THE FOLLOWING CONSTRUCTION BUILD UPS) AND THE EXISTING GROUND (FOLLOWING SITE STRIP). IT IS ASSUMED THAT THE FILL VOLUME ABOVE REQUIRED TO ACHIEVE FORMATION LEVEL WILL COMPRISE EXISTING SITE-WON MATERIAL THE SUITABILITY OF SITE WON MATERIAL TO BE USED WITHIN THE BULK EARTHWORKS EXERCISE IS TO BE CONFIRMED.

BUILD UP DEPTHS	
RAMP/ PLATFORM FOOTPRINT	600mm
EMBANKMENT AREAS	100mm

BUILD UP DEPTHS ARE INDICATIVE ONLY AND TO BE CONFIRMED BY PILING CONTRACTOR. MATERIAL ASSUMED TO COMPRISE IMPORTED GRANULAR MATERIAL TO CONTRACTOR SPECIFICATION/ REQUIREMENTS.

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CUT / FILL BANDS

CUT	FILL
0.00 - 0.50m	0.00 - 0.50m
0.50 - 1.00m	0.50 - 1.00m
1.00 - 1.50m	1.00 - 1.50m
1.50 - 2.00m	1.50 - 2.00m
2.00 - 2.50m	2.00 - 2.50m
2.50 - 3.00m	2.50 - 3.00m
3.00 - 3.50m	3.00 - 3.50m
3.50 - 4.00m	3.50 - 4.00m
4.00 - 5.00m	4.00 - 5.00m
5.00 - 6.00m	5.00 - 6.00m

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THE SITE STRIP MATERIAL IS NOT CONSIDERED SUITABLE FOR RE-USE WITHIN THE BULK EARTHWORKS AND IS TO BE REMOVED FROM SITE.

THE SUITABILITY OF SITE WON MATERIAL TO BE USED WITHIN THE BULK EARTHWORKS EXERCISE IS TO BE CONFIRMED.

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P01	19.05.23	FIRST ISSUE	ARJ	MN

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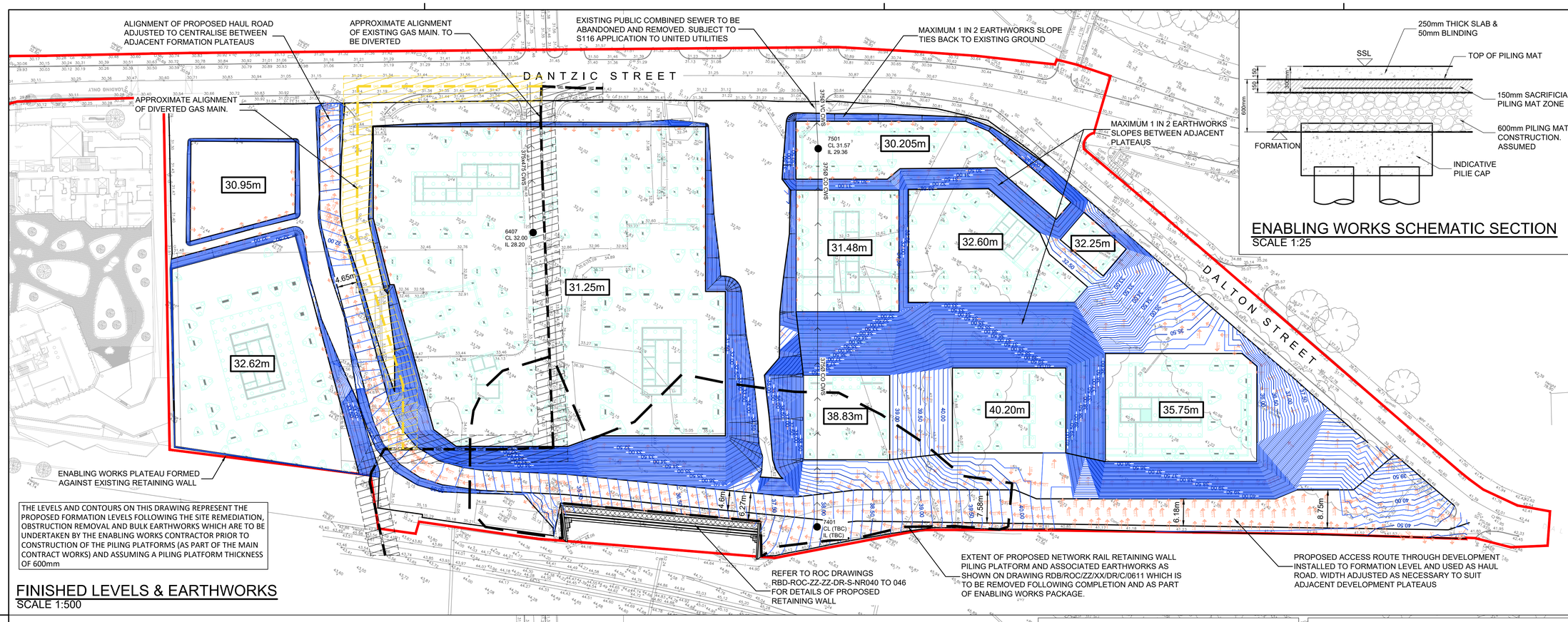
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NETWORK RAIL VIADUCT
PILING PLATFORM OPTION 2
LEVEL & CUT-FILL ANALYSIS

DRAWING No.	REV.
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THE LEVELS AND CONTOURS ON THIS DRAWING REPRESENT THE PROPOSED FORMATION LEVELS FOLLOWING THE SITE REMEDIATION, OBSTRUCTION REMOVAL AND BULK EARTHWORKS WHICH ARE TO BE UNDERTAKEN BY THE ENABLING WORKS CONTRACTOR PRIOR TO CONSTRUCTION OF THE PILING PLATFORMS (AS PART OF THE MAIN CONTRACT WORKS) AND ASSUMING A PILING PLATFORM THICKNESS OF 600mm

FINISHED LEVELS & EARTHWORKS
SCALE 1:500

ENABLING WORKS SCHEMATIC SECTION
SCALE 1:25

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5. THE PROPOSED FINISHED LEVELS SHOWN ON THIS DRAWING REPRESENT THE ENABLING WORKS FORMATION I.E. UNDERSIDE OF THE PROPOSED PILING PLATFORMS.

CUT / FILL BANDS

CUT		FILL	
	0.00 - 1.00m		0.00 - 1.00m
	1.00 - 2.00m		1.00 - 2.00m
	2.00 - 3.00m		2.00 - 3.00m
	3.00 - 4.00m		3.50 - 4.00m
	4.00 - 5.00m		4.00 - 4.60m
	5.00 - 6.00m		
	6.00 - 7.00m		
	7.00 - 8.00m		
	8.00 - 9.00m		
	9.00 - 9.30m		

BANDS INDICATE THE DEPTHS OF CUT & FILL BETWEEN THE PROPOSED FORMATION AND THE EXISTING SITE FOLLOWING SITE STRIP (100mm) AND CONSTRUCTION OF THE NETWORK RAIL ENABLING WORKS PLATFORM (RDB/ROC/ZZ/XX/DR/0611).

THE SITE STRIP MATERIAL IS NOT CONSIDERED SUITABLE FOR RE-USE WITHIN THE BULK EARTHWORKS AND IS TO BE REMOVED FROM SITE.

THE MATERIAL USED WITHIN THE NETWORK RAIL PLATFORM COMPRISE A MIXTURE OF SITE WON AND IMPORTED GRANULAR MATERIAL.

THE SUITABILITY OF SITE WON MATERIAL TO BE USED WITHIN THE BULK EARTHWORKS EXERCISE IS TO BE CONFIRMED.

ASSESSMENT OF SITE WON MATERIAL

GROSS CUT	MADE GROUND	NATURAL GROUND
37,537m³	31,762m³	5,775m³

SITE STRIP (100mm)

2D AREA	VOLUME
18,903m²	1,890m³

SITE STRIP ABOVE EXCLUDES AREA BENEATH NETWORK RAIL RAMP/PLATFORM FOOTPRINT AS QUANTIFIED ON ROC DRAWING RDB/ROC/ZZ/XX/DR/C/0611 AND DISPOSED OF SEPERATELY. IT IS ASSUMED THAT THE MATERIAL CANNOT BE RE-USED AND IS TO BE REMOVED OFF-SITE.

SITE WIDE CUT AND FILL SUMMARY
(EXCLUDING SITE STRIP VOLUME)

AREA	2D AREA	GROSS CUT	GROSS FILL	NET CUT/FILL
FULL	20,030m²	41,902m³	1,810m³	40,092m³ CUT
Adjustment for use of site won material to form Network Rail Platform to formation as shown on dwg. RDB/ROC/ZZ/XX/DR/0611		-2,555m³	-	37,537m³ CUT

CUT & FILL VOLUMES ABOVE ARE BASED ON A REDUCED LEVEL DIG BETWEEN PROPOSED FORMATION (USING THE FOLLOWING CONSTRUCTION BUILD UPS) AND THE EXISTING GROUND FOLLOWING SITE STRIP AND CONSTRUCTION OF THE NETWORK RAIL ENABLING WORKS PLATFORM (RDB/ROC/ZZ/XX/DR/C/0611)

BUILD UP DEPTHS

PLATEAU FOOTPRINT	600mm
HAUL ROAD	665mm

PLATEAU BUILD UP DEPTH IS INDICATIVE ONLY AND TO BE CONFIRMED BY PILING CONTRACTOR. DEPTH FOR HAUL ROAD BASED ON LANDSCAPE ARCHITECTS LEVELS AND PAVEMENT TYPES (RDB/OPN/00/ZZ/DR/LA/210000 P01 & 210100 P01)

ISOPACHYTE CONTOURS & VOLUMETRIC
SCALE 1:500

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P01	19.05.23	FIRST ISSUE	ARJ	MN

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DRAWING TITLE
ENABLING WORKS
PLATEAU LEVELS &
CUT-FILL ANALYSIS

DRAWING No.	REV.
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THIS DESIGN IS BASED ON STAGE 3 INFORMATION AS OF 19.05.23. ALL INFORMATION ON THIS DRAWING IS SUBJECT TO CHANGE AS THE SCHEME IS DEVELOPED AS THE FOLLOWING INFORMATION IS EITHER YET TO BE FINALISED.

- LANDSCAPE/ EXTERNAL WORKS LEVELS
- LANDSCAPE/ EXTERNAL WORKS FINISHES

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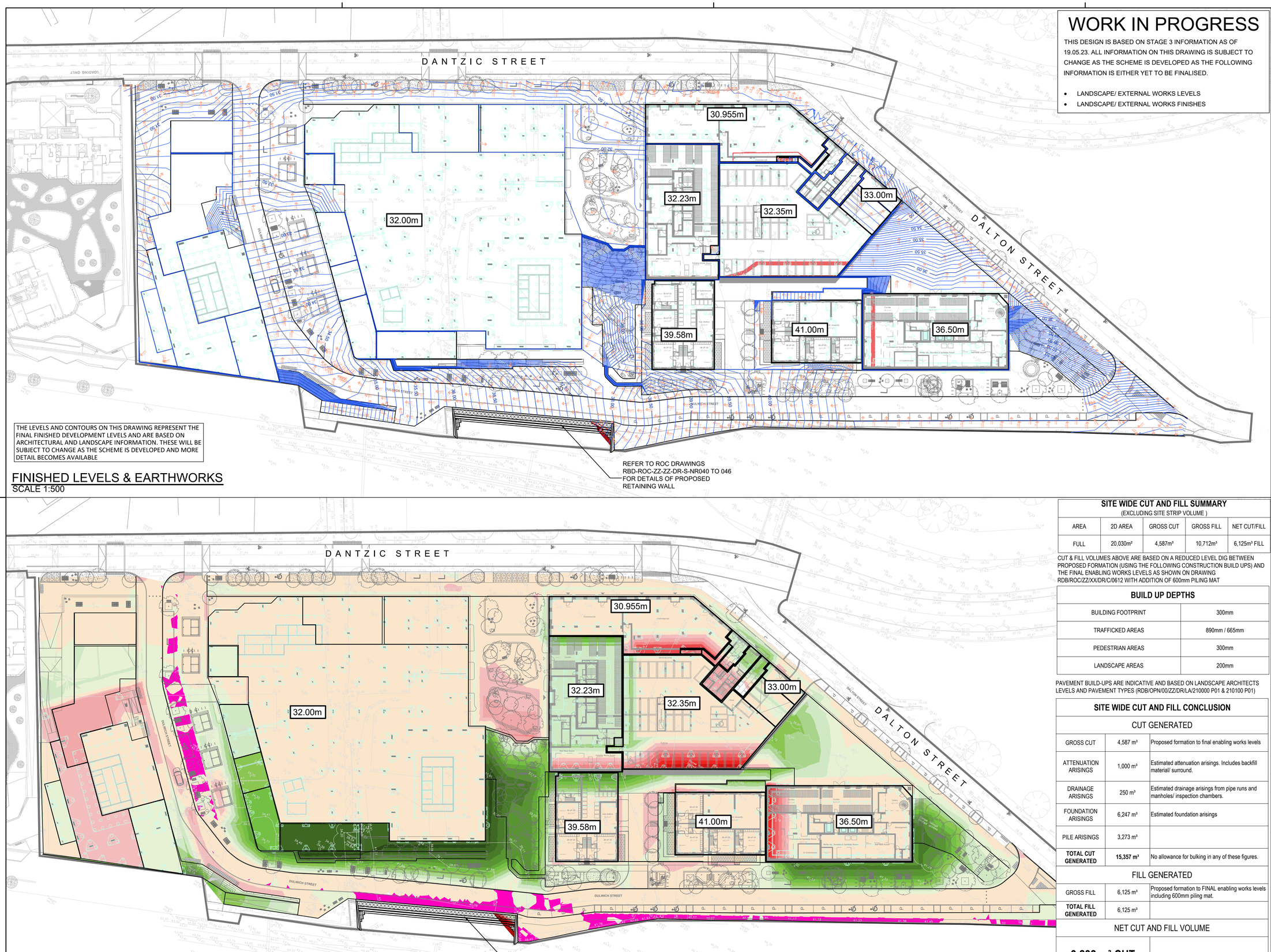
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5. THE PROPOSED FINISHED LEVELS SHOWN ON THIS DRAWING REPRESENT THE ENABLING WORKS FORMATION I.E. UNDERSIDE OF THE PROPOSED PILING PLATFORMS.

CUT / FILL BANDS

CUT		FILL	
	0.00		0.00 - 0.50m
	0.00 - 0.50m		0.50 - 1.00m
	0.50 - 1.00m		1.00 - 1.50m
	1.00 - 1.50m		1.50 - 2.00m
	1.50 - 2.00m		2.00 - 2.50m
	2.00 - 2.50m		2.50 - 3.00m
	2.50 - 3.00m		3.00 - 4.00m
	3.00 - 3.50m		4.00 - 5.00m
	3.50 - 4.00m		5.00 - 6.00m
	4.00 - 5.00m		6.00 - 7.00m
	5.00 - 6.00m		

BANDS INDICATE THE DEPTHS OF CUT & FILL BETWEEN THE PROPOSED FORMATION AND THE FINAL ENABLING WORKS LEVELS I.E. THOSE SHOWN ON DRAWING RDB/ROC/ZZ/XX/DR/C/0612 WITH THE ADDITION OF THE 600mm PILING MAT.



THE LEVELS AND CONTOURS ON THIS DRAWING REPRESENT THE FINAL FINISHED DEVELOPMENT LEVELS AND ARE BASED ON ARCHITECTURAL AND LANDSCAPE INFORMATION. THESE WILL BE SUBJECT TO CHANGE AS THE SCHEME IS DEVELOPED AND MORE DETAIL BECOMES AVAILABLE

REFER TO ROC DRAWINGS RBD-ROC-ZZ-ZZ-DR-S-NR040 TO 046 FOR DETAILS OF PROPOSED RETAINING WALL

FINISHED LEVELS & EARTHWORKS

SCALE 1:500

REFER TO ROC DRAWINGS RBD-ROC-ZZ-ZZ-DR-S-NR040 TO 046 FOR DETAILS OF PROPOSED RETAINING WALL

ISOPACHYTE CONTOURS & VOLUMETRIC

SCALE 1:500

SITE WIDE CUT AND FILL SUMMARY
(EXCLUDING SITE STRIP VOLUME)

AREA	2D AREA	GROSS CUT	GROSS FILL	NET CUT/FILL
FULL	20,030m²	4,587m³	10,712m³	6,125m³ FILL

CUT & FILL VOLUMES ABOVE ARE BASED ON A REDUCED LEVEL DIG BETWEEN PROPOSED FORMATION (USING THE FOLLOWING CONSTRUCTION BUILD UPS) AND THE FINAL ENABLING WORKS LEVELS AS SHOWN ON DRAWING RDB/ROC/ZZ/XX/DR/C/0612 WITH ADDITION OF 600mm PILING MAT

BUILD UP DEPTHS

BUILDING FOOTPRINT	300mm
TRAFFICKED AREAS	890mm / 665mm
PEDESTRIAN AREAS	300mm
LANDSCAPE AREAS	200mm

PAVEMENT BUILD-UPS ARE INDICATIVE AND BASED ON LANDSCAPE ARCHITECTS LEVELS AND PAVEMENT TYPES (RDB/OPN/00/ZZ/DR/LA/210000 P01 & 210100 P01)

SITE WIDE CUT AND FILL CONCLUSION

CUT GENERATED		
GROSS CUT	4,587 m³	Proposed formation to final enabling works levels
ATTENUATION ARISINGS	1,000 m³	Estimated attenuation arisings. Includes backfill material/ surround.
DRAINAGE ARISINGS	250 m³	Estimated drainage arisings from pipe runs and manholes/ inspection chambers.
FOUNDATION ARISINGS	6,247 m³	Estimated foundation arisings
PILE ARISINGS	3,273 m³	
TOTAL CUT GENERATED	**15,357 m³**	No allowance for bulking in any of these figures.
FILL GENERATED		
GROSS FILL	6,125 m³	Proposed formation to FINAL enabling works levels including 600mm piling mat.
TOTAL FILL GENERATED	6,125 m³	
NET CUT AND FILL VOLUME		
9,232 m³ CUT		

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APPENDIX E
GENERIC ASSESSMENT CRITERIA

Appendix E.1 Commercial Reuse Screening Values (for use beneath buildings & hardstanding)

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were initially published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report[3] and associated chemical specific reports[6], and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the CLEA tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. The SAC are also termed GAC.

Conceptual model

In accordance with SR3[5], the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In

accordance with Box 3.1 of SR3[5], the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated chemical specific reports[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a LLTC[3,6] has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3[5] notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3], with a dust loading factor detailed in Section 9.3 of SR3[5]. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3[5] input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 3 and the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

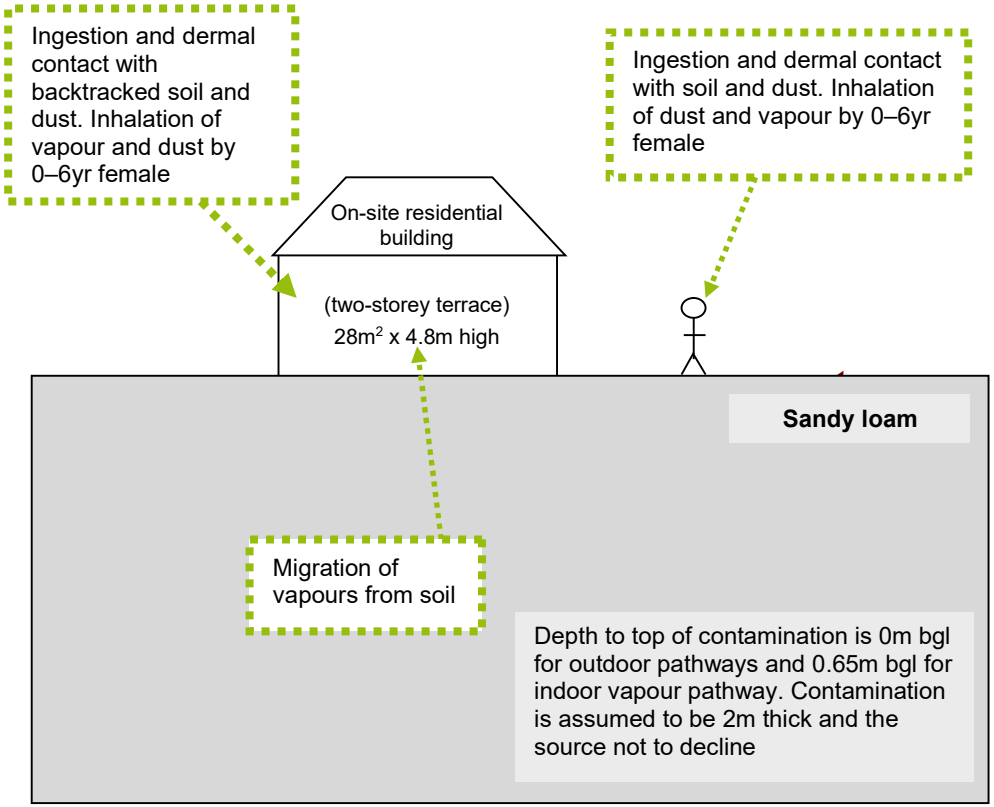


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3[5]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[5]. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[5]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[5]
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[5]
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010[3]					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]					
Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3[1], Science Report SC050021/Cadmium SGV[1] and the project report SP1010[3] for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Barium	(b)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Beryllium		1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR
Boron		1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR
Cadmium	(a)	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg^{4+})		1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Vanadium		1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR
Zinc	(b)	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds													
Benzene	(a)	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.87E+04	1.04E+02	1.04E+02	2.04E+04	3.87E+04	1.69E+02	1.69E+02	3.31E+04	3.87E+04	3.21E+02	3.19E+02	6.27E+04
Trichloroethene (TCE)		9.73E-03	3.61E-02	NR	1.54E+03	2.04E-02	7.57E-02	NR	3.22E+03	4.52E-02	1.68E-01	NR	7.14E+03
Tetrachloroethene (PCE)		1.80E+03	3.19E-01	3.19E-01	4.24E+02	1.80E+03	7.15E-01	7.15E-01	9.51E+02	1.80E+03	1.64E+00	1.64E+00	2.18E+03
1,1,1-Trichloroethane		7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride (chloroethene)		4.85E+00	1.47E-02	1.47E-02	1.36E+03	4.85E+00	1.90E-02	1.90E-02	1.76E+03	4.85E+00	2.91E-02	2.89E-02	2.69E+03
1,2,4-Trimethylbenzene		NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(a)pyrene	(a)	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrysene		3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Dibenzo(a,h)anthracene		3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02
Fluorene		5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Naphthalene		2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenanthrene		1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Phenol		6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_{10}		2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

Table 4
Human health generic assessment criteria for residential without home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	40	40	40
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	11,000	11,000	11,000
Cadmium	149	149	149
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	7,100	7,100	7,100
Lead	310	310	310
Elemental Mercury (Hg^0)	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	56	56	56
Methyl Mercury (Hg^{4+})	9	12	15
Nickel	180	180	180
Selenium	430	430	430
Vanadium	1,200	1,200	1,200
Zinc	40,000	40,000	40,000
Cyanide (free)	40	40	40
Volatile Organic Compounds			
Benzene	0.9	1.6	3.3
Toluene	900 (869)	1,900	3,900
Ethylbenzene	80	190	440
Xylene - m	80	190	450
Xylene - o	90	210	480
Xylene - p	80	180	430
Total xylene	80	180	430
Methyl tertiary-Butyl ether (MTBE)	100	170	320
Trichloroethene (TCE)	0.010	0.020	0.045
Tetrachloroethene (PCE)	0.32	0.71	1.64
1,1,1-Trichloroethane	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	3.9	8.0	17.2
Carbon Tetrachloride	0.026	0.056	0.128
1,2-Dichloroethane	0.009	0.013	0.023
Vinyl Chloride (chloroethene)	0.015	0.019	0.029
1,2,4-Trimethylbenzene	5.6	12.9	26.9
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	6,600 (57)	7,200	7,400
Acenaphthylene	6,600 (86)	7,200	7,400
Anthracene	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	11.0	13.6	15.0
Benzo(a)pyrene	5.3	5.3	5.3
Benzo(b)fluoranthene	4.0	4.0	4.1
Benzo(g,h,i)perylene	355	358	359
Benzo(k)fluoranthene	106	107	107
Chrysene	30	31	32
Dibenzo(a,h)anthracene	0.31	0.32	0.32
Fluoranthene	1,500	1,600	1,600
Fluorene	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	45	46	46
Naphthalene	23	55	125
Phenanthrene	1,300 (36)	1,450	1,520
Pyrene	3,700	3,800	3,800
Phenol	440*	688	1,170
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	42	78	161
Aliphatic hydrocarbons >EC_6-EC_8	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	27	65	155
Aliphatic hydrocarbons >EC_{10}-EC_{12}	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC_8-EC_{10}	47	115	269
Aromatic hydrocarbons >EC_{10}-EC_{12}	300	600	1,200
Aromatic hydrocarbons >EC_{12}-EC_{16}	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC_{16}-EC_{21}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{21}-EC_{35}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	1,900	1,900	1,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. SAC - soil assessment criteria.

[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

Appendix E.2 Residential Without Plant Uptake Screening Values (for use beneath areas of proposed soft landscaping)

Generic assessment criteria for human health: public open space (public park) scenario

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014 the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs. The publication of C4SL introduced two new land-use scenarios relating to public open spaces.

C4SL were initially published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report[3] and associated chemical specific reports[6], and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications have been applied. The RSK GAC have also been produced with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the CLEA tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3].

Conceptual model

This GAC derivation considers POS_{Park} be used for the following scenarios:

- family visits and picnics
- children's play areas
- sporting activities such as football on an informal basis (not considered as a dedicated sports pitch)

- dog walking.

The POS_{Park} scenario considers risk to a child receptor (female) between the ages of 0 and 6 years old. In accordance with Section 3.6.4.3 of the SP1010 project report[3], the pathways considered for production of SAC in the POS_{Park} scenario are

- ingestion of soil outdoors
- dermal contact with soil outdoors
- inhalation of dust outdoors
- inhalation of vapours outdoors.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible, as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances the vapour pathway should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface correction factor of 10 into the CLEA chemical database for all petroleum hydrocarbons (including BTEX, trimethylbenzenes, and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated chemical specific reports[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a LLTC[3,6] has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the POS_{Park} scenario, project report SP1010[3] considers there to be no buildings with the public park, the park being a relatively large area (>0.5ha) of predominantly grassed open space with no more than 25% of exposed soil. The input parameters were based on the air dispersion model and the vapour model detailed in SR3[5]. Full details of the land-use scenario are presented in Table 3.7 of project report SP1010[3].

The parameters for a sandy loam soil type were used in line with SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%.

The SAC were produced using the input parameters in Table 1 below and Table 3.6 of project report SP1010[3]. The GAC by pathway are presented in Table 2 and the combined GAC presented in Table 3.

Figure 1: Conceptual model for CLEA public open space (park) scenario

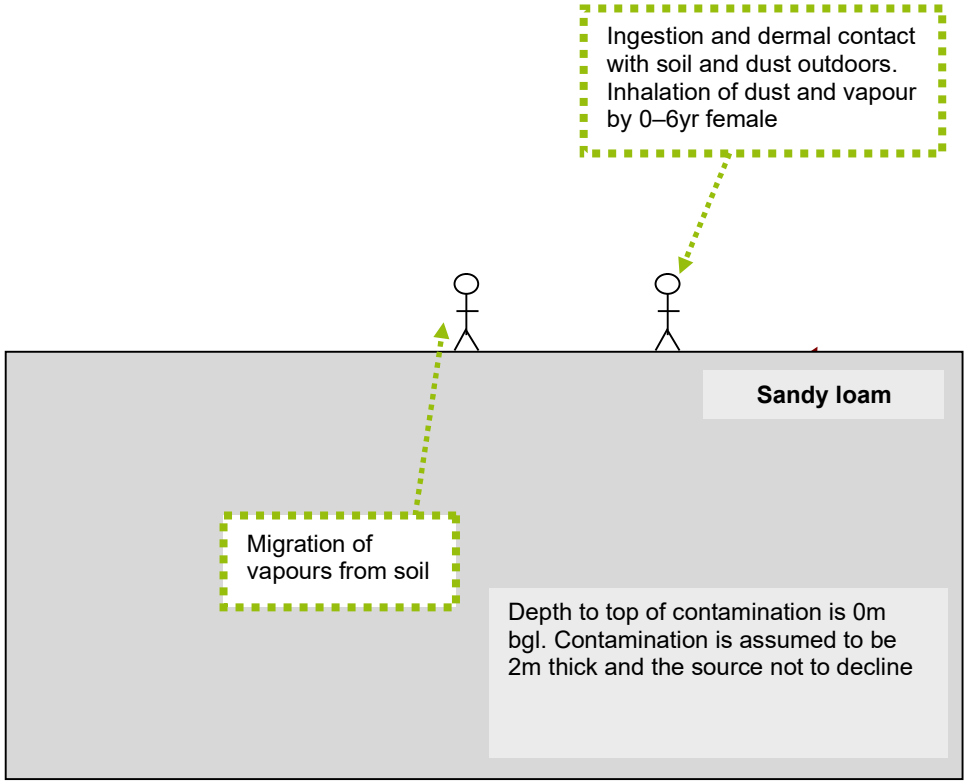


Table 1: Exposure assessment parameters for public open space (park) scenario

Parameter	Value	Justification
Land use	Public open space (park)	Chosen land use. Table 3.7 of SP1010[3]
Receptor	Female child	Taken as female child exposed over 6 years from 0 to 6 years, Table 3.7, SP1010[3]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[5])
Start age class (AC)	1	Range of AC corresponding to key generic assumption that the critical receptor is a young female child aged 0–6 years. From Table 3.7, SP1010[3]
End AC	6	
SOM (%)	6	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (PUBLIC PARK)

Table 2

Human Health Generic Assessment Criteria for Public Open Space (public park)

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	1.68E+02	1.91E+04	NR	NR	1.68E+02	1.91E+04	NR	NR	1.68E+02	1.91E+04	NR	NR
Barium	(b)	5.77E+03	NR	NR	NR	5.77E+03	NR	NR	NR	5.77E+03	NR	NR	NR
Beryllium		6.68E+02	6.27E+01	NR	NR	6.68E+02	6.27E+01	NR	NR	6.68E+02	6.27E+01	NR	NR
Boron		4.62E+04	1.89E+08	NR	NR	4.62E+04	1.89E+08	NR	NR	4.62E+04	1.89E+08	NR	NR
Cadmium	(a)	9.13E+02	2.35E+04	8.82E+02	NR	9.13E+02	2.35E+04	8.82E+02	NR	9.13E+02	2.35E+04	8.82E+02	NR
Chromium (III) - trivalent	(c)	8.47E+04	3.30E+04	NR	NR	8.47E+04	3.30E+04	NR	NR	8.47E+04	3.30E+04	NR	NR
Chromium (VI) - hexavalent	(a,d)	2.52E+02	7.48E+02	NR	NR	2.52E+02	7.48E+02	NR	NR	2.52E+02	7.48E+02	NR	NR
Copper		4.62E+04	5.12E+05	4.44E+04	NR	4.62E+04	5.12E+05	4.44E+04	NR	4.62E+04	5.12E+05	4.44E+04	NR
Lead	(a)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	2.63E+01	NR	4.31E+00	NR	2.86E+01	NR	1.07E+01	NR	3.02E+01	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		2.45E+02	1.32E+05	2.44E+02	NR	2.45E+02	1.32E+05	2.44E+02	NR	2.45E+02	1.32E+05	2.44E+02	NR
Methyl Mercury (Hg^{4+})		7.32E+01	4.59E+02	6.32E+01	7.33E+01	7.32E+01	6.40E+02	6.57E+01	1.42E+02	7.32E+01	9.33E+02	6.79E+01	3.04E+02
Nickel	(d)	8.04E+02	6.60E+03	NR	NR	8.04E+02	6.60E+03	NR	NR	8.04E+02	6.60E+03	NR	NR
Selenium	(b)	1.85E+03	NR	NR	NR	1.85E+03	NR	NR	NR	1.85E+03	NR	NR	NR
Vanadium		5.03E+03	5.32E+04	NR	NR	5.03E+03	5.32E+04	NR	NR	5.03E+03	5.32E+04	NR	NR
Zinc	(b)	1.73E+05	1.32E+09	NR	NR	1.73E+05	1.32E+09	NR	NR	1.73E+05	1.32E+09	NR	NR
Cyanide (free)		1.72E+02	4.98E+05	1.71E+02	NR	1.72E+02	4.98E+05	1.71E+02	NR	1.72E+02	4.98E+05	1.71E+02	NR
Volatile Organic Compounds													
Benzene	(a)	2.99E+02	5.20E+02	1.90E+02	1.22E+03	2.99E+02	7.09E+02	2.11E+02	2.26E+03	2.99E+02	1.02E+03	2.32E+02	4.71E+03
Toluene		1.17E+05	3.44E+05	8.71E+04	8.69E+02	1.17E+05	5.11E+05	9.50E+04	1.92E+03	1.17E+05	7.70E+05	1.01E+05	4.36E+03
Ethylbenzene		5.24E+04	2.41E+04	1.65E+04	5.18E+02	5.24E+04	3.70E+04	2.17E+04	1.22E+03	5.24E+04	5.65E+04	2.72E+04	2.84E+03
Xylene - m		9.43E+04	2.06E+04	1.69E+04	6.25E+02	9.43E+04	3.16E+04	2.37E+04	1.47E+03	9.43E+04	4.84E+04	3.20E+04	3.46E+03
Xylene - o		9.43E+04	2.13E+04	1.74E+04	4.78E+02	9.43E+04	3.27E+04	2.43E+04	1.12E+03	9.43E+04	4.99E+04	3.26E+04	2.62E+03
Xylene - p		9.43E+04	2.02E+04	1.66E+04	5.76E+02	9.43E+04	3.09E+04	2.33E+04	1.35E+03	9.43E+04	4.73E+04	3.15E+04	3.17E+03
Total xylene		9.43E+04	2.02E+04	1.66E+04	6.25E+02	9.43E+04	3.09E+04	2.33E+04	1.47E+03	9.43E+04	4.73E+04	3.15E+04	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		1.58E+05	2.62E+05	9.84E+04	2.04E+04	1.58E+05	3.34E+05	1.07E+05	3.31E+04	1.58E+05	4.60E+05	1.17E+05	6.27E+04
Trichloroethene (TCE)		4.10E+01	2.01E+02	NR	1.54E+03	5.36E+01	2.91E+02	NR	3.22E+03	6.91E+01	4.33E+02	NR	7.14E+03
Tetrachloroethene (PCE)		7.31E+03	1.73E+03	1.40E+03	4.24E+02	7.31E+03	2.58E+03	1.91E+03	9.51E+02	7.31E+03	3.91E+03	2.55E+03	2.18E+03
1,1,1-Trichloroethane		3.15E+05	6.99E+04	5.72E+04	1.43E+03	3.15E+05	1.00E+05	7.59E+04	2.92E+03	3.15E+05	1.48E+05	1.01E+05	6.39E+03
1,1,1,2 Tetrachloroethane		2.99E+03	2.89E+03	1.47E+03	2.60E+03	2.99E+03	4.40E+03	1.78E+03	6.02E+03	2.99E+03	6.71E+03	2.07E+03	1.40E+04
1,1,2,2-Tetrachloroethane		2.99E+03	4.60E+03	1.81E+03	2.67E+03	2.99E+03	6.58E+03	2.06E+03	5.46E+03	2.99E+03	9.75E+03	2.29E+03	1.20E+04
Carbon Tetrachloride		2.10E+03	1.98E+02	1.89E+02	1.52E+03	2.10E+03	2.94E+02	2.73E+02	3.32E+03	2.10E+03	4.42E+02	3.96E+02	7.54E+03
1,2-Dichloroethane		6.31E+01	3.17E+01	2.11E+01	3.41E+03	6.31E+01	3.81E+01	2.37E+01	4.91E+03	6.31E+01	4.98E+01	2.78E+01	8.43E+03
Vinyl Chloride (chloroethene)		1.98E+01	2.68E+02	1.84E+01	1.36E+03	1.98E+01	3.04E+02	1.86E+01	1.76E+03	1.98E+01	3.76E+02	1.88E+01	2.69E+03
1,2,4-Trimethylbenzene		NR	3.09E+02	NR	4.74E+02	NR	3.63E+02	NR	1.16E+03	NR	4.08E+02	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		3.07E+04	5.14E+05	2.89E+04	5.70E+01	3.07E+04	8.07E+05	2.95E+04	1.41E+02	3.07E+04	1.24E+06	2.99E+04	3.36E+02
Acenaphthylene		3.07E+04	4.91E+05	2.89E+04	8.61E+01	3.07E+04	7.69E+05	2.95E+04	2.12E+02	3.07E+04	1.18E+06	2.99E+04	5.06E+02
Anthracene		1.53E+05	5.73E+06	1.49E+05	1.17E+00	1.53E+05	8.99E+06	1.51E+05	2.91E+00	1.53E+05	1.38E+07	1.52E+05	6.96E+00
Benzo(a)anthracene		7.93E+01	1.27E+02	4.88E+01	1.71E+00	7.93E+01	1.96E+02	5.65E+01	4.28E+00	7.93E+01	2.94E+02	6.25E+01	1.03E+01
Benzo(a)pyrene	(a)	2.14E+01	7.45E+01	NR	9.11E-01	2.14E+01	1.14E+02	NR	2.28E+00	2.14E+01	1.70E+02	NR	5.46E+00
Benzo(b)fluoranthene		2.00E+01	3.91E+01	1.32E+01	1.22E+00	2.00E+01	6.02E+01	1.50E+01	3.04E+00	2.00E+01	8.97E+01	1.63E+01	7.29E+00
Benzo(g,h,i)perylene		1.76E+03	6.52E+03	1.39E+03	1.54E-02	1.76E+03	9.80E+03	1.49E+03	3.85E-02	1.76E+03	1.41E+04	1.57E+03	9.23E-02
Benzo(k)fluoranthene		5.27E+02	1.21E+03	3.67E+02	6.87E-01	5.27E+02	1.86E+03	4.11E+02	1.72E+00	5.27E+02	2.75E+03	4.42E+02	4.12E+00
Chrysene		1.59E+02	2.22E+02	9.25E+01	4.40E-01	1.59E+02	3.44E+02	1.09E+02	1.10E+00	1.59E+02	5.19E+02	1.21E+02	2.64E+00
Dibenzo(a,h)anthracene		1.59E+00	4.16E+00	1.15E+00	3.93E-03	1.59E+00	6.35E+00	1.27E+00	9.82E-03	1.59E+00	9.34E+00	1.36E+00	2.36E-02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (PUBLIC PARK)

Table 2

Human Health Generic Assessment Criteria for Public Open Space (public park)

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Fluoranthene		6.39E+03	4.87E+05	6.30E+03	1.89E+01	6.39E+03	7.61E+05	6.33E+03	4.73E+01	6.39E+03	1.16E+06	6.35E+03	1.13E+02
Fluorene		2.04E+04	4.57E+05	1.96E+04	3.09E+01	2.04E+04	7.17E+05	1.99E+04	7.65E+01	2.04E+04	1.10E+06	2.01E+04	1.83E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (PUBLIC PARK)

Table 2

Human Health Generic Assessment Criteria for Public Open Space (public park)

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Indeno(1,2,3-cd)pyrene		2.27E+02	4.12E+02	1.46E+02	6.13E-02	2.27E+02	6.35E+02	1.67E+02	1.53E-01	2.27E+02	9.48E+02	1.83E+02	3.68E-01
Naphthalene		1.00E+04	1.24E+03	1.10E+03	7.64E+01	1.00E+04	1.92E+03	1.61E+03	1.83E+02	1.00E+04	2.95E+03	2.28E+03	4.32E+02
Phenanthrene		6.35E+03	2.44E+05	6.19E+03	3.60E+01	6.35E+03	3.83E+05	6.25E+03	8.96E+01	6.35E+03	5.88E+05	6.28E+03	2.14E+02
Pyrene		1.53E+04	1.11E+06	1.51E+04	2.20E+00	1.53E+04	1.73E+06	1.52E+04	5.49E+00	1.53E+04	2.64E+06	1.52E+04	1.32E+01
Phenol		2.77E+05	7.78E+03	7.57E+03	2.42E+04	2.77E+05	8.60E+03	8.34E+03	3.81E+04	2.77E+05	9.66E+03	9.34E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		1.31E+06	9.65E+04	9.47E+04	3.04E+02	1.31E+06	1.31E+05	1.27E+05	5.58E+02	1.31E+06	1.88E+05	1.81E+05	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		1.31E+06	1.51E+05	1.46E+05	1.44E+02	1.31E+06	2.25E+05	2.15E+05	3.22E+02	1.31E+06	3.41E+05	3.16E+05	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.63E+04	1.85E+04	1.43E+04	7.77E+01	2.63E+04	2.89E+04	1.83E+04	1.90E+02	2.63E+04	4.45E+04	2.14E+04	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		2.63E+04	4.12E+04	2.09E+04	4.75E+01	2.63E+04	6.49E+04	2.31E+04	1.18E+02	2.63E+04	1.00E+05	2.43E+04	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		2.63E+04	1.19E+05	2.47E+04	2.37E+01	2.63E+04	1.88E+05	2.53E+04	5.91E+01	2.63E+04	2.91E+05	2.57E+04	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	4.55E+05	NR	NR	8.48E+00	4.78E+05	NR	NR	2.12E+01	4.94E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	4.55E+05	NR	NR	8.48E+00	4.78E+05	NR	NR	2.12E+01	4.94E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_{10}		1.05E+04	1.12E+04	7.22E+03	6.13E+02	1.05E+04	1.75E+04	8.50E+03	1.50E+03	1.05E+04	2.70E+04	9.29E+03	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		1.05E+04	2.61E+04	9.24E+03	3.64E+02	1.05E+04	4.10E+04	9.75E+03	8.99E+02	1.05E+04	6.33E+04	1.00E+04	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		1.05E+04	8.62E+04	1.02E+04	1.69E+02	1.05E+04	1.36E+05	1.03E+04	4.19E+02	1.05E+04	2.10E+05	1.04E+04	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	7.63E+03	NR	NR	5.37E+01	7.72E+03	NR	NR	1.34E+02	7.77E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	7.82E+03	NR	NR	4.83E+00	7.84E+03	NR	NR	1.21E+01	7.85E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	7.82E+03	NR	NR	4.83E+00	7.84E+03	NR	NR	1.21E+01	7.85E+03	NR	NR	2.90E+01

Notes:

Public open space (resi) and (park) GAC are based on the exposure parameters detailed within SP1010 "Development of Category 4 Screening Levels for Assessment of Land affected by Contamination", Final, 20th December 2013

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for barium and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - PUBLIC OPEN SPACE (PUBLIC PARK)

Table 3
Human Health Generic Assessment Criteria for Public Open Space (public park)

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	170	170	170
Barium	5,770	5,770	5,770
Beryllium	60	60	60
Boron	46,000	46,000	46,000
Cadmium	880	880	880
Chromium (III) - trivalent	33,000	33,000	33,000
Chromium (VI) - hexavalent	250	250	250
Copper	44,000	44,000	44,000
Lead	1,300	1,300	1,300
Elemental Mercury (Hg^0)	30 (4)	30 (11)	30 (26)
Inorganic Mercury (Hg^{2+})	240	240	240
Methyl Mercury (Hg^{4+})	63	66	68
Nickel	800	800	800
Selenium	1,800	1,800	1,800
Vanadium	5,000	5,000	5,000
Zinc	173,200	173,200	173,200
Cyanide (free)	170	170	170
Volatile Organic Compounds			
Benzene	190	210	230
Toluene	90,000 (869)	90,000 (1,916)	100,000 (4,357)
Ethylbenzene	17,000 (518)	22,000 (1,216)	27,000 (2,844)
Xylene - m	17,000 (625)	24,000 (1,474)	32,000 (3,457)
Xylene - o	17,000 (478)	24,000 (1,120)	33,000 (2,618)
Xylene - p	17,000 (576)	23,000 (1,353)	31,000 (3,167)
Total xylene	17,000 (625)	23,000 (1,474)	31,000 (3,457)
Methyl tertiary-Butyl ether (MTBE)	98,400 (20,400)	107,100 (33,100)	117,400 (62,700)
Trichloroethene (TCE)	41	54	69
Tetrachloroethene (PCE)	1,400 (424)	1,900 (951)	2,500 (2,180)
1,1,1-Trichloroethane	60,000 (1,425)	80,000 (2,915)	100,000 (6,392)
1,1,1,2 Tetrachloroethane	1,500	1,800	2,100
1,1,2,2-Tetrachloroethane	1,800	2,100	2,300
Carbon Tetrachloride	189	273	396
1,2-Dichloroethane	21	24	28
Vinyl Chloride (chloroethene)	18	19	19
1,2,4-Trimethylbenzene	310	360	410
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	29,000	30,000	30,000
Acenaphthylene	29,000	30,000	30,000
Anthracene	149,000	151,000	152,000
Benzo(a)anthracene	49	56	62
Benzo(a)pyrene	21	21	21
Benzo(b)fluoranthene	13	15	16
Benzo(g,h,i)perylene	1,390	1,490	1,570
Benzo(k)fluoranthene	367	411	442
Chrysene	93	109	121
Dibenzo(a,h)anthracene	1.1	1.3	1.4
Fluoranthene	6,300	6,300	6,400
Fluorene	19,600	19,900	20,100
Indeno(1,2,3-cd)pyrene	146	167	183
Naphthalene	1,200 (76)	1,900 (183)	3,000
Phenanthrene	6,200	6,200	6,300
Pyrene	15,000	15,000	15,000
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	90,000 (304)	130,000 (558)	180,000 (1,150)
Aliphatic hydrocarbons >EC_6-EC_8	150,000 (144)	210,000 (322)	320,000 (736)
Aliphatic hydrocarbons >EC_8-EC_{10}	14,000 (78)	18,000 (190)	21,000 (451)
Aliphatic hydrocarbons >EC_{10}-EC_{12}	21,000 (48)	23,000 (118)	24,000 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	25,000 (24)	25,000 (59)	26,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	450,000	480,000	490,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	450,000	480,000	490,000
Aromatic hydrocarbons >EC_8-EC_{10}	7,200 (613)	8,500 (1,503)	9,300 (3,580)
Aromatic hydrocarbons >EC_{10}-EC_{12}	9,200 (364)	9,700 (899)	10,000
Aromatic hydrocarbons >EC_{12}-EC_{16}	10,200	10,300	10,400
Aromatic hydrocarbons >EC_{16}-EC_{21}	7,600	7,700	7,800
Aromatic hydrocarbons >EC_{21}-EC_{35}	7,800	7,800	7,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	7,800	7,800	7,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

Public open space (resi) and (park) GAC are based on the exposure parameters detailed within SP1010 "Development of Category 4 Screening Levels for Assessment of Land affected by Contamination", Final, 20th December 2013

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene,BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS) The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.

APPENDIX F
SOIL & GROUNDWATER RTV COMPARISONS

Comparison of RTVs against measured concentrations in soil

COPC	Lab sample ID	22/07379/8	23/09425/2	23/09425/5	23/09491/7	23/09491/2	23/09491/3	23/09229/2	23/09229/4	23/09229/5	23/09229/6	23/10932/9	23/10932/10	23/11040/1	23/11040/4	23/10932/4	23/10932/7	23/10932/12	23/10932/13	23/10932/14	23/10932/2	22/07002/5	22/07002/2
	Borehole ID	RBH203	RBH401	RBH401	RBH401	RBH402	RBH402	RBH403	RBH403	RBH403	RBH403	RBH501	RBH501	RBH502	RBH502	RBH503	RBH503	RBH504	RBH504	RBH504	RBH505	TP202	TP203
	Depth to top	3	6.5	15	1	1.5	3.7	3.5	6	9.9	10.2	0.8	2	1	4.5	1.2	4	1.5	1.9	3.1	2.1	0.5	0.3
	Depth to bottom																						
	Date sampled	25/07/2022	20/09/2023	21/09/2023	20/09/2023	19/09/2023	19/09/2023	13/09/2023	14/09/2023	14/09/2023	14/09/2023	01/11/2023	01/11/2023	03/11/2023	07/11/2023	31/10/2023	31/10/2023	02/11/2023	02/11/2023	02/11/2023	31/10/2023	13/07/2022	12/07/2022
	Sample type																						
	RTV (mg/kg)																						
Trichloroethene	0.224	0.006	<0.025	<0.001	<0.025	<0.001	<0.025	<0.025	<0.025	<0.025	<0.001	0.151	<0.001	0.018	0.011	<0.001	<0.001	0.049	0.009	0.007	<0.001	0.012	<0.001
Carbon tetrachloride	0.116	<0.001	<0.025	<0.001	<0.025	<0.001	<0.025	<0.025	<0.025	<0.025	<0.001	<0.001	<0.001	0.002	0.028	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in soil

COPC	Lab sample ID	22/07217/6	22/07217/5	22/07217/2	22/07217/8	23/03693/3	23/03693/1	22/07379/1	22/07379/2	22/07002/6	22/07379/6	23/03602/17	23/03602/18	23/03602/19	23/03602/20	23/03602/21	23/03602/13	23/03602/14	23/03602/15	23/03602/16	23/03602/1	23/03602/2	23/03602/3
	Borehole ID	TP214	TP215	TP216	TP218	TP307	TP310	WS202	WS203	WS204	WS210	WS301	WS301	WS301	WS301	WS301	WS302	WS302	WS302	WS302	WS303	WS303	WS303
	Depth to top	0.8	1	0.6	0.5	0.6	0.5	1.5	0.5	0.4	0.5	0.5	1.5	2.5	3.5	4.5	0.5	1.5	2.5	3.5	0.4	1.2	1.8
	Depth to bottom																						
	Date sampled	18/07/2022	18/07/2022	18/07/2022	19/07/2022	12/04/2023	12/04/2023	21/07/2022	21/07/2022	13/07/2022	22/07/2022	04/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	03/04/2023	03/04/2023	03/04/2023
	Sample type																						
	RTV (mg/kg)																						
Trichloroethene	0.224	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03	<0.001	<0.001	0.067	0.026	0.017	0.043	<0.001	0.004	0.602	0.021	0.094	0.015	0.036	0.007
Carbon tetrachloride	0.116	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	0.003	<0.001	<0.001	<0.025	0.001	0.008	<0.001	<0.025	<0.001

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in soil

COPC	Lab sample ID	23/03602/4	23/03602/28	23/03602/30	23/03602/32	23/03602/33	23/03602/5	23/03602/6	23/03602/25	23/03602/26	23/03602/27	23/03602/34	23/03602/7	23/03602/8	23/03602/9	23/03602/10	23/03602/11	23/03602/12	23/03693/8	23/03602/35	23/03602/36	23/03958/3	23/03602/37
	Borehole ID	WS303	WS304	WS304	WS304	WS304	WS305	WS305	WS306	WS306	WS306	WS307	WS308	WS308	WS308	WS309	WS309	WS309	WS309	WS310	WS311	WS311	WS312
	Depth to top	3.1	0.5	1.5	2.5	3.5	0.5	1	0.5	1.5	2.5	0.4	0.6	1	2	0.7	1.9	2.5	0.4	0.4	0.4	1.8	0.6
	Depth to bottom																						
	Date sampled	03/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	03/04/2023	03/04/2023	04/04/2023	04/04/2023	04/04/2023	04/04/2023	03/04/2023	03/04/2023	03/04/2023	03/04/2023	03/04/2023	03/04/2023	11/04/2023	05/04/2023	05/04/2023	20/04/2023	05/04/2023
	Sample type																						
	RTV (mg/kg)																						
Trichloroethene	0.224	<0.025	0.23	0.016	0.074	0.043	0.06	0.427	0.098	0.15	0.006	0.066	0.569	1.13	0.039	0.072	0.015	0.003	<0.001	0.001	<0.001	<0.001	<0.025
Carbon tetrachloride	0.116	<0.025	0.004	<0.001	0.004	0.002	0.002	0.009	<0.001	<0.002	<0.001	<0.002	0.034	0.038	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.025

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in soil

COPC	Lab sample ID	23/03602/38	Maximum concentration detected in soil (mg/kg)	Total No. of soil samples analysed	Number of detects in soil above the RTV
	Borehole ID	WS312			
	Depth to top	1			
	Depth to bottom				
	Date sampled	05/04/2023			
	Sample type				
	RTV (mg/kg)				
Trichloroethene	0.224	<0.001	1.13	67	5
Carbon tetrachloride	0.116	<0.001	0.038	67	0

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in groundwater

COPC	Lab sample ID	22/09651/12	22/09651/13	23/00479/2	22/09831/2	23/00479/3	23/04296/7	23/04477/5	22/09651/1	22/09651/2	22/09651/5	22/09831/1	23/00479/1	23/04296/6	23/04477/4	23/11247/1	23/04296/1	23/04477/1	23/04296/2	23/04477/2	23/11247/2
	Borehole ID	LK BH01	LK BH01 (2) Duplicate	LK BH01	LK BH03	LK BH03	LK BH03	LK BH03	RBH201	RBH201 (2) Duplicate	RBH203	RBH203	RBH203	RBH203	RBH203	RBH203	RBH301	RBH301	RBH302	RBH302	RBH302
	Depth to top	13	13	5.4	10	7.45	7.6	7.6	22	22	13	10	7.4	7.6	7.6	14.9	5.65	5.7	7.5	7.5	10.65
	Depth to bottom																				
	Date sampled	27/09/2022	27/09/2022	19/01/2023	04/10/2022	19/01/2023	04/05/2023	10/05/2023	27/09/2022	27/09/2022	27/09/2022	04/10/2022	19/01/2023	04/05/2023	10/05/2023	13/11/2023	04/05/2023	10/05/2023	04/05/2023	10/05/2023	13/11/2023
	Sample type																				
	RTV (µg/l)																				
Trichloroethene (TCE)	27.1	2	2	2	250	80	43	39	<1	<1	480	572	418	214	200	215	<1	<1	4	3	2
Carbon tetrachloride (tetrachloromethane)	149	<1	<1	3	58	73	53	48	<1	<1	95	104	265	164	107	84	<1	<1	207	159	142
Cis/trans 1,2-dichloroethene (DCE)	90	490	485	602	3	6	3	4	4	<1	2	2	4	4	3	4	86	102	1	1	<1
Vinyl Chloride (chloroethene)	4.25	16	15	11	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	1	<1	<1	<1

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in groundwater

COPC	Lab sample ID	23/11247/3	23/11247/4	23/11247/9	23/11487/1	23/11247/5	23/11247/7	23/11247/10	23/11247/6	23/11247/8	22/09651/3	22/09651/4	23/04296/3	23/04477/3	23/04296/4	23/04510/1	23/11247/11	23/04296/5	23/04510/2	22/08782/1	22/09651/7	22/08782/2
	Borehole ID	RBH501	RBH502 P1	RBH502 P2	BH502 P2	RBH503	RBH505 P1	RBH505 P2	RBH504	WS311	RBH202	RBH202 (2)	RBH303	RBH303	RBH305	RBH305	RBH305	RBH306	RBH306	BH205	RBH205	BH206
	Depth to top	13.7	15.8	18.9	18.9	8.7	11.2	13.7	10.7	1	23	23	7.05	7.1	6.5	6.5	7	6	6	6.5	22	7
	Depth to bottom																					
	Date sampled	13/11/2023	13/11/2023	13/11/2023	20/11/2023	13/11/2023	13/11/2023	13/11/2023	13/11/2023	13/11/2023	27/09/2022	27/09/2022	04/05/2023	10/05/2023	04/05/2023	11/05/2023	13/11/2023	04/05/2023	11/05/2023	02/09/2022	27/09/2022	02/09/2022
	Sample type																					
	RTV (µg/l)																					
Trichloroethene (TCE)	27.1	27	3		4	<1	<1	<1	17	<1	4	3	277	221	3	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride (tetrachloromethane)	149	17	24		<1	<1	<1	<1	14	<1	<1	<1	38	22	2	<1	<1	<1	<1	<1	<1	<1
Cis/trans 1,2-dichloroethene (DCE)	90	2	<1		80	100	<1	<1	151	<1	<1	<1	81	84	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl Chloride (chloroethene)	4.25	<1	<1		<1	44	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

Comparison of RTVs against measured concentrations in groundwater

COPC	Lab sample ID	22/09132/1	22/09651/8	22/09132/3	22/09651/9	22/09132/2	22/09651/10	22/09132/4	22/09651/11	Maximum concentration detected in groundwater (mg/l)	Total No. of groundwater samples analysed	Number of detects in groundwater above the RTV
	Borehole ID	RBH207	RBH207	RBH208	RBH208	RBH209	RBH209	RBH210	RBH210			
	Depth to top	22	22.5	15.5	21.5	21.5	15.5	22	22			
	Depth to bottom											
	Date sampled	14/09/2022	27/09/2022	14/09/2022	27/09/2022	14/09/2022	27/09/2022	14/09/2022	27/09/2022			
	Sample type											
	RTV (µg/l)											
Trichloroethene (TCE)	27.1	<1	<1	<1	<1	<1	<1	<1	<1	572	48	12
Carbon tetrachloride (tetrachloromethane)	149	<1	<1	<1	<1	<1	<1	<1	<1	265	48	4
Cis/trans 1,2-dichloroethene (DCE)	90	<1	<1	<1	<1	<1	<1	<1	<1	602	48	6
Vinyl Chloride (chloroethene)	4.25	<1	<1	<1	<1	<1	<1	<1	<1	44	48	4

Notes:

LMDL Laboratory method detection limit

COPC Contaminant of potential concern

DQRA Detailed quantitative risk assessment

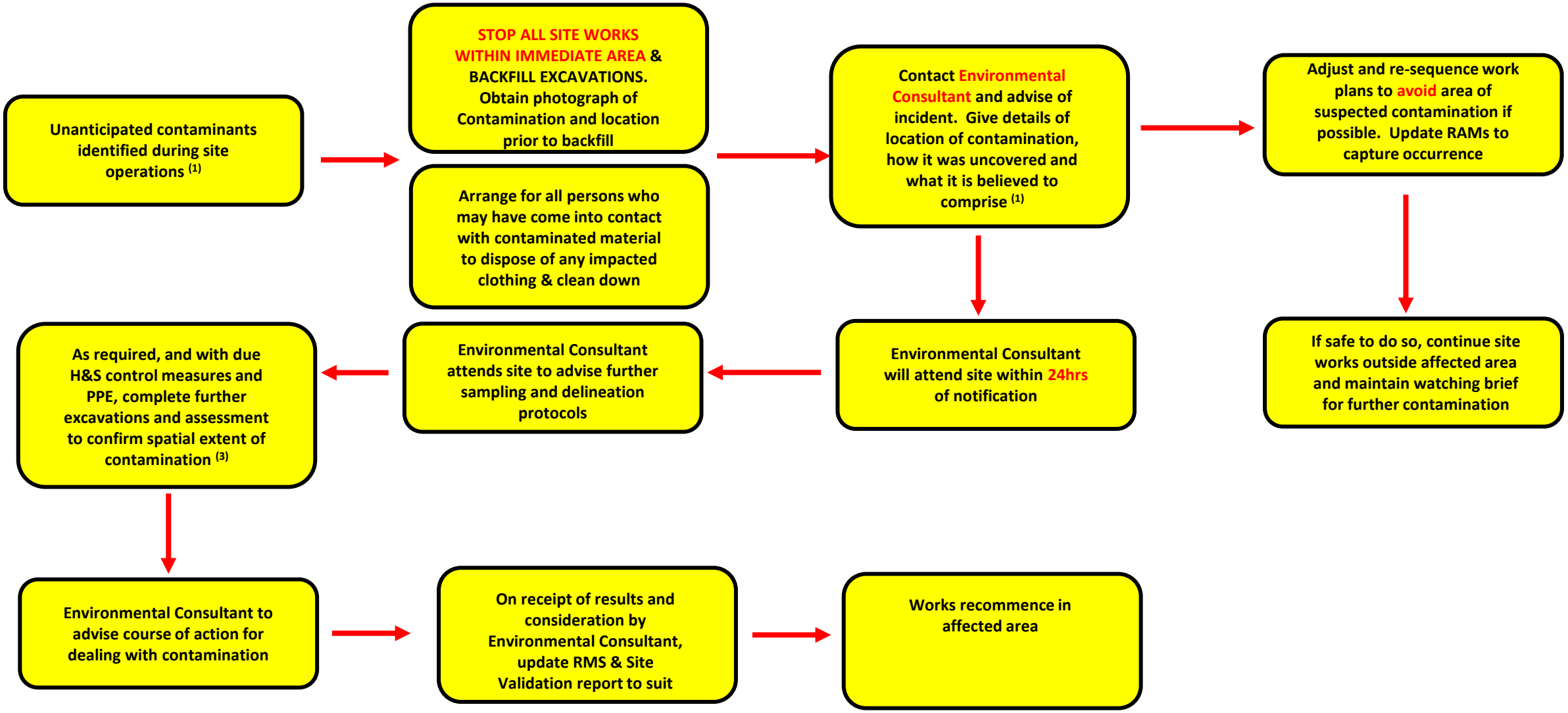
< Result less than the LMDL

RTV Remedial target value

- COPC not analysed

Measured concentration in excess of RTV

APPENDIX G
CONTAMINATION DISCOVERY STRATEGY



1) See examples of potential sources of contamination on sketch ESK101
2) Site manager should also confirm any persons who have come into contact with material are not feeling any health effects Including sampling of soils and groundwater to confirm risks posed

RSK GEOSCIENCES

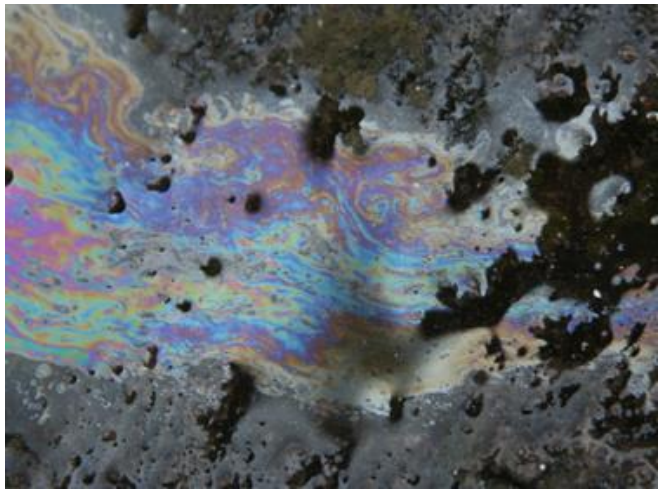
JOB NO	11834	SKETCH NO	ESK100	DRAWN BY : As 10/11/2023
PROJECT TITLE	Plot NT02.3 & 4	SKETCH TITLE	Unexpected Contamination, Discovery Strategy	



Asbestos Contamination



Soil Impacted Hydrocarbon (fuel oils) Contamination*



Groundwater Impacted Hydrocarbon (fuel oils) Contamination*



“Blue Billy” Gas Works spent oxide Contamination



Unrecorded waste disposal or landfill practices



Unrecorded below ground storage tank

* Will also likely be accompanied by strong chemical or oil odor

RSK GEOSCIENCES

JOB NO	11834	SKETCH NO	ESK101	DRAWN BY : As 10/11/2023
PROJECT TITLE	Plot NT02.3 & 4	SKETCH TITLE	Example sources of contamination, note these are generic and may not apply to this site	

APPENDIX H
MONITORING WELL RETENTION PLAN

GROUNDWATER MONITORING WELLS

BH I.D.	Easting	Northing	Response zone from (mOD)	Response zone to (mOD)	Lithology at response zone
RBH505 P1	384588.94	399458.10	26.91	19.61	CF
RBH505 P2	384588.94	399458.10	18.41	16.91	MM
RBH504	384644.07	399415.75	29.54	22.09	CF
RBH503	384612.61	399439.30	26.65	21.65	CF
RBH502 P1	384599.85	399394.37	28.09	15.29	CF
RBH502 P2	384599.85	399394.37	14.29	13.29	MM
RBH501	384638.99	399388.87	29.09	18.59	CF
RBH403	384717.73	399423.13	31.98	26.53	RD
RBH401	384697.40	399411.32	32.02	26.57	RD
RBH301	384576.68	399444.27	27.41	21.41	CF
RBH302	384608.42	399383.57	28.59	21.59	CF
RBH303	384640.07	399422.36	28.01	23.01	CF
RBH304	384680.66	399402.07	29.66	25.66	Terrace Deposits
RBH305	384636.01	399469.21	27.15	23.15	CF
RBH306	384692.00	399446.81	24.73	22.73	MM
RBH307	384749.15	399493.27	30.84	19.84	MM
RBH201	384597.08	399455.18	10.40	6.40	MM
RBH202	384638.05	399446.26	11.76	7.76	MM
RBH203	384619.36	399403.83	23.59	18.59	CF
RBH205	384721.68	399517.64	11.38	6.38	MM
RBH206	384701.70	399491.17	11.00	7.00	MM
RBH207	384797.90	399510.73	16.17	11.17	MM
RBH208	384757.48	399461.38	23.00	18.00	MM
RBH209	384796.49	399492.29	28.46	23.46	MM
RBH210	384845.14	399489.02	21.38	16.38	MM
LKBH01	384593.48	399443.85	26.41	16.41	CF & MM
LKBH03	384634.56	399391.59	30.59	13.59	CF & MM

ROC RBH205
ROC RBH207
ROC RBH206
ROC RBH307
ROC RBH209
ROC RBH210
ROC RBH208
ROC RBH305
ROC RBH306
ROC RBH201
ROC RBH505
LK BH01
ROC RBH301
ROC RBH503
ROC RBH202
ROC RBH403
ROC RBH303
ROC RBH504
ROC RBH401
ROC RBH203
ROC RBH304
ROC RBH502
LK BH03
ROC RBH501
ROC RBH302

ALL GROUNDWATER MONITORING WELLS ARE TO BE RETAINED UNTIL THE GROUNDWATER REMEDIATION DESIGN IS FINALISED BY THE REMEDIATION CONTRACTOR

RETAINED MONITORING WELLS ARE TO HAVE RAISED COVERS FITTED TO PROVIDE ADDITIONAL PROTECTION DURING DEMOLITION WORKS.

DECOMMISSIONING OF WELLS IS TO BE UNDERTAKEN IN ACCORDANCE WITH ENVIRONMENT AGENCY SCIENCE REPORT SC020093 "GUIDANCE ON THE DESIGN AND INSTALLATION OF GROUNDWATER QUALITY MONITORING POINTS".

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NOTES

ROC RBH3XX — GROUNDWATER MONITORING WELL TO BE DECOMMISSIONED

ROC RBH3XX — GROUNDWATER MONITORING WELL TO BE RETAINED

APPROX PLOT NT02 BOUNDARY

APPROX PLOT NT03 BOUNDARY

APPROX PLOT NT04 BOUNDARY

EXTENT OF SOIL TURNOVER

DRAWING NOTES

1. TO BE READ IN CONJUNCTION WITH ROC CONSULTING PHASE 1 DESKTOP STUDY REF: 4328-ROC-ZZ-XX-RP-ES-PH1DTS AND PHASE 2 SITE INVESTIGATION REPORT REF: 4328-ROC-ZZ-XX-RP-ES-P2-101.
2. EXPLORATORY HOLE LOCATIONS SHOWN AT APPROXIMATE EXTENTS.
3. EXISTING SITE LEVEL INFORMATION TAKEN FROM PARAGON SURVEYS TOPOGRAPHICAL SURVEY REF:PS-2158-TS--00
4. ROC CONSULTING ACCEPTS NOT RESPONSIBILITY FOR ANY DAMAGES OR LOSS ARISING AS A RESULT OF THE USE OF THIS DRAWING

REV.	DATE	DETAILS	DRN.	CHK.
02	JAN 24	LKBH01 ADDED TO LIST OF WELLS TO BE RETAINED	RM	AS
01	JAN 24	FIRST ISSUE	RM	AS

DRAWING STATUS: INFORMATION

RIBA STAGE:

RoC CONSULTING
Commercial Wharf
6 Commercial Street
Manchester M15 4PZ
T 0161 214 5390
W rocconsulting.com

DRAWN	DATE	SCALES
RM	JAN 24	1:500
CHECKED	DATE	THE ABOVE SCALES APPLY WHEN PLOTTED AT A1 SIZE --DO NOT SCALE--
AS	JAN 24	
APPRVD.	DATE	EMAIL FOR DRAWINGS
AS	JUN 24	info@rocconsulting.com

CLIENT: FAR EAST CONSORTIUM INTERNATIONAL LTD

PROJECT TITLE: PLOTS NTO2, NTO3 & NTO4 NORTHERN GATEWAY

DRAWING TITLE: GROUNDWATER MONITORING WELL DECOMMISSIONING PLAN

DRAWING No.: 4328-ROC-ZZ-XX-DR-ES-ES214

REV.: 02

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G:\Common\Jobs\4328 Plot NT02 Dantzic St\01 ROC\Drawings\ES\4328-ROC-ZZ-XX-DR-ES-ES214.dwg



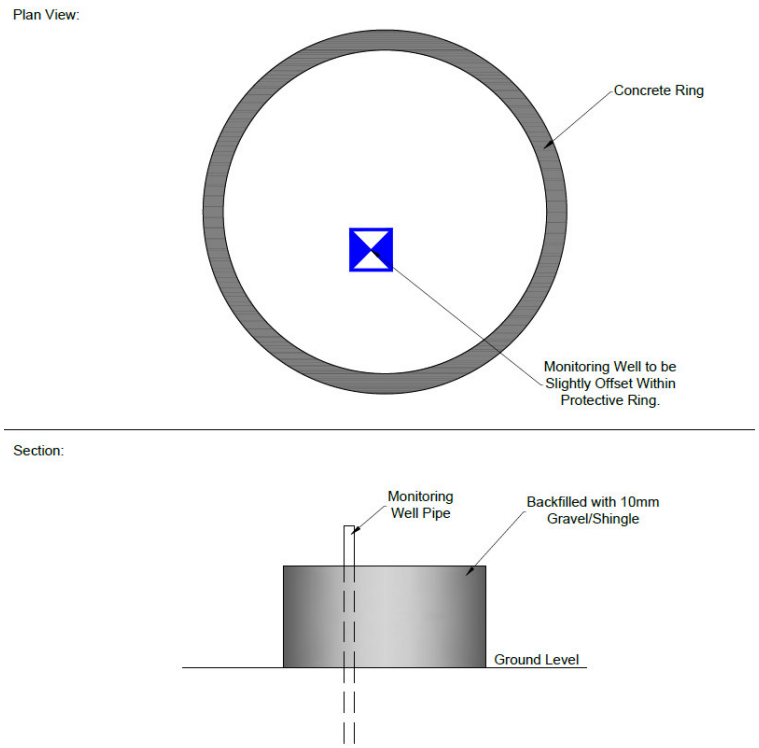
Example 1 : Fenced in well enclosure



Example 2 : Marker post well identification



Example 3 : Concrete manhole rig enclosure



Example 3 : Concrete manhole rig enclosure design example

Note : Example 3 using concrete manhole chamber is likely to be the most effective on this site

RSK GEOSCIENCES

JOB NO	11834	SKETCH NO	ESK100	DRAWN BY : 10 01 2024 AS
PROJECT TITLE	Plot NT02,03 & 04	SKETCH TITLE	Examples of Groundwater Monitoring Well Protection Measure	

APPENDIX I
REGULATORY CORRESPONDENCE

From: Laura Miller <laura.miller@manchester.gov.uk>
Sent: 27 November 2023 09:27
To: Mike Newman
Cc: Reece McGuinness; Alex Smiles
Subject: Re: Environmental Health Soil Screening Criterial - Permission 136814/FO/2023 [Filed 27 Nov 2023 10:12]

Categories: Filed by Mail Manager

CAUTION: This email originated from outside the Organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Mike

Thank you for the added information.

I am happy with the approach to zone the site and use public open space criteria for reuse for the green areas and commercial reuse under the buildings and hardstanding areas.

For the Orange areas and planting on the podium areas will this all be imported soil or are there plans to reuse site won soils as part of the 1200mm depth of soil?

Kind Regards

Laura

Laura Miller (MRes, MA, BSc(Hons))

Please note that due to working compressed hours Wednesdays are a non-working day for me, I will respond to your email when I return to the office

Environmental Protection Officer
Environmental Protection Section
Environmental Health
Neighbourhoods Directorate
Manchester City Council

email: laura.miller@manchester.gov.uk
website: www.manchester.gov.uk
Telephone: 0161 234 1742
Internal: 31742

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From: Mike Newman <mike.newman@rocconsulting.com>
Sent: 20 November 2023 09:27
To: Laura Miller <laura.miller@manchester.gov.uk>
Cc: Reece McGuinness <reece.mcguinness@rocconsulting.com>; Alex Smiles <ASmiles@rsk.co.uk>
Subject: RE: Environmental Health Soil Screening Criterial - Permission 136814/FO/2023

Laura

Many thanks for your swift response, and apologies for the delay in reply.

The further SI has now been completed and we are in the process of compiling the updated SI to captured this. Lab results still pending.

On the private courtyard, a number of these are formed on podium structures with under croft parking. Please see attached sketch indicating the building footprints, hard landscaping and other areas. The orange soil cells/green paving are part of the street scape and not private. The soil cells being a 1200mm deep crated system backfilled with planting medium and the green paving a mix of hard paving with intermediate grass/sedum strips.

As can be seen, significant portions of the site are in affect hard standing, meaning exposure to occupies from contaminated soils is minimal. Would you accept an approach which targets public open space screening only to the marked green areas? Given their size, this should be manageable from a earthworks management perspective.

Kind regards,

Mike

From: Laura Miller <laura.miller@manchester.gov.uk>
Sent: Monday, November 13, 2023 3:09 PM
To: Mike Newman <mike.newman@rocconsulting.com>
Cc: Reece McGuinness <reece.mcguinness@rocconsulting.com>; Alex Smiles <ASmiles@rsk.co.uk>
Subject: Re: Environmental Health Soil Screening Criterial - Permission 136814/FO/2023

CAUTION: This email originated from outside the Organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Mike,

I have been passed your email as I provided the contaminated land comments for this site.

I have looked back at my comments and there was further site investigation to be undertaken including delineating TCE impact and some more gas monitoring. Has this now been undertaken?

In terms of your proposals below I have looked at the drawings and there is a fairly large private courtyard associated with NT04, as such I am not sure if commercial/industrial re-use criteria will be sufficient, even with the 600mm clean cover. I will need further justification for your choice of criteria as POSresi may be more appropriate given no private gardens are proposed.

To support any change in the site classification you will need to provide an associated DQRA, I have no objections to the change in reuse criteria below buildings and hardstanding and any small areas of landscaping, it is only with respect to private court yard areas/terraces/any areas of public realm and as such the site may need to be zoned accordingly.

I am happy to discuss your proposals with you and we can do this via teams (or similar).

Kind Regards

Laura

Laura Miller (MRes, MA, BSc(Hons))

Please note that due to working compressed hours Wednesdays are a non-working day for me, I will respond to your email when I return to the office

Environmental Protection Officer
Environmental Protection Section
Environmental Health
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website: www.manchester.gov.uk
Telephone: 0161 234 1742
Internal: 31742

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From: Mike Newman <mike.newman@rocconsulting.com>
Sent: Friday, November 10, 2023 10:23 AM
To: Graeme Souter <graeme.souter@manchester.gov.uk>; Sharon McAndrew <sharon.mcandrew@manchester.gov.uk>
Cc: Reece McGuinness <reece.mcguinness@rocconsulting.com>; Alex Smiles <ASmiles@rsk.co.uk>
Subject: Environmental Health Soil Screening Criterial - Permission 136814/FO/2023

> Some people who received this message don't often get email from mike.newman@rocconsulting.com. Learn why this is important

Morning Graeme/Sharon

I am hoping you can assist, or point me in the right direction. We are completing the remediation strategy for permission 136814/FO/2023 and we would like to discuss the screening criterial for contaminated soils.

Given the following considerations, we would like to make a case for Commercial/Industrial screening criteria for the development.

1. The proposed development for Plots NT02-04 comprises high rise apartment style residential development with limited soft landscaping in public realm
2. The proposed ground floor plans (ref RDB-HBA-2X-LG-DR-AR-080098, RDB-HBA-2X-IT-DR-AR-080099 and RDB-HBA-2X-UG-DR-AR-080100, attached for reference) submitted with the planning app indicate there are no residential aspects to the scheme at GF level (NT02 and NT03), with internal space comprising either lobby areas, lift pits, stairwells or commercial end uses.
3. Given the absence of more sensitive development on GF level the adoption of less stringent “Commercial / Industrial” Human Health Soil Screening criteria (GAC’s) would be an appropriate classification for the development.
4. In addition, any areas of soft landscaping would require a 600mm clean natural soil capping systems that would require the use of imported soil screened against the more stringent apartment style residential end use criteria.

The use of less stringent commercial end use criteria for the soil reuse within our detailed Phase 3a Rem Strat would seem to be an appropriate measure for the site given ground floor usages. The adoption would also allow the retention of more site won material and soils on site, thereby reducing associated environmental impacts of its disposal from site.

Would MCC EHO be acceptable to this approach?

Kind regards,

Mike

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Far East Consortium (FEC)
UK (London Office)
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London
W1K 1AW

Our ref:
SO/2023/123379/04-L01
Your ref:
'Application '5' - 136814/FO/2023
Date of Issue:
05 January 2024

FAO: Far East Consortium (FEC) 'Application 5' Project Team: John Sherrington / Mike Newman / Alex Smiles

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CHARGEABLE PLANNING AGREEMENT ENVPAC/1/GMC/00443 – VICTORIA NORTH – APPLICATION 4 & APPLICATION 5 (REDBANK & NEWTOWN NEIGHBOURHOOD)

ENVIRONMENT AGENCY / FAR EAST CONSORTIUM:

1. **PRELIMINARY VIRTUAL DISCUSSION MEETING 20TH DECEMBER 2023 [13:00-15:00]**

2. **PRELIMINARY TECHNICAL REVIEW OF DRAFT REPORTING SUBMISSIONS ADDRESSING THE REQUIREMENT(S) OF CONDITION 17 (GROUND INVESTIGATIONS, REMEDIAL STRATEGY AND REMEDIAL VERIFICATION PLAN) ATTACHED TO PLANNING PERMISISON 136814/FO/2023 (GRANTED 18TH DECEMBER 2023)**

Dear Far East Consortium (FEC) 'Application 5' Project Team,

Thank you again for requesting and undertaking preliminary engagement with the Environment Agency (EA) regarding addressing relevant conditional requirements, relating to the protection and enhancement of controlled waters, placed upon planning permission 136814/FO/2023 for 'Application 5' (Plots NT02-NT04) of the wider Victoria North strategic regeneration.

Further to virtual (MS Teams) collective meeting discussions held on the 20th December 2023 (refer to separate meeting record email issued 21/12/2023 - 10:39), as instructed, we have progressed under chargeable planning agreement ENVPAC/1/GMC/00443 a further technical review of the reporting submissions listed below. The intention of this review is to identify any wider matters to be addressed by the FEC project team in the progression of condition discharge efforts associated with Application 5 / Plots NT02-NT04.

Condition 4 (Enabling Works Phase Plan / Strategy) Related Submissions Received:

I. Plots NT02,NT03, NT04 Enabling Works- Rev 03 08/12/2023.

II. Block XX Enabling Works Soil Remediation Phasing Plan. Drawing No: RDB-ROC-xx-xx-DR-C-PP01 Rev P02

III. Block XX Groundwater Remediation Phase Plan, drawing No: RDB-ROC-XX-XX-DR-C-PP02 Rev P01.

Condition 17 (Site Investigation / Remedial Strategy / Verification Plan) Related Submissions Received:

IV. Phase 2 Site investigation, NT02, NT03 and NT04 Dantzic Street, Far East Consortium Ltd-Rev 05 dated 15/12/2023.

V. Plots NT02, NT03 and NT04, Northern Gateway, Dantzic Street, Phase 3a Detailed Remediation Strategy Report- Rev 01dated 15/12/23.

VI. Plot NT02 Dantzic Street, Controlled Waters Risk Assessment – Rev 01 15/12/2023

N.B – Further to the above listed reporting, we note we are in receipt of email correspondence from Alex Smiles / RSK providing the missing initial 'Discovery Strategy' of the Phase 3a Remedial Strategy report (V).

Preamble - EA Review Context & Understanding of Proceedings Associated with Application 5 Condition Discharge

As preamble to our wider technical review commentary below, we advise the EA's understanding for the benefit of this further technical review is as follows:

1. Planning permission for 136814/FO/2023 / 'Application 5' has now been granted by Manchester City Council planning authority on the 18th December 2023. As such, conditional requirements and numbers are formalised / 'frozen' and conditional discharge is now possible to progress by the FEC project team.

2. As per virtual discussions held on the 20th December 2023 and wider associated email correspondence, it remains the intention of the FEC Project Team to further update the Phase 3a Detailed Remedial Strategy Submission to ensure this includes robust and appropriate details of:

    a. A discovery strategy - how any unsuspected contamination (of adverse levels) will be monitored for and identified (with defined criteria for this).

    b. The anticipated parameters for a groundwater monitoring programme (of benefit to contingency planning, remedial strategy refinement and unforeseen contamination identification).

    c. Details of the anticipated 'contingency plan' to be enacted should adverse mobilisation of groundwater contamination be observed and / or unforeseen contamination be identified during the progression of site enabling / development works.

3. In connection with (2) above and HIF funding, the assignment of a remedial contractor to progress remedial works within the 'Application 5' development area

is premised and fully dependent upon condition 17 attached to 136814/FO/2023 being effectively discharged prior.

4. In connection with (3) above, it is the intention of FEC the project team, alongside relevant final technical submissions supporting / seeking the formal discharge of condition 17 attached to 136814/FO/2023 to also submit in connection with this reporting a 'Statement of Intention'. The submitted 'Statement of Intention' will:

    - Clearly outline a recognition that further elements of the remedial strategy will only be possible to refine and fully delineate upon assignment of a remedial contractor which (as per 3 above) is premised and critically dependent upon the effectual discharge of condition 17.

    - Noting the limitations of detail which can be provided prior to remedial contractor assignment, a written commitment to work further with key stakeholders (EA and Manchester City Council Environmental Health) to ensure that the final detailed strategy enacted and developed (post-condition 17) is sufficient to address the requirements of condition 18 (remedial strategy verification) and, as appropriate, support condition 21 (groundwater monitoring) and condition 22 (piling risk assessment).

5. Further to (1) above and conversations held on the 20th December 2023, the FEC Project Team has now formally submitted for Condition 4 (Enabling Phase Plan) for full discharge under planning application CDN/23/0876.

Should any of the EA's understanding outlined above prove incorrect, then we ask that we are notified by the FEC project team at the earliest possible opportunity to make further representation.

EA Technical Review Commentary – Condition 4 (Enabling Works Phase Plan / Strategy) Related Submissions

As identified within preamble above (refer to point 5), from third-party correspondence with the Local Planning Authority (LPA) we are aware that the FEC project team has now formally submitted for the discharge of Condition 4 under CDN/23/0876.

From a review of the separate formal submissions made under CDN/23/0876, we have identified that the updated iterations of documents (I), (II) and (III) listed above have been submitted, responding to preliminary feedback provided by the EA in December 2023 post-meeting.

We advise the FEC project team that we have reviewed these revised Condition 4 submissions and are satisfied that they are sufficient to address the conditional requirement of condition 4 in so far as the EA is concerned.

An EA formal planning response for CDN/23/0876, to the effect to the of the above, will be issued to the LPA shortly. However, noting the intrinsic link of the Condition 4 Enabling Phase Plan to site remedial requirements, we wish to take this opportunity to provide the following notes and observations to benefit the FEC Project Team's further efforts:

As per the written wording of the Condition 4 Enabling Phase Plan formally submitted under CDN/23/0876, it will be necessary for the remedial strategy (subject of condition

17) to include sufficient details of the ‘discovery strategy’, ‘contingency plan’ and ‘groundwater monitoring’ programme to be undertaken in association. As per EA understanding points (3) and (4) written above, the EA accepts that full exact details for these elements of the remedial strategy will not likely be possible to provide prior to remedial contractor assignment. However, for the purpose of formal discharge of condition 17 submissions, it will need to be ensured sufficient details are provided to enable the EA confidence that matters associated with the protection and enhancement of controlled waters will be achieved. In the absence of ‘full and ‘final’ details of these three elements of the remedial strategy, we consider a ‘Statement of Intention’ as a formal submission will be critical to address this limitation.

In association with the above, as per discussions held on the 20th December 2023, we strongly recommend early perspective on this matter is sought from the LPA and their Environmental Health Department as to whether the ‘Statement of Intention Approach’ will be more widely acceptable. We note final determination of whether to grant planning condition discharge is the responsibility of the LPA not the EA i.e. whether the ‘Statement of Intention’ approach is viable cannot be determined by the EA.

As per the revised Groundwater Remediation Phase Plan, drawing No: RDB-ROC-XX-XX-DR-C-PP02 formally submitted, we note the ‘groundwater remediation’ area now extends to encompass the built development area of plot NT03.

Further to discussions held on the 20th December, identifying need for revision (in reflection to latest TCE groundwater monitoring), we can confirm we are satisfied with the revised extend of the ‘groundwater remediation zone’ presented. However, noting the encroachment of the revised zone area into the spatial footprint of plot NT03, we advise that going forwards careful consideration will need to be given to this as part of any subsequent Construction Phase(s), subject of condition 11.

Completion of groundwater remediation ahead of attempted progression of built-form development within Plot NT03 is advisable. If it is considered that built-form development within plot NT03 needs to be progressed prior to full groundwater remediation, then we ask that we are notified and advocate for further early discussion with the EA regarding this matter, noting the wording of condition 18 (remedial verification report) and potential complication for interim verification reporting sign-off.

Linking to the above, we note to the formally submitted iteration of the Enabling Phase Plan/Strategy does not include reference or detail as to when in sequence basement excavations within ‘Area B’ will be undertaken. Whilst we do not consider the omission of this detail to prevent the discharge of condition 4, we note from the lower ground floor plans approved under 136814/FO/2023 that ‘basement excavations’ may be required as part of the progression of Plots NT02-NT04.

As above, we would advocate for the completion of all groundwater remedial works prior to extensive excavation / void creation and encourage preliminary engagement with the EA if it anticipated basement excavation in Area B will occur prior to the conclusion of groundwater remedial works.

Finally, we note that no reference is currently made within the enabling phase plan to addressing pre-commencement condition 21 (borehole management). We presume it is the intention of the FEC project to address the requirement of condition 21 upon remedial contractor assignment i.e. post-discharge of condition 17 given the level of detail required to be supplied for the purpose of condition 21. However, we request we are notified if an alternative intention exists.

Cont/d..

EA Technical Review Commentary – Condition 17 (Site Investigation / Remedial Strategy / Verification Plan Related Submissions

Whilst, in conjunction with the preamble detailed above for the purpose of this preliminary review, we do not consider the current suite of reporting submissions provided sufficient to address the full extent of the requirements detailed under condition 17 attached to136814/FO/2023, the following points pertinent to further discharge efforts are noted:

- Additional fully detailed information regarding the implementation of the remedial strategy cannot be provided until the remedial contractor has been appointed, which is contingent on the condition 17 being discharged.

- Plots NT02, NT03 and NT04 have been subjected to a sufficiently detailed level of characterisation, with the identified contaminants of potential concern assessed via way of a DQRA. Conclusions reached about the level of risk posed and the identification of suitable remedial options are considered robust.

- Whilst it is acknowledged and considered by the EA that further ground investigation and groundwater monitoring maybe required to fully develop the remedial strategy in detail, it is considered by the EA unlikely that any further ground investigations / monitoring undertaken will result in material changes or impact the viability of the risk assessment and remedial options appraisal. However, the EA do consider that additional groundwater monitoring is required as part of the contingency plan (see below comments below).

In virtue of the above, our considerations for the specifics listed requirements of condition 17 are as follows:

- Condition 17, Part 1 - Effectively addressed in relation to the EA's remit.

- Condition 17, Part 2 – In relation to the EA's remit, there is currently insufficient information to discharge this part of the condition, due to the requirement for full details of the remedial measures and how they will be implemented.

- Condition 17 Part 3 – In relation to the EA's remit, there is currently insufficient information to discharge this part of the condition as worded due to lack of details on the long-term monitoring, maintenance and arrange for a contingency action plan. Noted - the subject of the 'Statement of Intention Strategy' required needs to be discussed with Manchester City Council planning department.

- Condition 17, Part 4 - Effectively addressed in relation to the EA's remit.

- Condition 17, Part 5 – To be addressed via Manchester City Council's Environmental Health Officer. EA cannot advise.

- Condition 17, Part 6 – In relation to the EA's remit, this point is considered to have been addressed. There are numerous other investigation locations in proximity to TP214 which indicate the lack of a wider infilled area.

- Condition 17, Part 7 - As per Part 1 above, effectively addressed in relation to the EA's remit.

- Condition 17, Part 8 - To be addressed via Manchester City Council's Environmental Health Officer. EA cannot advise.

- Condition 17, Part 9 - As per Part 2 above, effectively addressed in relation to the EA's remit.

- Condition 17, Part 10 - This appears to duplicate the requirements of part 2, although is less prescriptive. A remediation strategy has been provided which, while not detailed, sets out a high-level strategy which is generally acceptable.

- Condition 17, Part 11 - Concluding paragraph sets out requirements for dealing with unexpected contamination. A discovery strategy has been provided, but it is considered that the wording should also be altered to ensure that the discovery strategy is consistent with the wording of this part of the condition. EA consideration is that Part 11 will remain live, but only triggered if unexpected contamination is encountered.

Expanding on the above, we wish to take this opportunity to provide the following additional element specific commentary to aid the further efforts of the FEC Project Team:

<u>Discovery Strategy Commentary</u>

The general approach set out in the discovery strategy is acceptable in principle. However, further to the iteration of reporting currently supplied to the EA, prior to formal submission, the report wording will need to be amended to ensure an accurate reflection and acknowledgement to the wording of part 11 of condition 17. This wording is as follows:

"*In the event that ground contamination, groundwater contamination and/or ground gas, not previously identified, are found to be present , at any time, before the development is occupied, then development on the relevant Phase or phases shall cease and on-site works not recommenced until a report outlining what measures, if any, are required to remediate the relevant land (the Revised Remediation Strategy) is submitted to and approved in writing by the City Council as Local Planning Authority . In the event that the identified contamination can be isolated or is contained to a localized area of the site, subject to agreement, works can continue following submission of a plan identifying the area of contamination. Development shall then be carried out in accordance with the approved Revised Remediation Strategy, which shall take precedence over any Remediation Strategy or earlier Revised Remediation Strategy of relevance."*

So, for example, the discovery strategy will need to capture the requirements for works to cease, for the regulators to be informed, submission of a report detailing what remedial works, if any, are required etc.

<u>Benzene and TPH Commentary</u>

During the most recent groundwater sampling round (which included the new 500 series boreholes), concentrations of benzene and TPH were encountered. TPH was characterised as heavier with lower mobility fractions which, along with the localised nature of the contamination, is considered unlikely to pose a risk.

Cont/d..

The distribution of benzene observed from current ground investigations is suggestive of a potential offsite source, although the potential for an on-site source cannot be fully discounted. Caution is therefore advised (linking to discovery strategy).

Based on lines of evidence and level of risk posed, we consider that requesting further ground investigation is undertaken at this stage would be disproportionate and that it would be more appropriate that consideration to this risk is given via way of the discovery strategy discussed above.

During slab breaking and groundworks within the TCE impacted soils area, there is the potential for additional contamination to be mobilised. As TCE has been confirmed as the main contaminant of concern in soils, rather than dealing with any additional leaching under unexpected contamination, it will be covered via a monitoring strategy and specific contingency plan.

Contingency plan and Monitoring Strategy Commentary

We note that Part 3 of condition 17 requires a long-term monitoring, maintenance plan and arrangements for contingency action plan, with respect to contamination.

It is noted that the Phase 2 Ground Investigation report includes some commentary on risks of slab removal and associated recommendations (10.0.12). While the contents of this are fine in the context of the phase 2 report, as identified within the meeting discussion and wider correspondence, it is not sufficiently detailed to be considered a contingency plan. As collectively identified and as recognised under the Enabling Phase Plan submitted in support of the discharge of condition 4, this will need to be a level of detail supplied within the remedial strategy itself.

Point 2 of paragraph 10.0.19 identifies the need to protect boreholes at a level of detail appropriate for the phase 2 report but not considered sufficiently detailed to form a monitoring plan. As collectively identified and as per the Enabling Phase Plan submitted in support of the discharge of condition 4, this will need to be a level of detail supplied within the remedial strategy itself.

As above, the EA's expectation is that a monitoring strategy and contingency plan is included within further updated iteration of the Phase 3a remedial strategy. As per our meeting discussion and associated correspondence, it is acknowledged that it will not be possible to provide full details until such a time as the specialist remedial contractor has been appointed. However, it has been collectively agreed as possible for the FEC project team to provide further details at this stage on these matters, thereby enabling the EA confidence that the protection and, where possible, enhancement of controlled water resources can be achieved.

In terms of a further updated Phase 3a remedial strategy, examples of the information the EA expect to see includes:

- Identification of the minimum number of monitoring rounds required to establish baseline conditions.

- Parameters to be monitored for.

- Further monitoring undertaken should include benzene and TPH.

Cont/d..

NB - The EA considers that this monitoring will seek to further confirm conditions, (especially with the 500 series boreholes currently subject to a single monitoring round).

- Detailed methodology for establishing trigger values and / or intended trigger values.

- An indicative contingency plan, as a minimum, identifying what the contingency plan should achieve in its enactment.

There would be benefit at this stage in establishing were responsibility for these various actions sit.

Importation criteria:

Plots NT02, NT03 and NT04, Northern Gateway, Dantzic Street, Phase 3a Detailed Remediation Strategy Report (Rev 01dated 15/12/23) Table 11: Criteria for the simple soil cover system are to be used as importation criteria. Excavated soils being imported from another site meeting these criteria would be considered waste and cannot be placed without an Environmental Permit.

The DoWCoP document and subsequent FAQs provide detail on requirements for importing soils from donor sites and the criteria that must be met.

In order for soils being imported from a donor site (irrespective of whether it is brownfield or not), to meet the requirements of DoWCoP (and demonstrate that they are not waste) they need to meet the definition of “clean naturally occurring material” as per the DoWCoP main document. Please update the documents accordingly.

Summary

In summary to the above, we do not believe our technical further review (post 20th December 2023) of the Condition 4 and Condition 17 submissions provided under ENPAC/1/GMC/00443 has identified any further matters which have not already been identified to the FEC project team during prior conversations to be addressed as part of further iteration / revision. However, as collectively agreed and identified prior, further update the to the current iteration of the Phase 3 remedial strategy (Revision 1) will be required to ensure the elements of the discovery strategy, groundwater monitoring approach and contingency plan are effectually addressed (in alignment to the Phasing Plan submitted for Condition 4).

Further to the above, in virtue of the outlined contractual assignment limitations / challenges, we strongly recommend the viability of the ‘Statement of Intention’ approach for Condition 17 is discussed and agreed with Manchester City Council’s Planning and Environmental Health Departments. Understandably, if the ‘Statement of Intention’ approach is not deemed acceptable, we envisage this will materially alter the scope and level of detail required to be submitted to enable the effectual discharge of condition 17 and forward proceedings.

Finally, we ask that we are provided clarification on the queries raised under letter section ‘*EA Technical Review Commentary – Condition 4 (Enabling Works Phase Plan / Strategy) Related Submissions’*, as appropriate. Although, as stated, we do not anticipate these queries to impact the ability of the EA to recommend the discharge of Condition 4 as submitted under CDN/23/0876.

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We trust that the FEC project team finds the contents of this letter beneficial. However, any queries or questions regarding the contents of this letter, then please do not hesitate to get in contact with the EA Project Team.

Yours sincerely,

Mr Andy Davies
Green Growth Team Project Manager & Planning Advisor

Direct e-mail andy.davies1@environment-agency.gov.uk

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