

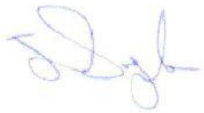
GROUNDTECH
CONSULTING

BRUNSWICK MILL

REMEDIAL SPECIFICATION

ARROWSMITH INVESTMENTS LIMITED

NOVEMBER 2023

Document Control Form	
PROJECT	*BRUNSWICK MILL*
REPORT NAME	*REMEDIAL SPECIFICATION*
REPORT REFERENCE	*GRO-22462-4692*
STATUS	*FINAL*
ISSUE DATE	*07 NOVEMBER 2023*
REVISION	
CLIENT	*ARROWSMITH INVESTMENT LTD*
CLIENT CONTACT	*JASON DONES*
For and Behalf of Groundtech Consulting	
SIGNATURE	
AUTHOR	Emma Lucy Welch MSc (Hons)
SIGNATURE	
CHECKED	Thomas Beach-Bruckner BSc (Hons) FGS
SIGNATURE	
REVIEWED	James Doyle BSc (Hons) CGeol FGS

CONTENTS

1.0 INTRODUCTION 3
1.1 Background 3
1.2 Proposed Works 3
1.3 Objectives 3
1.4 Remediation Specification Scope 4
1.5 Sources of Information 4
2.0 CONCEPTUAL SITE MODEL 5
2.1 Introduction 5
2.2 Site Details 5
2.3 Site History and Consultations 5
2.4 Geology and Hydrogeology 6
2.5 Hydrology 6
2.6 Mining 6
2.7 Preliminary Conceptual Site Model 6
2.8 Ground Model 7
2.9 Geo-Environmental Testing Results - Soils 8
2.10 Geo-Environmental Testing Results - Groundwater 10
2.11 Ground Gas 11
2.12 Outline Remedial Strategy 11
2.13 Geotechnical 12
3.0 POLLUTION LINKAGE ASSESSMENT REVIEW 14
3.1 Human Health 14
3.2 Controlled Waters 14
3.3 Groundworkers 14
4.0 REMEDIATION PROPOSALS AND APPRAISAL 15
4.1 Outline Remediation Proposals 15
4.2 Enabling Works Phase 16
4.3 Construction Phase 16
4.4 Project Setup and Management 17
4.5 Phasing of Works 17
5.0 IMPLEMENTATION OF SITE REMEDIATION PROCESSES 18
5.1 General 18
5.2 Enabling Phase Implementation 18
5.3 Construction Phase Implementation 24
6.0 SUPERVISION, VERIFICATION AND REPORTING 28
6.1 Site Supervision 28
6.2 Collection of Samples 28
6.3 Enabling Works Validation 28
6.4 Construction Phase Works Verification 29
6.5 Ground gas/Vapour Protective Measures 29
6.6 Cover System 30
7.0 REUSE OF SOILS AND MATERIALS MANAGEMENT 31
7.1 Waste Management Background 31
7.2 Certainty of Use and Quantity of Material 31
7.3 On Site Material Management 32

8.0 CONTINGENCY PLAN AND AREAS OF UNEXPECTED CONTAMINATION 33

APPENDIX 1 - PLANS
APPENDIX 2 - GENERAL REQUIREMENTS
APPENDIX 3 - REMEDIATION OPTIONS APPRAISAL
APPENDIX 4 - REMEDIAL TARGET VALUES
APPENDIX 5 - LIMITATIONS

Plans		
Plan Reference	*Revision*	*Title*
GRO-22462-P01	-	*Project Location Plan*
GRO-22462-P06	-	*Contamination Plan*
GRO-22462-P04	-	*Proposed Site Plan*

1.0 INTRODUCTION

1.1 Background

This Remedial Specification has been produced on behalf of Arrowsmith Group and relates to the remediation of a site at Brunswick Mill, Manchester.

The site currently consists of Brunswick Mill in the north eastern half of the site, and an area of cleared land which previously contained India Mills to the south west. The Ashton Canal towpath runs adjacent to the external area alongside the canal in the south east.

Brunswick Mill is of brick construction, four to seven storeys in height. A historic above ground steel tank is present along the southern elevation of the mill building adjacent to Bradford Road. The tank is located in a brick bund.

To the south-west of the mill building is an area of derelict land which is overlain with gravel and shrubs. Across this area are several soil bunds formed from demolition waste. A stockpile of gravel is present alongside the north-western boundary.

A gravel access track leads from the south-western corner of the site to a raised area of gravel which runs adjacent to the canal. Terraced houses and a methodist chapel previously existed in the south-west corner block on the southern boundary of the site before it was partially demolished in 2018. A relic brick wall of this building exists on this area above a suspected low pressure gas main.

Stockpiles of waste, litter and fly tipping are present scattered around the central area of the external site adjacent to the existing Brunswick Mill building. This includes multiple LPG gas cannisters.

A summary of the findings of the investigations are outlined in Section 2.0.

1.2 Proposed Works

Remediation will be undertaken at the site to prepare it for redevelopment as shown on the 'Proposed Site Plan' GRO-22462-P04. It is proposed to redevelop the current mill building (Phase 1) with retail, work spaces and community spaces on the ground floor, with 153 No. Apartment dwellings above. In addition, Phase 2 comprises the construction of 124 No. residential apartments in the disused land to the south-west. Both Phases will include associated garden areas, car parks, Public Open Spaces and infrastructure.

Brunswick Property Investments Ltd have submitted a planning application (130394/FO/2021) which is currently under consideration by Manchester City Council. This Remedial Specification has been commissioned to facilitate the discharge of any pre-commencement planning conditions that are likely to be enforced with regard to land contamination.

1.3 Objectives

The objective of this Remedial Specification is to present details of the remedial objectives, how the remediation of the site will be implemented and to outline how the works will be validated. This Remedial Specification details how the works will be permitted under the current regulatory regime.

The remediation will ensure that upon completion of the commercial and residential development, it can be demonstrated that the ground and groundwater conditions at the site are appropriate for its intended use and risks to identified receptors have been reduced to an acceptable level.

The following Remedial Specification includes the protection measures required during the enabling works phase and to be installed in the construction phase of the redevelopment for a worst case residential end use (without plant uptake).

This is a dynamic document that may require updating at certain stages of the process, the revisions should be undertaken in agreement with the relevant regulatory bodies. In addition, this Remedial Specification is subject to the approval of the regulators pre-commencement.

1.4 Remediation Specification Scope

The scope of the Remedial Specification is in accordance with current risk assessment guidance is as follows:

- *Summary of the Conceptual Site Model.*
- *Summary of the Pollution Linkage Risk Assessment.*
- *Remediation Options Appraisal including detailed assessment of preferred options.*
- *Implementation of preferred remedial solution.*
- *Specification for the remediation works.*

1.5 Sources of Information

In preparing the Remedial Specification the following documents were reviewed and should be read in conjunction with this report:

- *LK Consult Limited Phase 1 Preliminary Risk Assessment referenced LKC 18 1200, dated June 2018.*
- *Groundtech Consulting Geo-Environmental Appraisal referenced GRO-22462-4516, dated 5th July 2023.*
- *Groundtech Consulting Permanent Ground Gas Risk Assessment referenced GRO-22462-4732, dated September 2023.*

2.0 CONCEPTUAL SITE MODEL

2.1 Introduction

The following sections summarise the previous investigations undertaken by Groundtech Consulting and supplemented by relevant information from the LK Consult Limited Report.

2.2 Site Details

The site is located circa 2km east of Manchester City Centre and is approximately centred on National Grid Reference 393530, 398720.

The site is irregular in shape and covers an area of approximately 1.11 hectares. The topography of the site is generally level with an approximate 2.00m incline in the south-west towards the Ashton Canal towpath.

The site currently consists of Brunswick Mill in the north-eastern half of the site, and an area of disused land which previously contained India Mills to the south-west. The Ashton Canal towpath runs adjacent to the external area alongside the canal in the south-east.

2.3 Site History and Consultations

Brunswick Mill
The earliest historical records from the mid-19th century indicated Brunswick Mill. The chimney in the south-west corner was constructed in 1908. By the mid 1960's the Mill was split and used as industrial warehouses, works and depots, when in 1968 the whole building was annotated as a clothing factory. By 1989, the whole Mill had been annotated as a warehouse. No change has been noted since.

India Mill
Records from 1848 indicate India Mills in the south-west of the area, by 1908 it had been annotated as Manchester Works. In 1893, several residential houses were constructed in the west which were redeveloped into a methodist church by 1908, finally being demolished in 1989. In 1949, Manchester Works was renamed Emka Works, annotated as a clothing factory between 1968 to 1969, however by 2008 this building was not noted on OS maps. The land now lies vacant and disused.

Potential offsite sources of contamination include the following:

- *Garages c.10m north*
- *Ashton canal c.10m south*
- *Historic Brick Field c.20m south*
- *Backfilled reservoir c.160m south east*
- *Wellington mill c.20m south.*
- *Chemical works (tar distillery)*

These could be potential sources of asbestos, ash, clinker, heavy metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs), sulphates, inorganic compounds, solvents, soaps, detergents, Total Petroleum Hydrocarbons (TPH CWG), and ground gases.

2.4 Geology and Hydrogeology

BGS records indicate no Made Ground beneath the site, however previous ground investigations undertaken by both LK Consulting and Groundtech recorded Made Ground to a maximum depth of 4.0m bgl consisting of predominantly granular materials including brick, metal, plastic, rubber, and rare coal.

The site is shown to be underlain by superficial Glacial Till which was encountered to depths of 5.45m bgl where the previous Ground Investigation was terminated. This is classified as a secondary (undifferentiated) Aquifer.

The solid geology is the Etruria Formation, which is classified as a Secondary A Aquifer.

The site is not within 500m of a Source Protection Zone and there are no groundwater abstraction or potable water abstraction licences in the vicinity of the site.

2.5 Hydrology

The nearest watercourse is the Ashton Canal immediately south-west of the site.

There are no groundwater abstractions within 1000m of the site.

2.6 Mining

The Phase 1 Preliminary Risk Assessment Report undertaken by LK Consult Limited included a mining report due to past or current mining possible affecting the site.

The risk from recorded mine workings and mine entries is considered to be *Low* based on information provided by the Coal Authority.

A brick field was located circa 79m east (Holt Town brick field), which consisted of opencast extraction of clay and shale, the operations have since ceased.

2.7 Preliminary Conceptual Site Model

The following risks were determined by a combination of the PRA and previous Ground Investigation undertaken by LK Consult Ltd:

Receptor	Level of Risk	Comments
Controlled Waters	*Low to Moderate*	*Made Ground encountered to 2.15m bgl and sources of organic contamination have been identified. Ashton Canal lined with Clay which will act as an aquitard.*
Site End Users from contaminated soils	*Moderate*	*Based on industrial heritage on and off site. Made Ground encountered to a maximum depth of 4.00m bgl. Several contaminants of concern were above the generic screening value for residential end use (without plant uptake) including heavy metals, speciated PAHs, and TPHs.*
Site End Users from vapours	*Low*	*Onsite sources of Hydrocarbons identified.*
Site End Users from ground gas	*Low*	*No significant sources as no Ground Gas monitoring was undertaken in previous investigation.*

2.8 Ground Model

Scope of Works
The following scope of works was undertaken by LK Consult Limited on the 10th November and 11th November 2021:

- *13 No. windowless sample boreholes (WS101 to WS110) were advanced to depths between 0.9m and 5.45m bgl.*
- *4 No. hand pits (HD1 to HD4) were dug to depths between 0.3m and 1.2m bgl.*

Following this, a subsequent scope of works was completed by Groundtech Consulting Ltd between the dates of 2nd May and 12th May 2023:

- *15 No. windowless sample boreholes (WS01 to WS11) were advanced to depths between 0.1m and 4.0m bgl using a Dando Terrier rig.*
- *7 No. machine excavated trial pits (TP01 to TP07) were advanced to depths between 1.05m and 3.0m using a JCB 3CX excavator.*
- *3 No. cable percussive boreholes (BH1 to BH3) were advanced to depths between 16.0m and 20.0m bgl.*
- *3 No. rotary core follow on boreholes were advanced in BH1 to BH3 to depths between 22.0m and 26.0m bgl.*
- *14 No. hand excavated trial pits (HP01 to HP13A) were excavated to depths between 0.5m and 1.20m bgl.*

Made Ground
Made Ground deposits were encountered at all locations across the site to a maximum depth of 4.0m bgl surfacing level.

The surface of the site was predominantly of concrete, underlain with Made Ground of mainly granular composition such as clayey gravelly sand and clayey sandy gravel with minor constituents of brick, ash, concrete, coal, plastic, metal and wood. A gravelly sandy clay was encountered with similar minor constituents within the granular materials.

Natural Ground
The natural strata encountered was generally of firm to stiff grey brown gravelly sandy Clay, to a maximum depth of 17.8m bgl.

Groundtech Consulting also encountered a dark brown medium dense clayey sand to a maximum depth of 15.5m bgl.

Bedrock
The Groundtech Consulting Investigation identified residually weathered Sandstone bedrock in BH1 and BH3 between 1300m to 17.0m bgl. More competent bedrock was encountered in BH1 and BH3 in the form of weak Sandstone between 15.5m to 17.8m bgl.

Groundwater
Groundtech Consulting encountered Groundwater in BH3, HP04, HP07to HP10, TP01, TP04, and WS11 between the depths of 1.0m to 20.0m bgl.

Watching Brief
A watching brief was maintained during the Ground Investigation for visual and olfactory evidence of contamination.

LK Consult observed ash and clinker in the Made Ground soils. Olfactory evidence of contamination was recorded in the form of a hydrocarbon odour in WS102B, WS103, WS104, and WS105B.

Groundtech Consulting encountered a strong odour in HP11 where the material was visibly oily, this was adjacent to an existing above ground tank which is the likely source. In the Made Ground at locations HP01 to HP03 and WS09 to WS11 - ash and slag was encountered. Anthropogenic material was generally present throughout the Made Ground soils particularly in the vicinity of HP12 where numerous amounts of waste including brick, concrete, plastic, metal, fabric, glass, wood, rubber, paper, and ceramics, was present within the Made Ground which had been piled against the external mill walls.

2.9 Geo-Environmental Testing Results - Soils

LK Consult Ltd scheduled twenty-three soil samples for the following suite testing:

- *23 No. Metals and speciated Polycyclic Aromatic Hydrocarbons (PAHs)*
- *9 No. Total Petroleum Hydrocarbons (TPH CWG)*
- *23 No. Asbestos Screening*
- *2 No. Asbestos Quantification*

The following suite of testing was undertaken by Groundtech Consulting:

- *23 No. Metals and speciated Polycyclic Aromatic Hydrocarbons (PAHs)*
- *11 No. Total Petroleum Hydrocarbons (TPH CWG)*
- *5 No. Volatile Organic Compounds (VOCs)*
- *2 No. Semi Volatile Organic Compounds (SVOCs)*
- *23 No. Asbestos screening*
- *2 No. Asbestos Quantification*

Toxic/Phytotoxic Metals
LK Consult recorded elevated levels of arsenic and lead in samples of granular and cohesive Made Ground taken from HD1, HD2, WS103, WS108, and WS109 at depths of between 0.28 m and 1.20m bgl.

Elevated arsenic levels were between 46mg/kg and 61mg/kg and concentrated around the existing mill building.

Lead elevated concentrations were between 310mg/kg and 370mg/kg and were encountered in the far south west of the site and within the existing mill building in the north east of the site.

Groundtech Consulting recorded elevated levels of arsenic and lead detected in samples of granular Made Ground taken from HP02, HP11, TP01, TP02, TP05, TP06, WS06 and WS07A at depths between 0.5m and 1.0m bgl.

Elevated arsenic concentrations were between 43.7 mg/kg and 71.9 mg/kg when compared to the screening value of 40mg/kg. The elevated concentrations of arsenic were recorded around the existing mill building.

Lead was elevated at concentrations were between 319mg/kg and 3,285mg/kg in seven locations to the south-west of the existing mill at depths between 0.5m and 1.0m bgl, the screening value is 310mg/kg.

The likely source of the elevated arsenic and lead in the granular Made Ground is the former use of the site as a mill and finishing works and could also be linked to dyes used in the textile process. Other sources may include the ash content and traces of hydrocarbons within the shallow Made Ground soils.

Speciated Polycyclic Hydrocarbons (PAHs)

LK Consult recorded numerous PAHs above the screening values (Residential without Plant Uptake) in the cohesive and granular Made Ground within HD1, WS101, WS102B, WS103, WS104, WS106, WS108, and WS109. The contamination is mostly concentrated around the existing mill building however is considered to be site widespread as hotspots have also been encountered in the south west of the site.

The elevated PAHs include naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(123 cd)pyrene, and dibenzo(ah)anthracene.

Groundtech Consulting encountered several PAHs above the screening values in the Made Ground in the granular Made Ground soils encountered in HP03, HP10, HP11, TP01, TP02, TP07, WS08, WS09 and BH3 from depths between 0.5m and 1.0m bgl. The contamination has been identified around the existing mill building and also in the land to the south-west of the mill and is considered to be widespread throughout the site.

The elevated PAHs are similar to what was identified within LK Consults testing - naphthalene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(123cd)pyrene, and dibenzo(ah)anthracene.

The site has historically been used as a mill, which included a chimney. Ash and slag are present within the Made Ground which is the likely source of the elevated speciated PAHs. The elevated concentrations of Naphthalene are also above the vapour saturation limit based on a S4UL inhalation pathway, Naphthalene is semi-volatile and likely associated with former processes and the slag/ash content in the Made Ground.

Petroleum Hydrocarbons (TPH CWG and BTEX)

LK Consult encountered several TPH CWG concentrations above the laboratory detection limits within WS102B, WS105B, WS106, WS108, and WS109, however these elevations were not above the screening values,

A hydrocarbon odour was detected within the Groundtech Consulting investigation within HP11 in the vicinity of the former fuel tank. In addition, visual evidence of contamination was noted in HP11, HP12 and TP01 where an oily coating was noted in the Made Ground soils.

Generally, the source of these odours is likely to be the former use of the site as a mill and in the area of HP11, the source will have been from a former above ground fuel storage tank.

Geo-environmental testing has only recorded elevated concentrations of TPH in HP11 at 0.5m bgl which was excavated adjacent to the former fuel storage tank. Interpretation of the hydrocarbon results from this sample indicate that it is linked to degraded diesel, possible lubricating oil and possible tarmac/bitumen.

Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs)

Laboratory testing from the Groundtech Consulting Ground Investigation concluded the majority of samples were below laboratory limits of detection for VOCs and SVOCs. A small number of compounds were recorded above laboratory limits of detection however, none were elevated where screening values are available.

Many of the compounds recorded above the laboratory detection limits, including phenolic and phthalate compounds which are used in coal tar, dyes, solvents, paints, glue, adhesive and insecticide which are all linked

to the former use of the site as a mill. The presence of slag is also a major contributor to the presence of the contaminants encountered beneath the site.

Asbestos

LK consult tested twenty-three samples for asbestos with only two samples of Made Ground identifying Amosite and Chrysotile insulation within WS108 at 0.3m bgl to 2.0m bgl. Total asbestos ranged between 0.61% and 4.2%.

Groundtech consulting identified that asbestos was encountered within two samples of Made Ground that were screened. Chrysotile cement has been detected in HP11 at 0.5m bgl at a concentration of 0.57mass%, and fibre bundles of Amosite have been detected in TP07 at 1.0m bgl at a concentration of 0.002mass%.

The asbestos was detected in the granular Made Ground soils to the south-west of the mill building. The source of asbestos will most likely be the demolished buildings that were located on the site, and testing indicates that the presence of asbestos is not widespread.

2.10 Geo-Environmental Testing Results - Groundwater

Groundtech Consulting undertook groundwater testing on two occasions, 19th July 2023 and 16th October 2023, for a similar suite of Contaminants of Concern as the soil samples, with samples collected from BH1 and BH3. LK Consult did not conduct any groundwater testing.

Slightly elevated concentrations of nickel were recorded on the first visit within BH01 and BH03 and zinc was significantly elevated in BH03. Speciated PAHs were elevated in BH01 when compared against the stringent PAH screening values. The majority of TPH contaminants tested for were below laboratory detection limit except for C21 – C35 in BH01.

The second visit indicated only slightly elevated levels of nickel within BH01.

Historically, the site has been used as a mill. In addition, there are a number of offsite sources that could potentially impact the underlying groundwater at the site and include other mills, boiler works, engineering works, glass works, gas works, chemical works, landfills and printing works. The minor elevations of PAHs encountered within the groundwater of BH01 are not considered to be related to the elevated concentrations of PAHs recorded in the Made Ground soils as a significant thickness of natural Clay of between 14.0m and 17.0m is present beneath the site, therefore acting as an aquitard and protecting the underlying groundwater in the underlying Sandstone. In addition, no elevated concentrations of nickel or zinc were recorded in the Made Ground soils beneath the site.

There was a minor oily sheen present on some of the Made Ground soils, no evidence of contamination was present within the underlying groundwater samples obtained from the site.

The deeper groundwater table is at circa 20.0m below ground level and is not considered to be in hydraulic continuity or providing base flow to the Ashton Canal.

Naphthalene is an indicator of potential contamination as it is associated with the slag contamination identified at the site. Within the groundwater testing, naphthalene has been encountered at levels below the laboratory limit of detection which is a good indication that potential contamination from slag has not impacted the underlying groundwater.

The groundwater testing results have proven that the underlying groundwaters have not been impacted by the sources of contamination identified at the site.

2.11 Ground Gas

A ground gas risk assessment was undertaken by Groundtech Consulting which consisted of 4 No. visits over a period of 2 months.

No concentrations of methane were recorded during the monitoring period. Detectable levels of carbon dioxide (CO_2) were recorded within the standpipes up to a maximum concentration 9.2%v/v together with associated depleted oxygen (O_2) concentrations (minimum 0.8%v/v).

A positive gas flow rate of 6.3 l/hr was detected in BH1 during the first monitoring visit, which was completed during a period of steady barometric pressure.

The Permanent Ground Gas Risk Assessment has determined that the site is classified as lying within Characteristic Situation 2 (CS2), where gas precautions are required.

The site is indicated to be situated in an area requiring basic radon precautions within foundations.

2.12 Outline Remedial Strategy

Soils
Where Made Ground is present at formation level, a 600mm thick, clean cover system overlying a contamination warning membrane or a 100mm hard dig layer will be required in any areas of soft landscaping

The depth of the cover system placed, and the chemical suitability of the material should be validated by Groundtech Consulting.

The imported topsoil and subsoil used in the cover system will need to be tested to ensure it is suitably clean for the proposed residential without plant uptake end use. In addition, the depth of cover placed will also need to be validated.

Vapours
The majority of VOCs tested for were encountered below laboratory limits of detection with the exception of a select number of VOCs, however these were all below screening values. A hydrocarbon odour was identified in HP11 in the vicinity of the former fuel tank, along with elevated concentrations of TPH CWG at 0.5m bgl. All other TPH CWG concentrations were below laboratory limit detections. The vapour saturation limit was not exceeded for any of the speciated hydrocarbons detected.

The residual risk from vapours will largely be removed during the fuel tank removal where any impacted soils will be removed off site however, where it cannot be definitively demonstrated that the vapour source has been removed, a vapour membrane should be installed to mitigate the risk.

Above Ground Storage Tanks
Elevated concentrations of hydrocarbons have been recorded in HP11 in the area of a former above ground fuel storage tank. These soils will need to be excavated out and removed off site. If any free phase hydrocarbon contamination is identified, this will also need to removed and the resulting excavation will need to be validated to ensure that the soils remaining onsite are suitably clean for the proposed residential end use.

The above ground fuel storage tank will need to be decommissioned in accordance with current guidance and removed offsite in an appropriate manner.

Controlled Waters
Significant contamination has not been encountered within the underlying groundwater beneath the site with the exception of elevated concentrations of zinc and nickel being recorded in BH01 and BH03. Onsite sources of these toxic metals has not been identified and is likely to be associated with an offsite source. At this stage, no further action is required in regard to controlled waters, and no further monitoring visits are required to satisfy the EA subject to findings.

Ground Gas
The ground gas risk assessment *(Ref: GRO-22462-4732)* indicates that CS2 conditions prevail, and ground gas protection measures need to be undertaken. Such measures should take the form of a gas resistant membrane with a passive sub floor dispersal layer.

The site is located in an area requiring basic radon precautions.

In addition, due to the vapour risk generated from the presence of naphthalene contamination at the site, a vapour resistant membrane will also be required unless modelling determines a membrane is not required.

2.13 Geotechnical

Brunswick Mill
If additional loadings are proposed for the existing mill, an assessment of the existing foundations should be undertaken to determine if they have sufficient capacity.

Bearing strata or dimensions of foundations were not determined in several of the hand excavated trial pits and further investigation may be required.

Former India Mills and Disused land to South-West
In the area of the proposed new apartments, Made Ground was recorded to a maximum depth of 4.0m and was underlain by natural medium to very high strength Clay and medium dense to very dense sand, gravel and cobbles. Very weak to weak Sandstone was observed at depths of between 15.5m and 17.8m bgl.

Consideration will need to be given to obstructions that have been encountered beneath the site at depths of between 0.2m and 2.2m bgl. These will need to be grubbed up to allow foundations to be installed.

Foundations for the new apartments should be designed such that they do not undermine or surcharge any structures around that boundary of the site, including the adjacent canal wall. The development layout should also take into account any easement associated with the canal.

The proposed structure could be up to seven storeys in height if it is to be designed to match the existing mill and is expected to generate large column loads. Therefore, a traditional shallow foundation solution will not be a suitable option for the apartment block. At this stage, the loadings of the proposed structure are unknown and designs will need to be confirmed when they are available.

Loads will be transferred to the piles from ground beams, pile caps and floor slabs of the superstructure. Transverse loading on the piles and the requirement for reinforcement should be taken into consideration in the detailed design to satisfy Equilibrium Limit State conditions.

SuDS drainage is unlikely to be a feasible option at the site due to the presence of deep Made Ground and natural cohesive soils beneath the site which are capable of poor infiltration rates.

Soil percolation testing was attempted by Groundtech Consulting however, the sides of the excavations were unstable and natural strata was not encountered in the proposed locations.

3.0 POLLUTION LINKAGE ASSESSMENT REVIEW

The following section summarises the revised pollution linkage assessment undertaken by Groundtech Consulting Limited.

3.1 Human Health

Receptor	Level of Risk	Comments
Site End Users (Soils)	*Moderate*	*Elevated levels of arsenic, lead, PAHs, and TPH*
Site End Users (Vapours)	*Moderate to High*	*Significant elevated concentrations of PAHs*
Site End Users (Ground Gas)	*Moderate to High*	*Site has been classified as CS2 and requires basic radon precautions*

3.2 Controlled Waters

Receptor	Level of Risk	Comments
Groundwater	*Moderate to Low*	*Elevated levels of zinc and nickel*
Culverted Stream (On site)	*Low*	*Canal is a closed system.*

3.3 Groundworkers

Receptor	Level of Risk	Comments
Contractors	*Moderate*	*During remediation phase*

4.0 REMEDIATION PROPOSALS AND APPRAISAL

Remediation will be undertaken to ensure the site is suitable for its proposed residential end use which comprises the redevelopment of the current mill building into 153 No. residential apartments, and the construction of two additional blocks containing 124 No. residential apartments on the adjacent land to the south west.

The required level of remediation, to the satisfaction of the relevant regulators and discharge planning conditions, will be accomplished through a combination of techniques as outlined in the subsequent sections.

The implementation of the remediation proposals will be in accordance with the following documented quality assurance procedures:

1. ***Detailed Remediation Specification*** *which outlines the requirements to demonstrate the effectiveness of the remediation in order to meet the remediation objectives. These are detailed in the following sections of this report.*

2. ***Interim Enabling Works Verification Report*** *which will provide a complete record of the remediation activities undertaken during the enabling phase as part of the verification plan to support compliance with remediation objectives and criteria. The report will also contain descriptions of the works including photographic evidence and details of any unexpected conditions encountered during the remedial works and how they were dealt with.*

3. ***Cover System Validation Report*** *which will validate the suitability and depth of cover system in garden areas.*

4. ***Gas and Vapour Precautions Validation Report*** *will validate the suitability of the installation gas precaution measures and vapour membranes.*

In addition to the above, the preferred contractor will be required to secure all necessary permits and licences to allow remediation to be undertaken and prepare appropriate health and safety risk assessments and method statements in accordance with CDM Regulations 2015 and other relevant legislation. All roles and responsibilities should be agreed/delegated at a pre-start meeting.

4.1 Outline Remediation Proposals

Based upon the findings of the Ground Investigations, risk assessment and the remediation options appraisal in accordance with LCRM, the following remediation processes will be carried out to produce a site which is suitable for its proposed residential end use and adhere with the General Requirements set out in *Appendix 2*.

Remediation works will need to be completed in accordance with the 'CL:AIRE Definition of Waste Development Industry Code of Practice, 2nd Edition', where relevant. The contractor will need to write an appropriate materials management plan (MMP) and provide a 'Qualified Person' (QP) declaration. The remediation works will aim to maximise the reuse of soils on site and minimise off-site disposal.

The following phased remediation works will be undertaken to deliver the site suitable for the defined residential end use, the phases are divided into:

- *Enabling Works Phase*
- *Construction Phase*

The following remediation activities have been selected based on the Remedial Options Appraisal presented in *Appendix 3:*

- *Materials management comprising excavation, screening, and reuse of suitable material*
- *Watching brief for unidentified contamination.*
- *Decommissioning and removal of above ground fuel storage tank (AST)*
- *Removal of hydrocarbon impacted soils locally.*
- *Import crushed 6F2 material for piling mat and capping layer*
- *Disposal of excess or unsuitable soils.*
- *Installation of a cover system in gardens and Public Open Space*
- *Installation of required gas and radon protection measures*
- *Installation of vapour resistant membrane in the proposed development*

4.2 Enabling Works Phase

The following works are considered necessary during the enabling works phase:

1. *Break out of all hardsurfacing and below ground obstructions and processing for re-use (in the south west area)*
2. *Removal of all below ground substructure (in the south west area)*
3. *Cut site to required earthworks profile (in the south west area)*
4. *Watching brief for previously unidentified contamination, including beneath the existing Brunswick Mill and in the area of the site towards the former India Mill and AST*
5. *Decommissioning and removal of Above Ground Storage Tank (AST)*
6. *Excavate hydrocarbon impacted soils during AST removal.*
7. *Reuse of appropriate soils and materials management of soils*
8. *Placement of appropriately designed piling mat and capping*
9. *Offsite disposal of unsuitable or excess material*
10. *Validation during the enabling works*

It is anticipated the enabling works phase will be undertaken by a single contractor, referred to as the enabling works contractor.

All works need to be undertaken in accordance with the Remedial Specification and an approved MMP where required. All remediation works are to be overseen by the supervising consultant under a site watching brief.

Following completion of the Enabling Phase Validation Works, an interim validation report completed by the supervising consultant will be required to be submitted to the regulators for approval.

4.3 Construction Phase

It is anticipated that the construction phase of works will be undertaken by a separate contractor, referred to as the ground works contractor, who shall undertake the following:

1. *Excavations for foundations in the south-west of the site*
2. *Excavations for service runs and drainage*
3. *Installation of correct level potable water supply pipe*

4. *Placement of A 600mm thick, clean cover system overlying a contamination warning membrane or a 100mm hard dig layer will be required in any areas of soft landscaping*
5. *Installation of approved gas and radon gas protection measures within the building foundations*
6. *Installation of approved gas protection measures within the building foundations*
7. *Installation of approved vapour membrane in selected plots*

Following completion of the Construction Phase Validation Works, the cover system and ground gas verification reports are to be completed by the supervising consultant and to be submitted to the regulators for approval.

4.4 Project Setup and Management

Prior to commencement of site activities, detailed planning of the project shall be undertaken including liaison with the client, supervising consultant, contractors and regulators. The Remedial Specification should be submitted to the relevant regulators for approval prior to commencement.

The project is to be operated under the Construction, Design and Management (CDM) Regulations, (2015).

Under the CDM regulations, the Client should appoint a Principal Designer, who will provide the Pre-Construction Information Report and a Principal Contractor who would provide a comprehensive Construction Phase Health and Safety Plan (CPHASP) prior to works commencing. If the client does not appoint a Principal Designer, they will assume the role.

The Principal Designer will review the CPHASP and notify the local office of the Health and Safety Executive (HSE) of the works prior to commencing (via form F10), if necessary. The client is to nominate the Principal Contractor for each phase of works.

The appointed contractors will need to have suitable experience working in a similar setting, with similar ground conditions and with the contaminants of concern present at the site. It is the responsibility of the contractors to have read and understood the requirements of the Remedial Specification. Any queries should be clarified prior to the activity being undertaken.

4.5 Phasing of Works

Phasing of the works will be discussed and agreed between the contractors, supervising consultant and the client. The contractor is to liaise with the client to ensure the details of each phase are clearly understood. The activities attributed to each phase are discussed in the following section.

5.0 IMPLEMENTATION OF SITE REMEDIATION PROCESSES

5.1 General

The following remedial works are required to break pollution linkages, to reduce risks to an acceptable level and make the site suitable for the proposed residential end-use.

5.2 Enabling Phase Implementation

Activity E1 – Pre-Start and Site Clearance

The enabling works contractor shall be responsible for the true and proper setting-out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour.

The enabling works contractor shall carefully protect and preserve all benchmarks, sight rails, pegs and other things used in setting out the works.

Should the enabling works contractor find any discrepancies on the drawings, they are to refer the matter to the client for verification before proceeding with the part of the works affected.

Before starting the site clearance works, the enabling works contractor shall verify with the client and/or architect which existing fences, gates, walls, roads, paved areas, trees, shrubs, etc., are to be removed and undertake dilapidation survey of all adjacent features/construction including but not limited to boundary walls/fences, adjacent footpaths and road constructions etc. The enabling works contractor shall be responsible for all costs associated with rectification of damage to adjacent features/construction including but not limited to boundary walls/fences, adjacent footpaths and road constructions etc. resulting from the enabling works.

The enabling works contractor shall investigate the features of the structures, ascertain if shock or vibration could damage surrounding property or equipment therein or buried utilities and check the existence of toxic or flammable substances.

Statutory service records are for information only. The enabling works contractor is to ensure that the records are current and complete through discussion with all appropriate statutory bodies and is responsible for all disconnection, diversion, sealing or removing of existing services as necessary (unless otherwise advised by the client). Particularly attention should be paid to the culvert which crosses the site.

Trees, boundaries and other features of interest, which are to be retained, shall be clearly identified and protected by a robust fence to avoid accidental impact damage and prevent excavation within the root zone of influence of foundations. All works shall be undertaken in accordance with BS 5387: 1991 ‘Trees in relation to Construction’. All other trees and shrubs shall be grubbed up and disposed of appropriately off site.

Prior to any works, the site shall be cleared of rubbish, debris and approved vegetation. Stockpiles of waste and fly-tipping material have been observed against the side of the external mill walls. Care should be taken when removing the waste and fly tipped material as several LPG gas cannisters have been identified. Further dangerous objects may also be present.

Any impacted soils should be identified and handled in accordance with current guidance. All unsuitable material, as defined in the Remedial Specification, shall be disposed of by the enabling works contractor to appropriately licensed off-site facilities (tips) unless otherwise described in the contract or unless it is intended to reuse these materials in accordance with an MMP.

The enabling works contractor shall maintain records detailing the approximate location of any unsuitable material disposed, including a brief description.

All movement of materials shall be recorded and records shall be kept detailing the nature and quantity of materials, haulier details, final destination and any other relevant information.

Water or liquids shall not be pumped or emptied into the existing sewers/drainage system without the appropriate treatment and written permission of the relevant authority. If mobile tankers/bowsers are to be used, then disposal shall be at suitably licensed facilities in accordance with current legislation.

Documentation/certification of all materials disposed of are to be included in the H&S file prepared by the enabling works contractor.

Activity E2 - Break out of Hardstanding and Below Ground Obstructions and Processing for Re-use

The enabling works contractor shall turnover the Made Ground, including demolish, break up and remove all below ground structures within the south west of the site. These include, but are not limited to slabs, drains, hardsurfacing, foundations, relic structures, utility ducts, etc.

The Made Ground in the south western section should be turned over to identify obstructions, and potential contamination, that will constrain redevelopment of the site for residential end use. Localised deepening will be required where deeper contamination or obstructions are identified.

All broken up materials shall be segregated and stockpiled within the approved working area of the site. Material shall be stockpiled at locations to be agreed with the Client and after submission of the detailed method statements.

The enabling works contractor shall inform the consultant after each area is exposed so that they may attend and witness the excavation. The enabling works contractor shall survey to Ordnance Survey Grid along the base and sides of all excavations and will provide a composite base of excavation drawing for reference during the works, and as built records.

During the excavation of slabs etc, the enabling works contractor will undertake additional visual investigation, with any additional plausible source-pathway receptor linkages identified to be added to the remedial requirements.

The enabling works contractor shall provide adequate protection against collapse of the excavations and suitable groundwater control measures shall be put in place until the voids are backfilled to a suitable geotechnical specification.

The enabling works contractor shall ensure that, where structures or services cross the site boundary and are to remain, the risk of any future contamination entering or leaving the site area through these pollution linkages is negligible. The enabling works contractor shall state his methodology for ensuring this requirement.

A watching brief should be kept during the works by an independent environmental Consultant and if impacted material is present during excavation, these materials should be stockpiled separately for testing prior to reuse if suitable.

All unsuitable materials are to be removed from site to a suitably licensed facility.

Activity E3 – Asbestos Mitigation

Asbestos has been detected as chrysotile cement and amosite fibre bundles to the southwest area of the site and testing indicates the presence of asbestos is not widespread across the site. Analysis of the asbestos cement indicated a quantification of 0.57mass% and is indicative of ACMs.

The Principal Contractor must manage the risks in accordance with their legal requirements and will need to prepare appropriate health and safety documentation and obtain appropriate approvals, licences, consents and permits prior to commencement. All work is to be undertaken in accordance with the site-specific asbestos management plan that will include details of the air monitoring and dust suppression to be undertaken on an ongoing basis during the enabling works. This should include details of monitoring around excavations of Asbestos Containing Soils and perimeter monitoring.

The enabling works contractor shall have in place at the start of the contract, work procedures designed to ensure the contractor is working in full compliance of all Health and Safety requirements (including, but not exclusively CAR 2012) and that control measures in place are sufficiently robust to prevent release of airborne asbestos fibres into the surrounding environment.

Appropriate mitigation measures (by suitably trained operatives) will need to be designed and put in place by the contractors during excavation, processing, screening and placement of Made Ground soils to remove identifiable ACM and mitigate the risks of asbestos fibres becoming airborne.

The remediation works are designed to break the pollution linkage with regards to contaminants within the soil. Whilst appropriate measures are required for all contaminants present, the enabling works contractor shall note the additional details provided in Appendix 2 'General Requirements' with regards to asbestos in soils.

Task specific risk assessments and method statements shall be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and if required RPE shall be provided and utilised.

With regards to the excavation of soils and as far as reasonably practicable, the removal of gross ACM is required. It should be noted that:

- In accordance with CAR 2012 (Regulation 16) there remains a duty of the Contractor to 'prevent or reduce the spread of asbestos anywhere where work is being carried out under their control'. Where complete prevention is not reasonably practicable (this would constitute such a case), the regulation requires the Contractor to reduce to the lowest level reasonably practicable the spread/potential for fibre release of asbestos from any place where work under the Contractor control is carried out.
- CAR 2012 notes that the Contractor should select and use work methods that will reduce the disturbance and release of asbestos fragments and fibres to minimise the risk of spread, e.g. by removing items intact or whole and by using dust suppression techniques. ACM must never be left loose or in a state where they can be trampled on or spread. All asbestos waste should be bagged or wrapped promptly after removal and the waste should be removed from the work area regularly.
- Where enclosures cannot be used, the Contractors risk assessment should establish what will be required to make sure that, as far as is reasonably practicable:

    - *Spread of asbestos is prevented (airborne fibres and asbestos in soils).*
    - *People not involved in the work are excluded from the area.*
    - *Work area is totally cleaned after work is completed.*

- For the proposed activities, release fibres could occur through excavation of soils containing gross ACM and placement of soils containing gross ACM. It reasonably practicable for visible 'gross'/highly fibrous materials to be handpicked and doubled bagged at the point of excavation. As this material has then been removed and the potential to liberate fibres on the second activity (placement) has therefore been alleviated or reduced to as lower level as reasonably practicable.
- Hand picking of gross ACM is required during excavation and placement activities to ensure that as far as reasonably practicable all visible gross ACM has been removed. A reasonably practicable approach to the removal of gross ACM impacted soils will also need to be effective and feasible, and may need to be further defined during the remediation works.

It is recommended that all staff undertaking the hand picking must be suitably qualified to handle licenced ACM. The Contractor is to confirm the qualifications and the suitability of staff prior to commencement. Asbestos Awareness is not an appropriate level of competency to pick licenced ACM.

The working method, including task specific risk assessments and method statements should be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate monitoring, PPE and RPE should be provided and utilised. The working method shall be provided to Groundtech Consulting for comment two weeks prior to commencement on site.

All ACM shall be placed in a dedicated covered and lockable skip prior to off-site disposal to a suitably licensed facility. Such remediation measures will be undertaken by suitably qualified contractors and in accordance with CAR 2012.

Air monitoring for asbestos is required on an ongoing basis during the enabling works as set out in the asbestos management plan, and the results shall be compared with acceptable maximum standards set by the HSE. These air monitoring procedures and limits are given in HSG 248 entitled 'Asbestos: The analysts' guide for sampling, analysis and clearance procedures' and CAR 2012. The monitoring should be undertaken by a UKAS accredited laboratory. The limit used is governed by the levels stated in the above guidance documents and the accuracy of the testing used. The most stringent limit set by the HSE should be adopted. Air monitoring results are acceptable only if they fall below this limit and are as low as reasonably practicable. Exposure from work activities involving asbestos must be reduced to as far below the control limit as possible.

Activity E4 – Decommissioning and Removal of AST

An Above Ground Storage Tank (AST) is on the southern elevation of the mill building adjacent to Bradford Road. The AST should be decommissioned, emptied and removed off site by an approved contractor.

The contractor carrying out the work to render a tank safe by whichever method should complete two copies of the decommissioning certificate. One copy should be left with the site operator and the other forwarded to the Licensing Authority.

The person responsible for the removal of the tank should ensure that the recipient of the tank is made aware of the tank's previous use, the toxic hazard within the tank and the need to take adequate precautions against fires and explosions when dealing with it.

Prior to transportation, the Licensing Authority should ascertain the destination of the tank(s) and should inform the relevant Petroleum Licensing Authority.

The removal of all tanks, pumps and associated infrastructure should be completed under supervision by Groundtech Consulting.

Activity E5 – Removal of Hydrocarbon/Volatile Impacted Soils

A hydrocarbon odour has been detected in HP11 in the vicinity of the former fuel tank. In addition, visual evidence of contamination was noted in HP11, HP12 and TP01 where an oily coating was noted in the Made Ground soils. Elevated concentrations of TPH CWG was recorded in HP11 at 0.5m bgl. Several VOCs were recorded above laboratory detection limit however non were elevated above screening values.

Elevated concentrations of Naphthalene were recorded within HP03, HP11 and TP01 and are also above the vapour saturation limit based on a S4UL inhalation pathway, Naphthalene is semi-volatile.

HP11 is located in the vicinity of the former fuel tanks, HP12 is located near the foundations of Brunswick Mill and TP01 is located in the vicinity of the former foundations of India Mill. The locations of the elevations are provided on *GRO-22462-P06.*

Any free phase hydrocarbon encountered during the enabling works should be delineated, excavated and removed off site to an appropriately licenced waste disposal facility.

If soils containing free product are excavated, they are to be placed in a secure bunded area on an impermeable membrane with the free phase product being allowed to drain to a sump for collection. If materials escape, the contractor is to undertake at their cost appropriate remedial action as soon as possible.

The contractor will need to have an experienced geo-environmental engineer present during hotspot excavations to inspect for suspect material and oversee effective segregation, stockpiling and validation of soils. Validation is to be undertaken on behalf of the contractor by Groundtech Consulting.

Any drawings indicating the extent of contamination are provisional. The contractor is to satisfy itself with regards to volumes of soil to be excavated, remediated or disposed of and replaced. Groundtech Consulting accept no liability with regards to volume estimates undertaken.

The extent of the validation excavations will be surveyed in (position and depth) following the completion of the validation exercises and presented on a site plan for inclusion in the verification report. The quantity of materials excavated will be obtained and waste transfer notes provided by the client for inclusion in the enabling works validation report.

Validation is to be undertaken on behalf of the enabling works contractor by Groundtech Consulting in accordance with the appended Remedial Target Values (RTVs). However, remediation of this material will largely be based on observations due to the obvious nature where staining and obvious odours have been noted during the investigation works as well as using PID screening.

Activity E6 – Watching Brief

A watching brief should be maintained for the duration of the enabling works for visual or olfactory evidence of contamination. An ashy organic odour was recorded at locations TP01, TP02, TP04, TP07, WS01A, WS02A, WS04, WS06, HP01, HP02, HP03, HP12, WS09, WS10 and WS11. The odours were generally faint to moderate and presumably linked to ash and slag. A strong odour was noted in HP11 where the material was visibly oily, this was adjacent to an existing above ground tank which is the likely source. Ash and slag was observed in the Made Ground at locations HP01 to HP03 and WS09 to WS11. If any visual or olfactory evidence of previously unidentified contamination is identified, work should cease in that area and Groundtech Consulting consulted for advice and to revise the Remedial Specification, if required.

Asbestos fibres have been detected as chrysotile cement in HP11 and amosite fibre bundles in TP07 to the southwest area of the site and testing indicates the presence of asbestos is not widespread across the site.

The Principal Contractor must manage the risks in accordance with their legal requirements and will need to prepare appropriate health and safety documentation and obtain appropriate approvals, licences, consents and permits prior to commencement.

Activity E6 – Reuse of Soils and Placement of Soils

Reuse of soils is allowed and will need to be undertaken in accordance with the Contaminated Land: Applications In Real Environments (CL:AIRE) document: 'The Definition of Waste: Development Industry Code of Practice' (Version 2) (CoP), dated March 2011.

The supervising consultant or enabling works contractor is responsible for producing a MMP signed off by a QP if required. For further details with regards to materials management, please refer to *Section 7.0*.

As part of an MMP, the enabling works contractor should produce a cut/fill balance plan and movement of soils schematic plan to define the movement of the following soils:

1. *Cut of soils to achieve earthworks profile.*
2. *Reuse of suitable/acceptable soils.*
3. *Reuse of crushed 6F2 soils.*
4. *Placement of 6F2 crush as piling mat and capping.*
5. *Final trimming to form finished remediation profile across development areas.*

Testing of imported soils prior to placement is required as set out in this Remediation Specification.

If, in the opinion of the Consultant, the material is not suitable for use, the enabling works contractor is to remove and dispose of it in accordance with the Remedial Specification, at the enabling works contractor's cost.

Activity E7 - Offsite Disposal of Unsuitable or Surplus Material

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material (i.e. the enabling works contractor) to form their own view on whether or not it is waste.

All arisings should be regarded as contaminated unless proven otherwise. Any soils to be removed from site are to be removed to a licensed waste management facility. The waste is to be taken by a registered waste carrier in accordance with applicable Waste Management Regulations.

Any soils to be removed from site are to be removed to a licensed waste management facility and the waste is to be transported by a registered waste carrier in accordance with applicable Waste Management Regulations.

All testing to allow disposal of waste is to be undertaken by the enabling works contractor at the enabling works contractors cost.

Waste consignment/transfer notices will be required and are to be retained by the enabling works contractor. Copies of all waste consignment/transfer notices are to be provided to Groundtech Consulting for inclusion in a validation report.

Activity E8 - Validation Criteria During Enabling Works

The following sections detail validation criteria to be used during the enabling works.

Testing

The majority of the materials to be re-used on site or stockpiled for reuse have been tested during the previous investigations.

All sampling, logging and testing of soils shall be undertaken in accordance with BS 5930:2015 'Code of Practice for Site Investigations' and BS 10175:2011+A1:2013 'Investigation of Potentially Contaminated Sites – Code of Practice'.

All testing should be undertaken at a laboratory which holds UKAS and MCERTS accreditation for the specific tests.

General Reuse

The following geo-environmental testing is required to allow re-use of soils.

- *No visual contamination (oil staining etc.).*
- *Minimal deleterious material (organics, wood, metal etc.) in accordance with this Specification.*
- *No visible Asbestos Containing material (ACM).*

The visual requirements in the list above are to be confirmed by a Groundtech Consulting watching brief.

Activity E9 - Enabling Works Contractor's Validation Records

The enabling works contractor shall maintain a daily written and photographic record of the works undertaken.

All records provided by the enabling works contractor shall be available to the Client and Groundtech Consulting for comment along with all geo-environmental data.

5.3 Construction Phase Implementation

The construction phase of works will be undertaken by a separate Contractor, referred to as the ground works contractor.

It is the responsibility of the contractor to have read and understood the requirements of the Remedial Specification and any geotechnical specification documents. If there are any queries, please contact Groundtech Consulting for clarification.

The following will be undertaken during the construction phase of works by the appointed ground works contractor. The ground works contractor shall undertake:

- *Excavations for foundations in the south-west of the site.*
- *Excavations for service runs and drainage.*
- *Installation of correct level potable water supply pipe.*
- *Placement of a 600mm thick, clean cover system overlying a contamination warning membrane or a 100mm hard dig layer will be required in any areas of soft landscaping.*
- *Installation of gas and radon gas protection measures within the building foundations.*
- *Installation of approved vapour resistant membrane if required.*

Activity C1 - Installation of Correct level of Potable Water Supply Pipe

The correct potable water pipework is to be installed for all plots by the ground works contractor in accordance with local water company risk assessment. The works are to be validated by the ground works contractor, who is to provide to Groundtech Consulting:

- *Provision of delivery tickets showing correct potable supply pipework has been delivered to site.*
- *Photographic proof that correct potable supply pipework (or similar) has been installed.*

Activity C2 - Appropriate Materials Handling and Stockpiling to Allow Reuse of Excavated Soils

The contractor is to undertake a watching brief for materials which may potentially be contaminated during excavations of foundations and drainage. If suspect materials are encountered, the soils are to be stockpiled separately and Groundtech Consulting contacted immediately.

Any imported materials are to be tested by the contractor in accordance with this Remedial Specification to demonstrate they are suitable from a geotechnical and geo-environmental engineering perspective.

Reuse of soils excavated by the contractor will need to be undertaken in accordance with the CL:AIRE Definition of Waste: Development Industry Code of Practice, i.e. in accordance with an MMP approved by a QP where required.

Activity C3: Installation of the Cover System in Areas of Soft Landscaping

A clean cover system is required in garden areas and Public Open Space to reduce the risk to an acceptable level. The cover system installation by the ground works contractor should be undertaken in the following steps:

1. *Undertake geo-environmental testing and assessment of all imported soils (cohesive and granular) to establish they are suitable for use. Groundtech Consulting should be provided with the testing certificates prior to import and additional testing required after importation.*
2. *In areas where trees are planned as part of the landscaping the cover system should be increased to allow for the root ball. The dimensions of the tree pit (if required) are to be specified by a qualified arboriculturist.*
3. *Install house drainage and other services and storing excavated clean soils appropriately for re-use in gardens.*
4. *Validation of the cover system to be undertaken by Groundtech Consulting.*

The cover system requirements are set out below based on the specific use:

Specific Use	Requirements
Private gardens and soft landscaped areas	*The cover system should comprise 600mm of topsoil and subsoil (minimum of 150mm of topsoil) over a contamination warning membrane or 100mm hard dig layer.*

Physical Requirements of Imported Material

Imported material including Topsoil/Subsoil should be as agreed with the client and where possible should conform to BS 3882:2015. Imported subsoil should conform to BS 8601 where possible. It should be noted that clay soils are not recommended for the cover system as they are likely to become waterlogged during handling and placement.

The imported material is to be confirmed by visual inspection of the material by the consultant and if necessary. Imported material should be free from

- *Asbestos, metal, plastic, wood, glass, tarmac, brick, paper, concrete or other potentially hazardous foreign material which could cause injury.*
- *Aggressive / invasive weeds (especially Japanese Knotweed and Giant Hogweed) and bulk vegetative growth.*

Geo-Environmental Requirements of Imported Material

Any imported material should be from a source not expected to be contaminated and meet both physical and chemical criteria, as detailed in this Remedial Specification.

Minimal topsoil is present onsite, and it is anticipated that import of soils will be required to from the cover system.

Prior to importation of topsoil, subsoil or granular material from a commercial supplier, certification should be obtained from the supplier detailing the source site, its previous and current land use and relevant test results. A copy of this should also be forwarded to Groundtech Consulting for review and comparison against the import criteria.

If the proposed source is not from a commercial supplier, Groundtech Consulting recommend that the source is tested to confirm it is appropriate for use prior to import. Geo-environmental testing will also be required once the material arrives at site to confirm the soils imported are the same as those sampled at the donor site.

For material from a natural source, testing should be undertaken at a rate of one test per 150m^3, with a minimum of three tests to be undertaken on any individual source material.

If the source of the material is brownfield, chemical testing should be undertaken at a rate of one test per 100m^3, with a minimum of six tests to be undertaken on any individual source material.

Imported and site won crush is to be tested at a rate of one test per 500m^3 unless evidence can be provided demonstrating it comprises first generation natural quarried stone.

Depending on the source or variability of imported material, the consultant may instruct additional testing to be undertaken.

With regards to imported soils, the results of Geo-Environmental testing are to be compared with the criteria presented in *Appendix 3*. If any of these thresholds are exceeded the material shall be considered to be unsuitable unless treatment, further testing and risk assessment shows it to be satisfactory.

Testing should be carried out for the following general suite of contaminants and the results and compared to *Appendix 3*:

- *Arsenic, Cadmium, Chromium (total), Chromium (VI), Copper, Mercury, Nickel, Lead, Selenium, Zinc and pH*
- *Total TPH and speciated TPH (TPHCWG), if required*
- *Speciated Polycyclic Aromatic Hydrocarbons and organic matter*
- *Asbestos screening*

Activity C4 – Ground Gas / Vapour Protection Measures

Groundtech Consulting have classified the site as CS2 based on GSV concentrations for carbon dioxide.

The proposed apartments are classified as a Building Type B in accordance with BS 8485:2019 and the site falls in CS2 in accordance with Wilson & Card and as such, 3.5 points of protection are required. As per Table 4 from BS 8485 a minimum point score of 3.5 is required to mitigate against ground gas for CS2 conditions.

The required points of protection can be achieved through a minimum of two of the following methods:

1. *Ventilation – 1.5 points*
2. *Structural Barrier/Floor Slab – 1.5 points*
3. *Gas Resistant Membrane – 2 points*

In addition, the site falls in an area where 3% to 5% of properties are affected by radon and radon protection measures are required as part of the proposed development.

Recommended basic radon protection measures include the following, the CS2 level gas precautions will mitigate the risk from radon:

- *A well-installed 1200-gauge damp-proof membrane (DPM) modified and extended to form a radon barrier across the footprint of the building.*

Evidence of volatile contamination in the form of high concentrations of PAHs including Naphthalene has been encountered across the site and localised areas of hydrocarbons has been detected. It is recommended that a vapour resistant membrane is included within the proposed apartment units as source removal will be difficult as the PAH contamination is widespread, and the Made Ground soils are similar in nature. Alternatively, vapour intrusion modelling can be undertaken to determine if the requirements for a vapour resistant membrane can be removed.

The inclusion of a vapour resistant membrane as part of the proposed apartment building is a higher specification than bulk gases and radon and will be sufficient mitigate the risk. Therefore, It may be possible to install a membrane that is effective against vapours, radon gas and ground gas in the apartment buildings.

The gas protection details are to be detailed by the architect or the Structural Engineer.

Gas/vapour protection is to be installed by the ground works contractor (or specialist contractor on their behalf) and the installer should be qualified and experienced installer (minimum one operative to hold a NVQ Level 2 in gas protection installation). The ground gas protection should be installed with all due regard to best practice and guidance. Validation and verification will be required to the scope agreed with Manchester City Council.

6.0 SUPERVISION, VERIFICATION AND REPORTING

Necessary changes to the agreed Implementation Plan, arising during the course of the works, are to be agreed in writing with the Local Authority and Environment Agency prior to being undertaken on site.

It is recommended that details of the environmental works undertaken, the rationale and design for the implementation of this strategy and verification details of the works undertaken are appended to the deeds for the property to ensure the site is sold with full knowledge of the works undertaken and the ground conditions present.

6.1 Site Supervision

The contractor is to provide appropriate engineer supervision during excavation and validation works. Supervision should be undertaken by an appropriate, experienced person who has read and understand the requirements of this Remedial Specification. Remediation works are to be undertaken with a part time site watching brief by Groundtech Consulting (The Consultant) as outlined below:

- *Decommissioning and removal of the AST*
- *Testing of imported soils including to be used in cover system*
- *Validation of Gas precautions, radon protection measures and vapour protection measures installed*

6.2 Collection of Samples

All sampling, logging and testing of soils shall be undertaken in accordance with BS 5930:2020 'Code of Practice for Site Investigations' and BS 10175:2011+A2:2017 'Investigation of Potentially Contaminated Sites – Code of Practice'.

Soils for inorganic analysis will be sealed in air-tight polythene tubs, and soils for organic analysis will be sealed in amber glass jars with the minimal practicable headspace.

Groundwater samples will be collected in suitable containers and with the correct preservatives, as provided by the laboratory.

All samples shall be scheduled on chain of custody forms prior to being dispatched to the UKAS accredited laboratory for analysis.

The contractor shall undertake all testing at a laboratory which holds UKAS and MCERTS accreditation for the specific tests.

The results of all testing undertaken (and a copy of the test certificates), shall be submitted to the consultant as soon as they are reported.

6.3 Enabling Works Validation

On receipt of the records from the enabling works contractor, to demonstrate that all of the works have been undertaken in accordance with the Remedial Specification, Groundtech Consulting will provide an interim validation report.

The report will be prepared by Groundtech Consulting and will provide a summary of the key elements of work and will be referenced to the agreed redevelopment strategy and planning requirements with supporting information presented within appendices.

This shall be based on current risk assessment guidance and specifically will include supporting information as summarised below:

- *Details of methodology and programme.*
- *Decision records covering agreements with regulators.*
- *Records of works undertaken, and associated validation/monitoring records obtained from the contractor as detailed above.*
- *As built drawings.*
- *Final status of remediation and confirmation of remedial objectives to satisfy the planning conditions.*
- *Additional risk assessments/reactive works undertaken.*
- *Site stripping and clearance activities undertaken during remediation.*
- *Records of excavations, including:*
    - *Ordnance Datum survey of extents and depth (including a final composite base of excavation drawing).*
    - *Ordnance Datum survey of extents and depth of any residual features.*
    - *Record of decisions for over-excavation.*
    - *Photographic record of each excavation.*
- *Records of any ACM encountered during the works (type location and action).*
- *Records of laboratory analytical and in-situ field test results, including:*
    - *Laboratory results and location plan for each analytical test.*
    - *Laboratory measurements of accuracy and precision.*
    - *Calibration data for field measurement equipment in accord with manufacturers guidance.*
    - *Chain of Custody forms.*
    - *Copies of the certificates for geo-environmental testing.*
- *Approximate quantities for all materials removed from the site.*
- *Waste classification and management documentation, including copies of all consignment notes, in particular those relating to the hazardous waste regulations, details of waste facilities where materials were disposed of.*
- *Final as-built survey of the site (dwg format).*

On completion of the enabling works validation to development level the appropriate documentation will be forwarded to the client, for forwarding to the Local Authority.

6.4 Construction Phase Works Verification

Potable Water Supply Pipe Installation

It is the responsibility of the ground works contractor to record photographic evidence of the installation of pipework. This photographic evidence is to be provided to Groundtech Consulting for inclusion in the Verification Report

6.5 Ground gas/Vapour Protective Measures

The ground gas/radon gas/vapour mitigation measures shall be installed by the ground works contractor in accordance with CIRIA 665. Validation of ground gas membranes will be undertaken in accordance with CIRIA 735.

6.6 Cover System

Verification of cover system thickness is required. Testing of imported soils will be required in accordance with this Remedial Specification. Groundtech Consulting should be notified when the cover system has been placed and will undertake a visual inspection and random spot check excavations.

A proposed thickness validation frequency of 1 per 2 plots is proposed, validation of all soft landscaped areas will also be required.

If the cover system is deemed to be inadequate, the site manager will be informed and advised on remedial measures. Verification of the cover system will only be carried out where the cover system has been completed.

The cover system validation report will include:

- *Confirmation of the source of imported material*
- *Confirmation of the physical suitability of the material as per Section*
- *Confirmation that the geo-environmental test results pass when compared to the appended RTVs*
- *Confirmation of the depth of cover layer*

Validation will be undertaken in general accordance with BRE 465 and YALPAG guidance.

7.0 REUSE OF SOILS AND MATERIALS MANAGEMENT

7.1 Waste Management Background

As the site is brownfield, any material excavated on site will be classified as waste as soon as it is excavated, unless there is a clear plan in place for the reuse of soils at the site. This should be achieved as set out in the Contaminated Land: Applications In Real Environments (CL:AIRE) document: 'The Definition of Waste: Development Industry Code of Practice' (Version 2) (CoP), dated March 2011.

The handling, reuse or disposal of waste is regulated by the Environment Agency. The Agency will take into account the use of the CoP in deciding whether to regulate materials as waste.

If materials are dealt with in accordance with the CoP, the Environment Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development. This is because the materials were never discarded in the first place, or because they have been submitted to a recovery operation and have been completely recovered so that they have ceased to be waste.

7.2 Certainty of Use and Quantity of Material

There will be an opportunity to reuse soils at the site following excavation, processing and treatment. Any excess or unsuitable soils will be disposed of.

The following excavation, treatment and placement is proposed during the enabling works:

- *Turnover hardsurfacing/subsurface obstructions and crush demolition arising to create a Class 6F2 material for re-use in the works*
- *Excavate hotspots where required and UST*
- *Placement of soils as set out in this Remedial Specification*

The following excavation and placement are proposed during the construction works:

- *Excavation of foundations in the south west of the site*
- *Excavation of drainage runs*
- *Placement of clean natural soils for use as Subsoil and Topsoil in garden areas and POS*
- *Placement of 6F2 in road and pavements/working platforms*

Only materials deemed suitable for use by an appropriately qualified person will be utilised on site. Any out of specification material (geo-environmental and geotechnical) obtained from the site, which is not deemed suitable for use, will be classified as waste and will be disposed of or recovered in accordance with waste legislation.

Material re-used or imported to site will be subject to the necessary testing/review and comparison to this Remedial Specification prior to delivery to site to minimise the risk of the importation of unsuitable material. Any material deemed unsuitable upon arrival at the site will be rejected.

Only sufficient material required on site for the purposes of raising levels in accordance with the pre-determined proposals (planning conditions and drainage strategy) will be imported or reused on site. Any surplus material or material which does not meet the required specification will be disposed of off-site. It is the responsibility of the contractor at each stage of the works to have checked all volume calculations and have allowed for disposal of unsuitable or excess materials.

7.3 On Site Material Management

Stockpiles

Site won material for potential reuse will be stored on site in stockpiles. The stockpiles are to be managed by the enabling works and ground works contractors during the relevant phases of work and will be subject to operational constraints at the time of stockpiling.

Stockpile locations will be clearly marked and documented on working drawings maintained in the site office.

The contractor for each phase of works is to take appropriate mitigation measures and environmental precautions as considered necessary at storage locations. However, as a minimum, stockpiles should be compacted to prevent dust and they should be kept wet in periods of dry weather.

During the remediation works, including hydrocarbon impacted soils, will be stockpiled separately away from those proposed for reuse. Contaminated material should be stockpiled on an impermeable membrane and covered to prevent leaching of contaminants until the soils are removed off site.

Confirmatory Testing for Material for On Site Reuse – Excavated Material

Any soils proposed for reuse have already been tested during the investigations previously carried out by LK Consult and Groundtech Consulting. Further testing to validate the area of hydrocarbon contamination removal in the vicinity of the USTs will also be undertaken.

Materials found to be out of specification are to remain onsite in segregated stockpiles until such time that they can be disposed to a suitably licenced waste disposal facility.

At each phase of works, a record should be maintained by the contractor of the movement of the stockpiled material and the area within the excavation into which it is placed.

Confirmatory Testing for Material for Offsite Disposal

Any material requiring disposal during any phase of works shall be disposed of by the contractor. They shall ensure adequate and appropriate disposal, including testing to satisfy the proposed waste facility.

Records of the removal of stockpiles off site should be maintained by the contractor including details of the disposal or treatment site to which they have been taken. These details are to be passed to Groundtech Consulting to form part of the validation report.

Appropriate precautions should be taken by the contractor to ensure that the stockpiled material does not result in risks to neighbouring land users.

Confirmatory Testing for Imported Material

Imported soil will be tested to determine it is suitable for use.

The contractor importing the material is to provide laboratory testing results to Groundtech Consulting to prove the suitability of the material to be brought on to site in line with the requirements specified in this Remedial Specification. Once the soils are present on site, additional testing will be undertaken.

8.0 CONTINGENCY PLAN AND AREAS OF UNEXPECTED CONTAMINATION

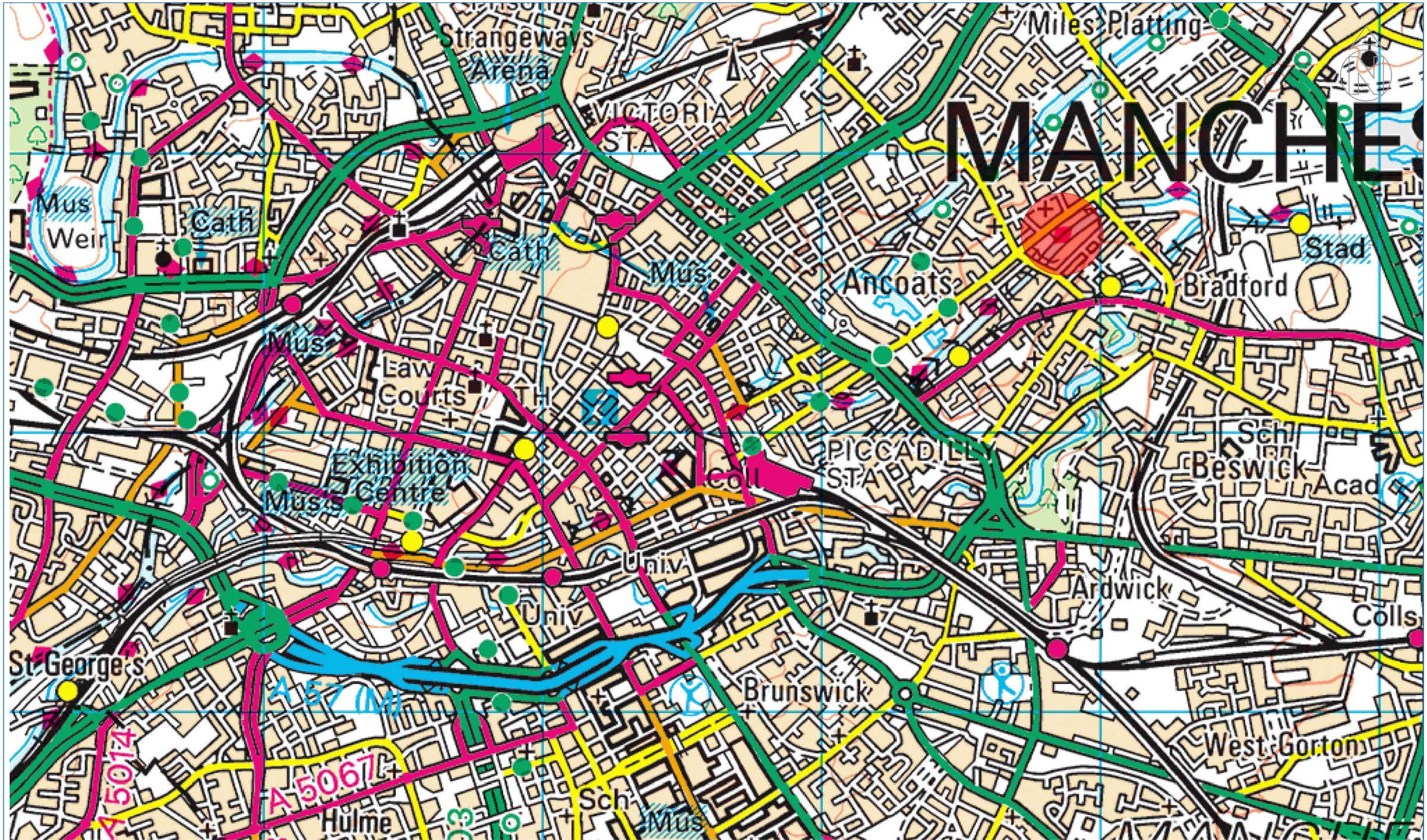
There is potential for areas of unexpected contamination to be present, due to the former use of the site. The strategy for unexpected contamination must be relayed to all site personnel during the enabling works phase and outline a clear allocation of responsibility for reporting and dealing with contamination.

Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the requirement to report this to the client and Groundtech Consulting.

A report will be prepared by Groundtech Consulting and submitted to the regulatory parties, the Local Authority and the Environment Agency where groundwater may potentially have been impacted.

If additional materials are identified, these materials will be subject to the procedures stated in this Remedial Specification.

APPENDIX 1 - Plans



GROUNDTECH CONSULTING

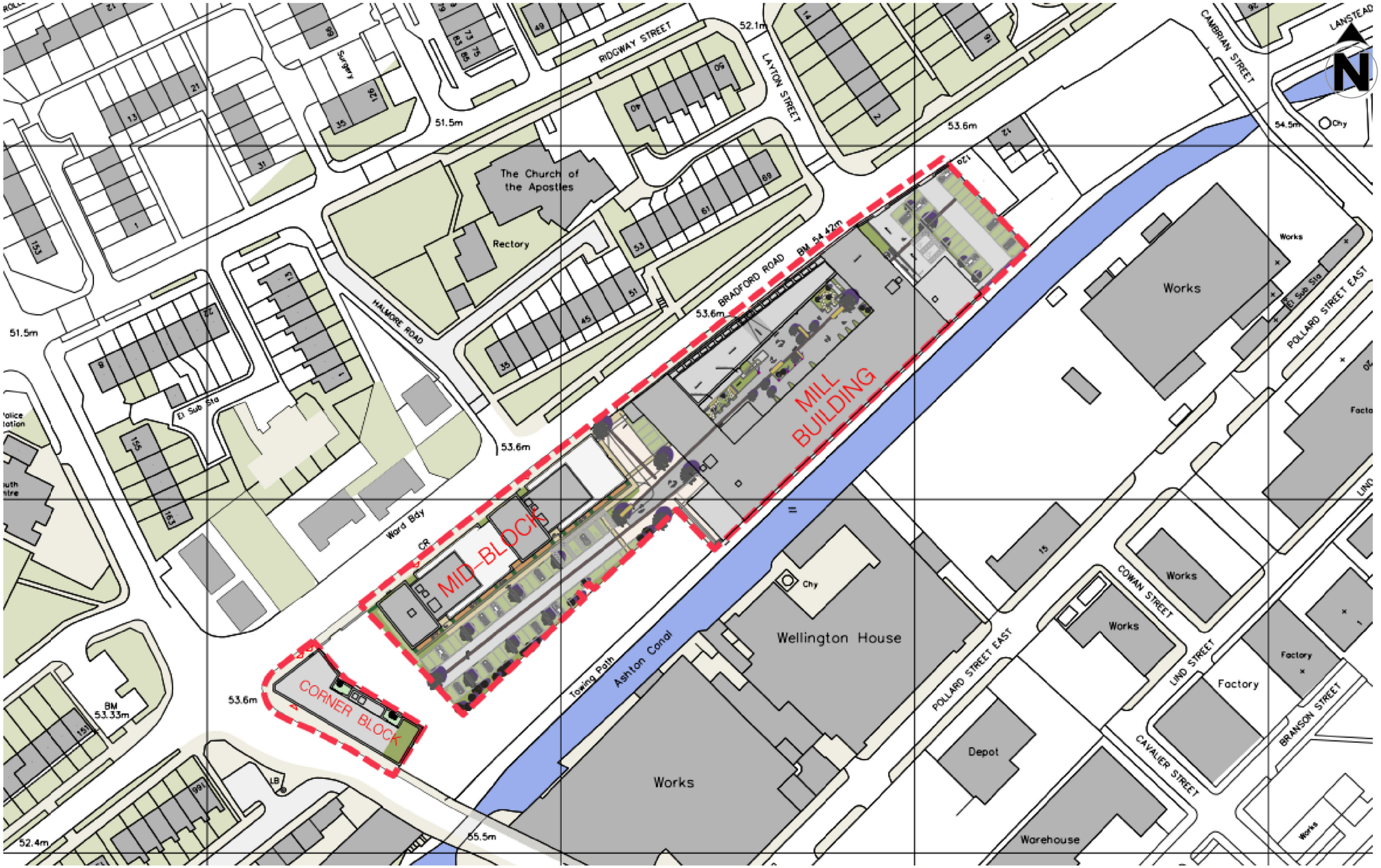
CLIENT	ARROWSMITH INVESTMENT LIMITED
PROJECT TITLE	BRUNSWICK MILL
PLAN TITLE	PROJECT LOCATION PLAN
DATE	JUNE 2023
SCALE	NTS
PLAN NUMBER	GRO-22462-P01

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

SITE LOCATION



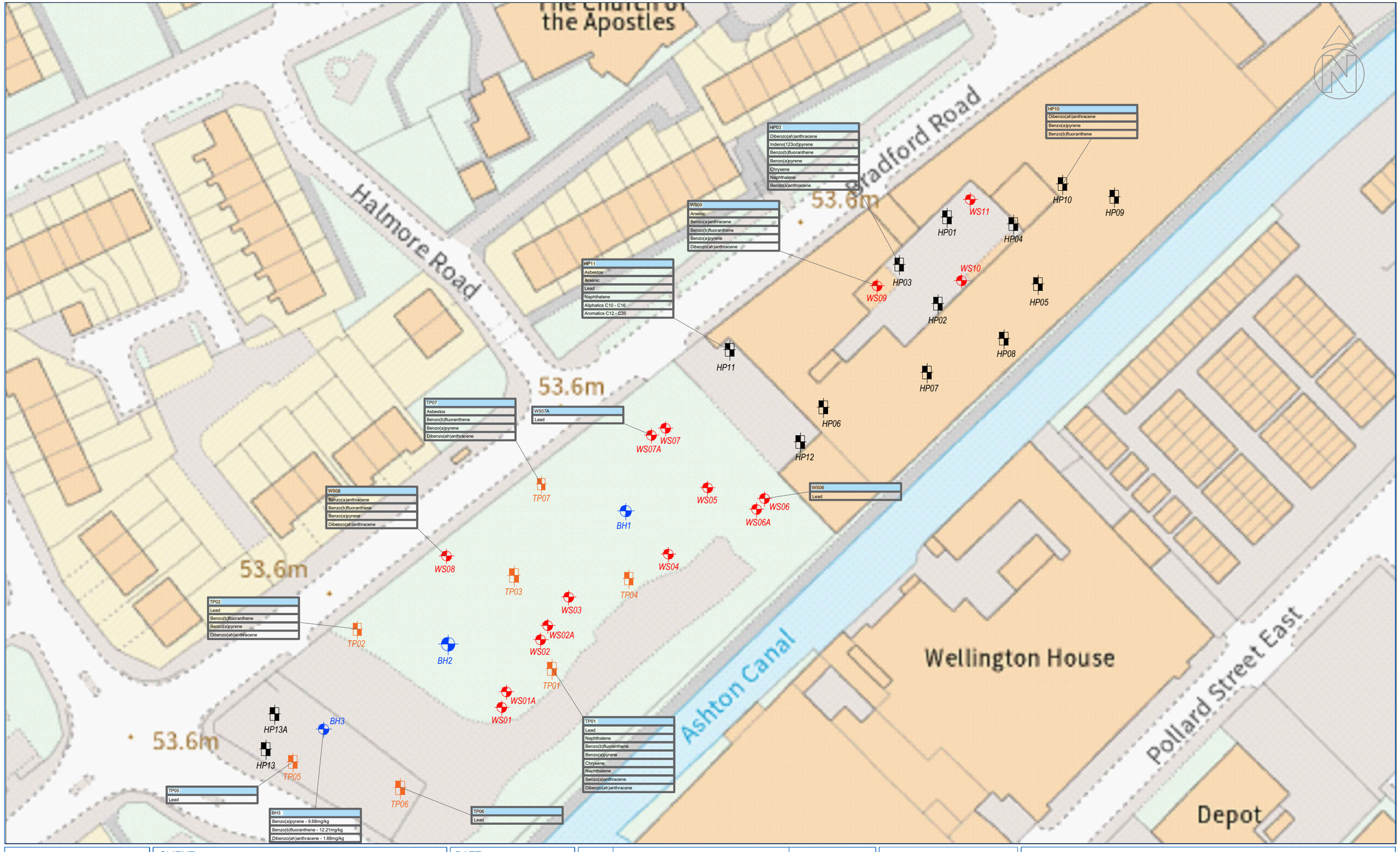
GROUNDTECH CONSULTING

CLIENT	ARROWSMITH INVESTMENT LIMITED
PROJECT TITLE	BRUNSWICK MILL
PLAN TITLE	PROPOSED SITE PLAN
DATE	OCTOBER 2023
SCALE	NTS
PLAN NUMBER	GRO-22463-P04

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes



GROUNDTECH CONSULTING	CLIENT: ARROWSMITH INVESTMENT LIMITED	DATE: JUNE 2023
	PROJECT TITLE: BRUNSWICK MILL	SCALE: NTS
	PLAN TITLE: CONTAMINATION PLAN	PLAN NUMBER: GRO-22462-P06

Rev.	Details	Date

Status	
Preliminary	
Draft	
Issued	●
For Comment	
Approved	

Notes

- HAND DUG PIT LOCATION
- TRIAL PIT LOCATION
- CABLE PERCUSSION AND ROTARY BOREHOLE LOCATION
- WINDOWLESS SAMPLE BOREHOLE LOCATION

APPENDIX 2 - General Requirements

1. Compliance with Legislation and Standards

The works are to be undertaken in compliance with all relevant British Standards, codes of practice, regulations, guidance and legislation. Whilst not an exhaustive list, works shall be in compliance with the latest revision of all relevant legislation, HSE Guidelines and good working practice including, but not be limited to, the following:

- *The Health and Safety at Work etc. Act 1974.*
- *Construction Health Safety and Welfare Regulations 1996.*
- *Health and Safety Executive 'Protection of Workers and the General Public during Redevelopment of Contaminated Land' HS (G) 66, HMSO 1991.*
- *The Construction, Design and Management Regulations 2007.*
- *The Control of Substances Hazardous to Health Regulations 2002 (COSHH Regulations).*
- *The Control of Asbestos Regulations, 2012.*

The Contractor is responsible for obtaining all necessary approvals, licences, consents and permits from regulatory bodies and third parties prior to commencement.

2. Licences, Permits and Consents

Any conditions associated planning permission should be addressed prior to carrying out the works.

It will be a requirement of the Contractor to obtain any of the necessary permits and undertake the appropriate notifications and assessments.

The Contractor should only expect approvals have been sought by others where explicitly provided to the Contractor or advised in writing.

Reuse of soils will need to be undertaken in accordance with the "Definition of Waste: Development Industry Code of Practice - Definition of Waste. Development Industry Code of Practice", Version 2 2011 i.e. in accordance with an approved Materials Management Plan and Qualified Person Declaration.

3. Health and Safety Requirements

The Principal Contractor must manage the risks in accordance with their legal requirements and all works are to be undertaken in compliance with all relevant regulations, guidance and legislation. A Construction Phase Health and Safety Plan (CPHASP) will be required to be submitted to the CDM co-ordinator, the Client and the LPA in advance of mobilisation to site. The CPHASP will be passed to the Site Manager who will implement all Health and Safety measures on site. The Site Manager will fully induct the Site Operatives prior to commencement of any works. The CPHASP will be kept as an open document and will be adapted as required to during the project. As a minimum this will include:

- *Welfare arrangements, storage and security.*
- *Air monitoring requirements (and action levels).*
- *Traffic management plan.*
- *Segregation of working areas and site welfare (and decontamination units if required).*
- *Site inductions, daily safety briefings and toolbox talks.*
- *Activity specific risk assessments.*
- *Method statement briefings.*
- *Daily inspection records.*
- *Permits to work.*

During the works it will be necessary to protect the health and safety of the site personnel.

General guidance on these matters is given in the Health and Safety Executive (HSE) document 'Protection of Workers and the General Public during the Redevelopment of Contaminated Land' HS (G) 66. In summary, the following measures are suggested to provide a minimum level of protection:

- *All ground workers should be issued with protective clothing (including high visibility clothing), hard hats, footwear and gloves, personnel instructed as to how it should be used.*
- *All personnel shall wear hard hats, high visibility clothing and protective footwear at all times.*
- *Ensure that everyone on site complies with the health and safety plan.*
- *Take reasonable steps to ensure that only authorised persons are allowed on site.*
- *Display, where they can be easily read, any notification that has been sent to the Health and Safety Executive.*
- *Hand washing and boot cleaning facilities shall be provided.*
- *No smoking except in designated areas.*
- *Good practices relating to personal hygiene shall be adopted.*
- *Prepare method statements for construction operations as required by the Principal Designer.*
- *Provide the CDM Co-ordinator with any other relevant information.*

Before site operations are commenced, the necessary COSHH Assessments, Method Statements and Health and Safety Plans should be completed, approved to the Principal Designers satisfaction and issued in accordance with the CDM Regulations.

The Construction Phase Health and Safety Plan (CPHASP) should pay particular attention to the following hazards which may be encountered:

- *Potentially hazardous or contaminated materials used or encountered on site.*
- *Deep excavations.*
- *The potential for ground gases and risks on confined spaced entry.*
- *Working in the vicinity of existing underground or overhead services.*
- *Working in confined spaces.*
- *Working on, or in the vicinity of highways.*
- *Working with materials which have the potential to contain asbestos and the risk of inhalation of asbestos fibres.*
- *Manual handling.*
- *The potential for fire.*
- *Working with electrical apparatus in the vicinity of mobile plant and the potential presence of water.*
- *Poor lighting.*
- *The potential for falling/slipping/tripping and sustaining injury.*
- *The possibility for biological agents to be present, including, but not limited to: psittacosis, leptospirosis (Weill's disease), tetanus, legionella, human waste.*
- *Working in the vicinity of voids and openings.*

The Contractor shall take all necessary safety precautions throughout the ground treatment operations and shall comply with the Health and Safety at Work Act 1974 or any subsequent re-enactment thereof.

The Contractor shall submit for approval all necessary method statements to the Client prior to commencing the works.

The Contractor shall provide details of emergency procedures. Emergency services shall be informed of the site operations prior to commencement.

All statutory records to be kept in the site manager's office and these may include (not an exhaustive list and note not all may be required):

- *ASB NNLW1 – Notification of non-licensed asbestos work if the work is deemed not be requiring a licence (if required).*
- *Appropriate licence with regards to CAR 1012 if the work is deemed to require a licence.*
- *HSE Notification F10.*
- *Construction Phase Health and Safety Plan.*
- *Method Statements and Risk Assessments; Environmental Permit deployment form and associated paperwork.*
- *Discharge Consents for disposal of groundwater.*
- *Competence records (including asbestos awareness training and face-fit test records).*
- *Utility records.*
- *Plant and machinery maintenance records.*
- *Duty of Care paperwork.*

In addition, it is recommended that:

- *Asbestos Awareness training/briefing to be given to all staff.*
- *Background and ongoing air dust monitoring to be undertaken to check for presence of asbestos fibres during the works.*

4. Site Establishment and Security

Prior to the commencement of any works, the contractor, in conjunction with the Client and the Supervising Engineer, shall establish the boundaries of the site and working areas.

The Contractor shall make adequate provision to secure the site boundary and prevent unauthorised access onto the site during the course of the works.

Prior to the commencement of any works, the contractor, shall undertake a dilapidation survey of all adjacent features/construction including but not limited to boundary walls/ fences, adjacent footpath and road constructions etc. The survey is to be agreed with the Client or their representative prior to commencing any work on site.

The Contractor shall be responsible for all costs associated with rectification of damage to adjacent features/construction including but not limited to properties, boundary walls/ fences, adjacent footpath and road constructions etc. resulting from the demolition works.

The Contractor is to provide surveying capability as set out in this document facilitate the above. Prior to the completion of the works the Contractor is to discuss the continuation of the site security, including the fences, with the client and acceptable arrangements for continued security are to be agreed prior to the removal of the contractor's security provision.

5. Traffic Safety and Management

The Contractor shall comply in all respects with Chapter 8 of the Traffic Signs Manual for works on or affected the public highway and/or private roads forming the highway access to/from the site. The Enabling Works Contractor shall obtain all necessary consents from the Local Highway Authority for works on the public highway.

On-site access and haul routes should be provided and maintained by the Enabling Works Contractor in such a manner so as not to endanger either the user, those working in the vicinity of such accesses/haul routes and or the Works. Access to the site will be agreed with the Clients prior to commencement.

Suitable precautions shall be taken to prevent the spread of mud and debris on the public highways. Regular inspections of the public highway adjacent to the site shall be carried out. If deemed necessary by the Contractor, the Client or the Supervising Engineer, the highway shall be swept regularly to remove any mud, slurry or dust deposited by vehicles entering or departing the site. If the Supervising Engineer considers that significant amounts of any detritus have been deposited on the public highway then operations shall be temporarily suspended until appropriate cleaning operations have been undertaken.

The Contractor is to co-operate with other Contractors if they are present during the works. The proposed works will generate a number of vehicle movements associated with the removal of soils and delivery to site of materials. Consideration should be given to the route and the timing of these vehicle movements, to minimise risk and disturbance to sensitive locations (such as schools, residential areas).

Risks associated with the transport of soils that are potentially containing contaminated, such as dust emission, should be appropriately managed.

6. Welfare Facilities

Site cabins and welfare facilities will be established at a location to be agreed with the Supervising Engineer.

The Contractor is deemed to have made provision and arrangements for all temporary utilities associated with the welfare facilities.

7. Working Hours

Noisy operations such as the use of hydraulic breakers shall be restricted to operating times as specified by the Client and by the Planning Permission. It is understood that these are 8:30 am to 5:30 pm, or other hours agreed with the Local Authority, Monday to Friday and 9.00 am to 1.00pm on Saturday. No working shall take place on Sunday or Bank Holidays.

Prior to commencement the Contractor is to make contact with the Local Authority to establish if any further restrictions apply.

8. Mobile Plant

Mobiles plant shall be operated by suitably trained and qualified operators experienced for each item of plant. When not in use all plant shall be locked to prevent all plant shall be locked to prevent unauthorised operation.

All traffic entering or working on site shall comply with a maximum 10 mph speed limit.

Fuelling of any plant shall be undertaken in a designated area and all above ground fuel storage tanks shall comply with the requirements of the Pollution Prevention Guidelines PPG2. Specifically, any storage tanks used should:

- *Be sited within an oil-tight secondary containment system such as an impermeable bund.*
- *The secondary containment must provide storage for at least 110% of the tanks maximum capacity.*
- *Be located within a secure area.*
- *All taps and valves should be fitted with a lock and kept locked shut when not in use. Maintenance of mobile plant should be undertaken in a designated area, unless absolutely necessary.*

Waste oil, hydraulic fluid etc. should not be tipped directly or discharged on to site. Such materials shall be stored separately, in a secure bunded area, for off-site disposal. Waste oil may be a special waste and disposal shall be undertaken by a registered carrier in accordance with the Duty of Care Regulations.

A spill kit shall be kept on site in an accessible place adjacent to the designated refuelling area.

9. Unexploded Ordnance (UXO)

A UXO risk has not been identified and UXO precaution measures are not necessary.

10. Surveying

The Contractor shall provide full time surveying personnel and equipment to undertake the following activities and any other requirement for topographical information relating to the project that arises through the duration of the enabling works contract. The survey personnel and equipment should be capable of providing accurate levels and co-ordinates in relation to the national grid and topographical survey provided within 1 day of request.

The following key activities are covered by the requirements for surveying:

- *Confirmation of topographical survey on possession of the site, and setting out of the site boundary.*
- *Confirmation of positions of existing utilities and site features.*
- *Surveying the base and extent of all excavations and remaining obstructions prior to backfilling.*
- *All setting out and levelling relating to delivery of the enabling works.*
- *The location of sub-structures removed.*
- *Interim surveys to be undertaken during the infilling works to provide information on issues such as depth of excavation, progress of earthwork, quantities of materials, testing depths and locations etc.*
- *The location and elevation of test samples and locations.*
- *As built survey information.*

The Contractor is required to undertake all necessary topographical survey works to verify these levels before the commencement of the contract. Should the Contractor find any discrepancies on the drawings they are to refer the matter to the Engineer for verification before proceeding with the part of the works affected.

The Contractor shall undertake a topographical survey following completion of the enabling works.

All topographical surveys shall include levels at maximum 10m spacing and details of any features, changes in slope, structures, services and any other features of interest.

All of the above features shall be surveyed for line and level at the site boundary and marked on a plan. Levels shall be to Ordnance Datum and locations to National Grid. The survey shall be calibrated against existing site surveys and benchmarks in the vicinity of the site.

11. Testing

The Contractor shall be responsible for undertaking all testing necessary to satisfy the Supervising Engineer that the works have been carried out in accordance with, and comply with this Remedial Specification and the Earthworks specification.

All soils and geo-environmental testing shall be carried out by a UKAS and MCERTS accredited laboratory, with accreditation for the specific analysis, to the approval of the Supervising Engineer.

The Enabling works Contractor is to make available on site at all times a file containing all test certificates in addition to the testing summary, for inspection by the Consultant.

Test results are to be summarised in a single master spreadsheet (which contains all data) and is to be in a format agreed with the Consultant. Data that does not meet the specification shall be highlighted and include details of what works were undertaken to address the non-compliance. The master spreadsheet, results of testing and drawings shall be maintained and kept up to date. .

12. Offsite Disposal

Materials for offsite disposal shall be sampled and analysed, by the contractor, at rates sufficient to allow the material to be adequately classified by assessment.

WAC testing should be undertaken on material exported from site to landfill, or other appropriately licensed facility. Material shall be hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, 1991, Environmental Permitting (England and Wales) Regulations 2016 and where appropriate the Special Waste Regulations, 1996 and Hazardous Waste (England and Wales) Regulations 2005. A transfer note shall be completed, signed and retained by all parties involved. The transfer note shall state the volume of waste, the nature of the material and statement to the chemical composition. The waste transfer notes shall be kept by the Contractor for a period of at least 2 years.

13. Contamination

Contractors should be made aware of the possibility of encountering contaminants within soils or groundwater at the site (including asbestos) through 'toolbox' talks.

Safe working procedures should be implemented in accordance with CIRIA132 and good standards of personal hygiene should be observed and appropriate levels of PPE provided and utilised.

Eating, drinking and smoking should be strictly prohibited in the development site other than in designated mess areas.

14. The Control of Noise, Vibration and Dust Nuisance

The Contractor shall comply with the recommendations for practical measures to reduce noise and vibration set out in BS5228-1:2009 and BS5228-2:2009 and with any specific Principal Contractor requirements.

The Contractor shall take all reasonable measures to prevent dust nuisance from being generated by construction traffic, etc.

If necessary working methods will be altered in order to ensure that the level of noise generated from the works is within published tolerable limits.

The requirements of the LPA are to be sought and undertaken.

General

No fires shall be permitted on site.

Dust Mitigation

Appropriate measures shall be implemented at all times during the demolition and enabling works to minimise any dust emissions.

Any main temporary haul roads shall, where practical to do so, be constructed of crushed hardcore products. The haul roads shall be maintained for the duration of their use to minimise any build-up of loose spoil etc.

Traffic both entering and working on site shall obey a maximum speed limit of 10 mph. Wagons that are to be used for the haulage of any contaminated material from site shall be appropriately sealed or sheeted to prevent the release of fugitive dust.

Mobile water bowsers and sprayers shall be available on site at all times to water unpaved haul roads and working areas. The water spray may include chemical dust suppressants or wetting agents to improve dust control. An

adequate supply of water shall be maintained on site at all times to allow for dust suppression activities to be carried out at short notice.

Where mobile water bowsers are not effective in suppressing dust then vapour masts shall be used. Such vapour masts shall be deployed at 20m centres on the downwind side of haul roads or excavations giving rise to significant dust or emissions of odour.

Air quality and dust monitoring stations will be set up and monitored by the Contractor to record the dust concentrations during the works.

With regards to stockpiles:

- *Stockpiles should be kept to a minimum to reduce 'wind whip' causing potentially hazardous material to be blown from the pile.*
- *Stockpiles should be placed on a suitable polythene membrane in a bunded area to prevent any cross contamination and care should be taken not to pierce the sheeting when placing the bulky elements of the material.*
- *Stockpiles should be dampened down or covered to prevent dust, whilst the final choice should be made by the Contractor based on site constraints, but the options include covering with plastic/polythene membrane, or by a layer of clean soil material.*
- *The drop distance from excavator bucket to stockpile will be kept as short as reasonably practicable to reduce dust.*

Odour

In general terms the excavation works are not considered likely to give rise to any significant odour problems. However; possible 'hotspots' cannot be discounted and it is advised that odours are assessed by twice daily inspections of all Site boundaries.

If highly odorous materials are encountered, which may give rise to nuisance to neighbouring properties, appropriate vapour masts shall be deployed to provide suitable odour control. Any odorous materials shall be covered at the end of each working day and any stockpiles will be located away from any sensitive areas.

Plant and machinery shall be serviced regularly to ensure that exhaust fumes are compliant with best practice and relevant regulations.

Noise

The requirements of the Local Planning Authority and BS 5228: 1997 'Noise and vibration control on construction sites' shall be adhered to at all times.

All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No items of plant shall be operated with engine covers raised.

The location of any crushing plant shall take into consideration the location of neighbouring properties and other noise sensitive receptors and shall be located away from these areas and located adjacent to proposed stockpile locations where possible.

15. Asbestos in Soils

The Contractor must manage the risks in accordance with their legal requirements and will need to prepare appropriate health and safety documentation and obtain appropriate approvals, licences, consents and permits prior to commencement.

The remediation works are designed to break the pollution linkage with regards to contaminants within the soil. Whilst appropriate measures are required for all contaminants present, the Contractor should note the additional details provided below with regards to asbestos in the soils:

- *Asbestos is a hazard to Human Health when airborne fibres are inhaled. Asbestos containing material (ACM) that is in a bound form (such as asbestos cement tiles) is not hazardous where the asbestos fibres cannot become airborne. However, if lagging is present or the ACM is broken or crumbled in a dry condition the asbestos fibres could become airborne and could then be inhaled. When soil with asbestos is covered by hardstanding, buildings or a cover of clean soil or when the soil is kept damp, the asbestos fibres are less likely to become airborne and the risk is greatly reduced.*
- *The Health and Safety at Work Act 1974 forms the basis of health and safety legislation in in the UK. In addition, the Control of Asbestos Regulations 2012 (CAR 2012) applies throughout the UK. CAR 2012 applies if land has significant asbestos content and is relevant to any work conducted on asbestos contaminated land.*
- *CAR 2012 defines a "control limit" of 0.1 fibres per cubic centimetre of air averaged over a continuous period of 4 hours. This limit is not risk based and may be much higher than the levels for control of environmental pollution.*
- *CAR 2012 applies even where exposure to asbestos of employees is sporadic and of low intensity and where exposure to asbestos of any employee will not exceed the control limit. The work must be of short non-continuous activities where non-friable materials are handled, or removal without deterioration of non-degraded materials in which asbestos fibres are firmly linked in a matrix.*
- *Lagging, broken fragments of asbestos and loose fibres have the potential to release airborne fibres in dry conditions. In addition, as the ACM and asbestos fibres have been contained in the soil for many years, the likelihood is that they would be degraded to some extent. However, the asbestos fibres detected at the site are within a soil matrix and if this is kept damp, this should assist in minimising the risk of the release of airborne fibres.*
- *The contractor should determine whether the works being undertaken would be exempt from CAR 2012 licensing requirements.*

It should be noted that information presented in this document is provided to assist in managing the soil at the site which contains asbestos. It is the responsibility of the contractor how the control measures associated with these risks are implemented and recommend that an appropriate asbestos specialist assist with both the preparation of documents and licences and site supervision.

Task specific risk assessments and method statements should be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and if required RPE should be provided and utilised.

Visible fragments of suspected asbestos containing materials on the site surface shall be handpicked. Hand picking needs to be undertaken in accordance with an Environmental Permit and ACM shall be placed in a dedicated covered and lockable skip pending off-site disposal to a suitably licensed facility. Such remediation measures will be undertaken by suitably qualified contractors and in accordance with CAR 2012.

16. Water Quality Controls

The Contractor shall provide for such measures as may be necessary to ensure that water, whether groundwater, from precipitation or any other source does not accumulate in excavations or on sub-grades.

Adequate drainage sumps will be installed during works and cut off trenches/dewatering measures will be used as required to manage surface water run-off, to prevent any water from entering watercourses, either directly as surface water run-off, or indirectly via the surface water drainage systems; If materials escape, appropriate the Contractor is to undertake (at their cost) appropriate remedial action as soon as possible.

17. Utilities

Utility records are to be provided by the Client for information purposes within the enabling works documentation. However, the Contractor shall be responsible for liaison with the statutory utility providers to ensure all service records are current and correct. The Contractor is also responsible for the safe disconnection of existing utilities entering the site, except those which are to remain operational.

Prior to site work commencing, the position of all utilities indicated as on site or offsite but close to the site boundary shall be determined and clearly identified where on site. The locations should be confirmed on site by appropriate investigation, observations and survey. Any discrepancies between the anticipated positions and confirmed locations are to be reported to the Supervising Engineer.

All retained manholes should be located and clearly identified on site to prevent damage. The location, depth, diameter and invert level of each manhole and the size and depth of all stream connections shall be recorded. Where drains or sewers are to be grubbed up the downstream ends should be plugged prior to commencement to prevent offsite systems becoming blocked or contaminated.

Where existing drains or sewers are to remain, CCTV surveys are to be provided by the contractor. These surveys must be undertaken on commencement prior to any physical work and on completion to demonstrate no damage has occurred.

Where damage has occurred, any remedial work must be agreed with the Supervising Engineer and relevant authority/owner prior to repairs commencing. The repair costs will be borne by the contractor.

All utilities on site that are to be retained through the works are to be positively located on site, reliance shall not be placed on existing records. Utilities are to be visibly marked and protected for the duration of the works. Appropriate methods are to be put in place to ensure all site staff working in the vicinity of retained utilities are fully briefed.

The Contractor is responsible for ensuring that all hydrant covers, stop tap boxes manhole covers and the like are raised or lowered to suit the finished levels associated with the proposed enabling works plateaus and future construction thicknesses.

Following the completion of the works, a survey plan of the location of terminated services is to be provided.

18. Damage to Property

All works are to be undertaken in accordance with the Party Wall etc Act 1996. The Contractor shall ensure that all precautions are taken in order to avoid any damage to existing property arising from the Works and shall be responsible for same in the event that any damage should arise from his failure to exercise due care.

Any adjacent structures, services and the like shall be inspected prior to commencement of the Works for evidence of existing defects and, if necessary, a dilapidation survey shall be carried out by the contractor, with the agreement of the Client and/or the Supervising Engineer, prior to works commencing on site. A re-inspection shall take place on completion of the Contract to verify that no damage or deterioration of the said structure, service or apparatus has occurred as a result of the Works. A schedule of the findings of this re-inspection shall be circulated to all parties concerned for their records.

The Contractor shall execute the works with care so as to avoid damage to existing structures and drains or other services to be retained.

All fences, trees, paths, shrubs, grassed areas and other surfaces required to be retained shall be protected by the Contractor from spillage and damage caused by site operations and upon completion of the works they shall be handed over in an undamaged and proper state to the satisfaction of the Engineer.

Refer to landscape architect drawings and specifications that define the areas that require protection. The Contractor shall not raise or lower the ground level beneath the spread of the branches of any tree to be retained without the approval of the Engineer.

19. Drawings and Supplied Information

Whilst efforts have been made to ensure that the information provided to the Contractor is correct and current, the Contractor is responsible for corroborating the existing information with the benefit of their site presence and to report any discrepancies encountered or anticipated to the Supervising Engineer immediately.

Where cutting and filling operations are to be carried out the Contractor is to undertake comparative assessments with the benefit of existing information, additional survey and their anticipated sequence of work to ensure sufficient and suitable material is available to undertake the works as proposed. Any anticipated shortfall or surplus is to be report immediately.

20. Photographs

A detailed dilapidation survey shall be undertaken of the site and adjacent properties including joint site boundaries, in conjunction with adjacent land owners. Such survey shall include roads, footpaths, street lighting and road signs. A copy of the survey, including record photographs shall be provided to the Client within seven days of commencement of site works.

The Contractor is to provide on-site a digital camera and e-mail facilities to enable electronic transfer of site photographs and other information for the full duration of the contract. Progress photographs are to be taken at least weekly across all parts of the site for inclusion within the contractor's report. Photographs are to be made available to the Engineer/Client in electronic format should they be requested during the contract. Record photographs should be provided as part of the validation information

APPENDIX 3 - Remediation Options Appraisal

Introduction

This Options Appraisal has been undertaken in general accordance with Chapter 3 (Options Appraisal) of CLR11 'Model Procedures for Management of Land Contamination'. There are four main stages to this appraisal:

1. Identifying Key Risk Drivers.
2. Identifying viable remediation options for each relevant pollutant linkage.
3. Carrying out a detailed evaluation of viable remediation options to identify the most appropriate option for each pollution linkage.
4. Producing a remediation strategy that reduces all relevant pollutant linkages to an acceptable level.

Key Risk Drivers for Remedial Action

Coopers Site Investigation Report and Supplementary Report have identified that the key risk drivers requiring remediation are:

- *Asbestos fibres and ACM within the Made Ground.*
- *Elevated heavy metals (arsenic & lead)*
- *Elevated PAHs*
- *Elevated TPH CWG*

The following sections of this report are intended to identify suitable and practical remedial techniques which can be applied in order to achieve a site which is suitable for the proposed residential development.

Remediation Options and Evaluation of Feasibility

Preliminary Assessment of Remediation Options
Investigation and risk assessment has concluded that the requires remediation to reduce the risk to receptors to an acceptable level.

The objectives of the remediation are to remove one or more elements of each of the *source-pathway-receptor* linkages.

The initial screening process considers the available remedial techniques based on following key criteria:

- *Effectiveness* - *the strategy must work within the context of the site and be effective in the removal of contamination linkages.*
- *Practicality* - *the strategy has to have been successfully used in similar situations on other sites and readily available within the UK market. Novel solutions or those still in the research stage are not considered here.*
- *Durability* - *the strategy needs to be durable and not reliant on ongoing maintenance to continue being effective.*
- *Relative Cost* - *the strategy must not be excessive cost.*
- *Relative Operational Time* - *the strategy should work in a feasible and realistic time scale.*
- *Sustainability* - more sustainable options are preferred.

The table below summarises all of the accepted remedial techniques readily available and assess each against the six key parameters listed above.

In the first instance, the feasibility of each of the listed remedial option is assessed in terms of effectiveness at treating the contamination, which is broken down into; effective (Y), partially effective (P) or ineffective (N).

The techniques are then assessed in terms of relative cost ranging from negligible cost (£) through moderately expensive (££) to prohibitively expensive (£££+).

The timescale the remedial technique is operational has been generally assessed in units of weeks, months, years and decades. The longevity of the technique should be for the duration of the development to be effective.

The main reasons for rejection of a remedial option are generally the ongoing operational constraints, the cost and the ineffectiveness to mitigate the risk from all contaminants present. In some situations, several treatment options may be applicable and will therefore be considered as part of the appraisal.

Viable Remedial Options

As described above, certain technologies were rejected based on the above reasons. The short-list of options presented below represents those technologies which were not rejected at the pre-screening process and as such, are taken forward to the options appraisal process:

- *Installation of a cover system in POS.*
- *Materials management, comprising excavation, screening, and reuse of suitable material.*
- *Disposal of surplus or unsuitable soils.*

Cover System

A cover systems is a proven technology for mitigating the risk from numerous contaminants. The process comprises the placement of a cover system to form a barrier between the contaminated Made Ground and site users breaking the pollution linkage.

This option is technically simple and represents a low-cost strategy that can be implemented rapidly, subject to favourable site levels to accommodate the cover system.

The timescale for installing a barrier is relatively quick allowing for rapid completion of the remediation objectives and this remediation solution could be designed and implemented within a matter of weeks/months.

Disposal of excess or unsuitable soils

Disposal involves the removal of contaminated soils and disposal at an appropriately licensed waste management facility or surplus material potentially to a recycling facility. The benefits of excavation and disposal are is short term implementation and the soils can be removed with a high degree of certainty by meeting proposed RTVs.

The cost of the method however can be significant depending on the classification and end disposal route, particularly in comparison to a cover system. The option will also take up valuable landfill space and present a significant carbon footprint in terms of vehicle movements.

The technique can be combined with other remedial options i.e. removal offsite of hotspots and reuse and/or treatment of general Made Ground.

Applicability of Remediation Options and Initial Assessment – Soils

Remedial Activity	Effective on Asbestos	Relative Cost	Relative Operational Time	Comments (Practicality/Sustainability/Durability)	Feasibility
Containment - Cover System	*Y*	*£*	*Weeks*	*Will break the pollution linkage between future site users and contaminants in the Made Ground.*	*Y – in conjunction with materials management.*
Excavation and Disposal	*Y*	*££*	*Weeks to months*	*Removal of unsuitable material and risk.*	*Y – in conjunction with materials management.*
Containment - hydraulic barriers	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Containment - in ground barriers	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Soil flushing	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Surface amendments	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Soil washing	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Hydraulic binders (such as cement)	*Y*	*££*	*Weeks to months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*

Remedial Activity	Effective on Asbestos	Relative Cost	Relative Operational Time	Comments (Practicality/Sustainability/Durability)	Feasibility
Vitrification	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Incineration	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*
Thermal desorption	*Y*	*£££*	*Months*	*Not applicable – cost and timescales not suitable for the level of contamination. Resulting in development not being economically viable.*	*N*

APPENDIX 4 - Remedial Target Values

Generic Assessment Criteria (GAC)

GROUNDTECH CONSULTING

Proposed End Use	Unit	Residential with Plant Uptake			Residential without plant uptake			Source
SOM	%	1	2.5	6	1	2.5	6	
Arsenic	mg/kg	37	37	37	40	46	40	LQM S4ULs
Beryllium	mg/kg	1.7	1.7	1.7	1.7	1.7	1.7	LQM S4ULs
Boron (water soluble)	mg/kg	290	290	290	11000	11000	11000	LQM S4ULs
Cadmium	mg/kg	10	10	10	85	85	85	SGVs
Chromium (Total)	mg/kg	910	910	910	910	910	910	LQM S4ULs
Chromium (VI)	mg/kg	21	21	21	-	-	-	DEFRA C4SLs
Copper	mg/kg	2400	2400	2400	7100	7100	7100	LQM S4ULs
Lead	mg/kg	200	200	200	310	310	310	DEFRA C4SLs
Mercury	mg/kg	1.2	1.2	1.2	1.2	1.2	1.2	LQM S4ULs
Nickel	mg/kg	180	180	180	180	180	180	LQM S4ULs
Selenium	mg/kg	350	350	350	430	430	430	SGVs
Vanadium	mg/kg	410	410	410	1200	1200	1200	LQM S4ULs
Zinc	mg/kg	3700	3700	3700	40000	40000	40000	LQM S4ULs
Aliphatic EC 5 - 6	mg/kg	42	78	160	42	78	160	LQM S4ULs
Aliphatic EC 6 - 8	mg/kg	100	230	530	100	230	530	LQM S4ULs
Aliphatic EC 8 - 10	mg/kg	27	65	150	27	65	150	LQM S4ULs
Aliphatic EC 10 - 12	mg/kg	130 (48) vap	330 (118) vap	760 (283) vap	130 (48) vap	330 (118) vap	770 (283) vap	LQM S4ULs
Aliphatic EC 12 - 16	mg/kg	1100 (24) sol	2400 (59) sol	4300 (142) sol	1100 (24) sol	2400 (59) sol	4400 (142) sol	LQM S4ULs
Aliphatic EC 16 - 35	mg/kg	65000 (8.48) f,sol	92000 (21) f,sol	110000 f	65000 (8.48) f,sol	92000 (21) f,sol	110000 f	LQM S4ULs
Aliphatic EC 35 - 44	mg/kg	65000 (8.48) f,sol	92000 (21) f,sol	110000 f	65000	92000 (21) f,sol	110000 f	LQM S4ULs
Aromatic EC 5 - 7	mg/kg	70	140	300	370	690	1400	LQM S4ULs
Aromatic EC 7 - 8	mg/kg	130	290	660	860	1800	3900	LQM S4ULs
Aromatic EC 8 - 10	mg/kg	34	83	190	47	110	270	LQM S4ULs
Aromatic EC 10 - 12	mg/kg	74	180	380	250	590	1200	LQM S4ULs
Aromatic EC 12 -16	mg/kg	140	330	660	1800	2300	2500	LQM S4ULs
Aromatic EC 16 - 21	mg/kg	260 f	540 f	930 f	1900	1900	1900	LQM S4ULs
Aromatic EC 21 - 35	mg/kg	1100 f	1500 f	1700 f	1900	1900	1900	LQM S4ULs
Aromatic EC 35 - 44	mg/kg	1100 f	1500 f	1700 f	1900	1900	1900	LQM S4ULs
Benzene	mg/kg	0.33	0.33	0.33	0.38	0.7	1.4	SGVs
Toluene	mg/kg	610	610	610	880	1900	3900	SGVs
Ethyl Benzene	mg/kg	350	350	350	83	190	440	SGVs
Xylene - o	mg/kg	250	250	250	88	210	480	SGVs
Xylene - m	mg/kg	240	240	240	82	190	450	SGVs
Xylene - p	mg/kg	230	230	230	79	180	430	SGVs
MTBE (methyl tert-butyl ether)	mg/kg	49	84	160	-	-	-	CL:AIRE 2010
Acenaphthene	mg/kg	210	510	1100	3000	4700	6000	LQM SAULs
Acenaphthylene	mg/kg	170	420	920	2900	4600	6000	LQM S4ULs
Anthracene	mg/kg	2400	5400	11000	31000	35000	37000	LQM S4ULs
Benzo(a)anthracene	mg/kg	7.2	11	13	11	14	15	LQM S4ULs
Benzo(a)pyrene	mg/kg	2.2	2.7	5*	3.2	3.2	3.2	DEFRA C4SL*/LQM S4ULs
Benzo(b)fluoranthene	mg/kg	2.6	3.3	3.7	3.9	4	4	LQM S4ULs
Benzo(ghi)perylene	mg/kg	320	340	350	360	360	360	LQM S4ULs
Benzo(k)fluoranthene	mg/kg	77	93	100	110	110	110	LQM S4ULs
Chrysene	mg/kg	15	22	27	30	31	32	LQM S4ULs
Dibenzo(ah)anthracene	mg/kg	0.24	0.28	0.3	0.31	0.32	0.32	LQM S4ULs
Fluoranthene	mg/kg	280	560	890	1500	1600	1600	LQM S4ULs
Fluorene	mg/kg	170	400	860	2800	3800	4500	LQM S4ULs
Indeno(123-cd)pyrene	mg/kg	27	36	41	45	46	46	LQM S4ULs
Naphthalene	mg/kg	2.3 f	5.6 f	13 f	2.3	5.6	13	LQM S4ULs
Phenanthrene	mg/kg	95	220	440	1300	1500	1500	LQM S4ULs
Pyrene	mg/kg	620	1200	2000	3700	3800	3800	LQM S4ULs

Generic Assessment Criteria (GAC)

GROUNDTECH CONSULTING

Proposed End Use	Unit	Residential with Plant Uptake			Residential without plant uptake			Source
SOM	%	1	2.5	6	1	2.5	6	
Phenols	*mg/kg*	*420*	*420*	*420*	-			*SGVs*
Chlorophenols	*mg/kg*	*0.87* [g]	*2*	*4.5*	-			*LQM S4ULs*
Pentachlorophenol	*mg/kg*	*0.22*	*0.52*	*1.2*	-			*LQM S4ULs*
Carbon disulphide	*mg/kg*	*0.14*	*0.29*	*0.62*	-			*LQM S4ULs*
Hexachlorobutadiene	*mg/kg*	*0.29*	*0.7*	*1.6*	-			*LQM S4ULs*
1,1,1,2 Tetrachloroethane	*mg/kg*	*1.6*	*3.4*	*7.5*	-			*LQM S4ULs*
1,1,1 Trichloroethane	*mg/kg*	*8.8*	*18*	*39*	-			*LQM S4ULs*
Trichloroethene	*mg/kg*	*0.016*	*0.034*	*0.075*	-			*LQM S4ULs*
Tetrachoromethane (Carbon Tetrachloride)	*mg/kg*	*0.026*	*0.056*	*0.13*	-			*LQM S4ULs*
1,2-Dichloroethane	*mg/kg*	*0.0071*	*0.011*	*0.019*	-			*LQM S4ULs*
Chloroethene (Vinyl chloride)	*mg/kg*	*0.00064*	*0.00087*	*0.0014*	-			*LQM S4ULs*
Trichloromethane (Chloroform)	*mg/kg*	*0.91*	*1.7*	*3.4*	-			*LQM S4ULs*
Tetrachloroethene	*mg/kg*	*0.18*	*0.39*	*0.9*	-			*LQM S4ULs*
Hexachlorobenzene	*mg/kg*	*1.8 (0.2)* [vap]	*3.3 (0.5)* [vap]	*4.9*	-			*LQM S4ULs*
Pentachlorobenzene	*mg/kg*	*5.8*	*12*	*22*	-			*LQM S4ULs*
1,2,4,5-Tetrachlorobenzene	*mg/kg*	*0.33*	*0.77*	*1.6*	-			*LQM S4ULs*
1,2,3,5-Tetrachlorobenzene	*mg/kg*	*0.66*	*1.69*	*3.7*	-			*LQM S4ULs*
1,2,3,4-Tetrachlorobenzene	*mg/kg*	*15*	*36*	*78*	-			*LQM S4ULs*
1,3,5-Trichlorobenzene	*mg/kg*	*0.33*	*0.81*	*1.9*	-			*LQM S4ULs*
1,2,4-Trichlorobenzene	*mg/kg*	*2.6*	*6.4*	*15*	-			*LQM S4ULs*
1,2,3-Trichlorobenzene	*mg/kg*	*1.5*	*3.6*	*8.6*	-			*LQM S4ULs*
1,4-dichlorobenzene	*mg/kg*	*61* [f]	*150* [f]	*350* [f]	-			*LQM S4ULs*
1,3-dichlorobenzene	*mg/kg*	*0.4*	*1*	*2.3*	-			*LQM S4ULs*
1,2-Dichlorobenzene	*mg/kg*	*23*	*55*	*130*	-			*LQM S4ULs*
Chlorobenzene	*mg/kg*	*0.46*	*1*	*2.4*	-			*LQM S4ULs*
Gamma-Hexachlorocyclohexanes	*mg/kg*	*0.06*	*0.14*	*0.33*	-			*LQM S4ULs*
Beta-Hexachlorocyclohexane	*mg/kg*	*0.085*	*0.2*	*0.46*	-			*LQM S4ULs*
Alpaha - Hexachlorocyclohexane	*mg/kg*	*0.23*	*0.55*	*1.2*	-			*LQM S4ULs*
Beta -Endosulfan	*mg/kg*	*7*	*17*	*39*	-			*LQM S4ULs*
Alpha-Endosulfan	*mg/kg*	*7.4*	*18*	*41*	-			*LQM S4ULs*
Dichlorvos	*mg/kg*	*0.032*	*0.066*	*0.14*	-			*LQM S4ULs*
Atrazine	*mg/kg*	*3.3*	*7.6*	*17.4*	-			*LQM S4ULs*
Dieldrin	*mg/kg*	*0.97*	*2*	*3.5*	-			*LQM S4ULs*
Aldrin	*mg/kg*	*5.7*	*6.6*	*7.1*	-			*LQM S4ULs*
HMX	*mg/kg*	*5.7*	*13*	*26*	-			*LQM S4ULs*
2,4,6-Trinitrotoulene	*mg/kg*	*1.6*	*3.7*	*8.1*	-			*LQM S4ULs*
RDX	*mg/kg*	*120*	*250*	*540*	-			*LQM S4ULs*

[sol] S4UL exceeds the solubility saturation limit (which is presented in brackets)

[vap] S4ULS presented exceeds the vapour saturation limit, which is presented in brackets

[f] For naphthalene, the S4UL is based on a comparison of inhalation exposure with the TDI_{inhal} for localised affects

[f] S4UL based on comparison of inhalation exposure with inhalation TDI for localised effects

[dir] S4ULs based on a threshold protecive direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustation only

APPENDIX 5 - Limitations

Limitations

This report (Report) forms part of the Services and if applicable Additional Services undertaken by Groundtech Consulting Ltd pursuant to a written contract (Agreement) which contains detailed provisions including express limitations of the liability of Groundtech Consulting Ltd.

This Report was prepared using reasonable skill and care as stated in the Agreement for the purpose including intended end use stated by the Client (Purpose) and the liability of Groundtech Consulting Ltd in respect of the form and content of this Report is no greater than its liability under the Agreement. All records, measurements notes, or any other data (Data) obtained by or for the benefit of the Consultant were obtained at a specific point in time and it may not be assumed by the Client or any person relying on this Report that the Data will remain unaffected by the passage of time, the seasons, weather conditions, changes in the water table or the carrying out and completion of works at the Site.

Unless otherwise agreed this Report has been prepared exclusively for the use and reliance of the Client and may not be relied upon, by any other party except as provided for in the Agreement. A third party who relies on this Report, does so at their own and sole risk and Groundtech Consulting Ltd has no liability to such parties.

Groundtech Consulting Ltd that this Report is to be used for the Purpose. The Purpose was instrumental in determining the scope and of the Services provided. If the Purpose should change, the Client may not be able to rely on the Report without the separate agreement of Groundtech Consulting Ltd.

Since the Report was written, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change (see below) and should be investigated if there is any significant delay in acting on the findings of this Report. The period 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 in this Report should not be relied upon in the future without written confirmation from Groundtech Consulting Ltd that it is safe to do so.

The observations and conclusions outlined in this Report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting Ltd.

Groundtech Consulting Ltd is not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The Report is based upon Groundtech Consulting Ltd's observations of existing physical conditions at the Site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the Client on the history and usage of the Site. The findings and recommendations contained in this Report are based in part upon information provided by third parties, and Groundtech Consulting Ltd have relied upon such information assuming it to be correct.

Groundtech Consulting Ltd accepts no responsibility for errors or inaccuracies in third party information presented in this Report. Groundtech Consulting Ltd was not authorised 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 or Additional Services. Groundtech Consulting Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting Ltd and forms the contract with the client.

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. Ground conditions may also vary due to the ground's heterogeneous properties and because investigation exploratory locations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this Report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. If so stipulated in the Agreement, geo-environmental testing was carried out for a limited number of parameters based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

Any groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and groundwater levels may occur at other times of the year which are higher than were recorded during this investigation.

Any site drawings provided in this Report are preliminary and used to present the general relative locations of features on, and surrounding, the Site.

