soiltechnics

environmental ▪ geotechnical ▪ building fabric

Remediation Strategy

Residential Redevelopment

Barrington Road, Worthing

February 2023



soiltechnics
environmental ▪ geotechnical ▪ building fabric

Industrial Development

Document Title:	Remediation Strategy
Document no.:	STV5959-R01-Rev_A
Date:	February 2023
Client:	Bellway Homes Limited
Issuing office:	Soiltechnics Ltd Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY Tel: 01604 781 877 E-mail: mail@soiltechnics.net

Document history and status

Revision	Date	Description	Author	Checker	Reviewer
A	February 2023	First Issue	CR	KB	MOH

Table of Contents

1 Introduction 2
1.1 Scheme Outline 2
1.2 Site Setting 2
1.3 Brief 2
1.4 Aims and Objectives 3
1.5 Limitations 3
1.6 Options Appraisal 3

2 Site Conditions and Identified Contamination 4
2.1 Sources of information 4
2.2 Ground Conditions Encountered 4
2.3 Groundwater 5
2.4 Contamination Encountered 5
2.5 Underground Tanks and Sub-stations 5
2.6 Adjacent Gas Holder 5
2.7 Ground Gas Conditions Encountered 5
2.8 Sufficiency of Information 5

3 Site Considerations 7
3.1 Unexploded Ordnance 7
3.2 Adjacent Residents 7
3.3 Dust Control Measures 7
3.4 Wastewater Disposal 7
3.5 Soil Resources 8

4 Outline Remediation Strategy 9
4.1 General 9
4.2 Relevant Pollutant Linkages 9
4.3 Outline Remediation strategy 9

5 Discovery Strategy 10
5.1 General 10

6 Asbestos Controls for Construction Workers 11
6.1 General 11

8 Soils and Material Compliance 13
8.1 Material Sourcing 13
8.2 Contractor Pre-delivery Compliance Checks 13
8.3 Contractor Requirements Upon Delivery 13
8.4 Material Suitability Criteria 14
8.5 Unsuitable Materials 14
8.6 Inspection Verification Strategy 14
8.7 Chemical Verification Strategy 14
8.8 Exceptions 15

9 Soft Landscaping Clean Cover 16
9.1 Scope 16
9.2 Clean Cover Design 16
9.3 Additional Design & Suitability Considerations 16

9.4 Contractor Requirements 17
9.5 Verification Strategy 17

10 Verification Report 18
10.1 General Requirements 18
10.2 Client / Contractor Requirements 18
10.3 Report Requirements 18

11 Supplementary Further Works 19
11.1 General 19
11.2 Current Data-Gaps 19
11.3 Scope of Works 19
11.4 Vapour Assessment 21

12 Recommendations 22
12.1 Further Ground Investigation and Watching Brief 22

Appendix A Drawings

Appendix B Contamination Discovery Strategy and Underground Storage Tank Procedure

Drawing Register

Title	Produced by	Date	Reference
Exploratory Hole Location Plan (current layout)	Soiltechnics	February 2021	STS5226-D02
Exploratory Hole Location Plan (proposed layout)	Soiltechnics	January 2021	STV5959-D03-A
Indicative Further Testing Plan	Soiltechnics	January 2023	STV5959-D02-A

List of Tables

Table 2-A: Summary of previous reports 4
Table 2-B: Ground conditions encountered during Soiltechnics investigation 4
Table 4-A: Established relevant pollutant linkages from previous reports. 9
Table 8-A: Verification Sampling Plan 15
Table 10-A: Recommended Further Works (Post demolition, prior to enabling works) 22
Table 10-B: Recommended Further Works (Construction Phase) 22

1 Introduction

1.1 Scheme Outline

1.1.1 We understand the scheme will comprise the demolition of existing commercial buildings (former HM Revenues and Customs) and construction of a residential development comprising a mixture of houses, apartments and a care home. Plans of the existing and proposed site layout are provided within Appendix A. Approximately, this comprises of 139 residential plots, 6 blocks of flats, and a care home.

1.1.2 It is understood that the development is controlled under the Worthing Borough Council planning regime, under the planning application number AWDM/1979/19.

1.1.3 The report is based on the project proposals and information outlined above; should the scheme change then it will be necessary to review the report.

1.2 Site Setting

1.2.1 The site is situated in a predominantly residential area of Goring-by Sea, west Worthing, with access granted off Barrington Road. Essentially, the site comprises a vacant office complex. An area of undeveloped scrubland is present to the southwest, which was previously part of the site boundary but which is to now be developed under a separate planning application.

1.2.2 Historically the site was a brickworks until it was redeveloped for Inland Revenue Offices by c1953. A chimney and tanks were recorded in the centre of the site from 1967-68. The western most buildings were demolished by 2002 to make was for the existing car park.

1.2.3 The site is bound by a railway line to the north, and Barrington Road to the south, beyond which lies residential housing. A commercial building and car park border the site to the east and residential housing and undeveloped land border the site to the west.

1.3 Brief

1.3.1 This report has been prepared following instructions received from our client, Bellway Homes Limited. This report details a Remediation Strategy to support the proposed residential development at the former HM Revenues and Customs, Barrington Road, Worthing, West Sussex.

1.3.2 Compliance with condition 26 of the planning application requires the submission of a Remediation Strategy to deal with the risks associated with contamination of the site in respect of the development. The condition states that the strategy should include:

- A site investigation scheme for further investigations following demolition,
- An options appraisal and remediation strategy based on the findings of risk assessments carried out.
- A verification plan.

1.3.3 The Remediation Strategy will be carried out following the principles of BS10175: 2011+A2:2017 ‘Investigation of potentially contaminated sites – Code of Practice’ and the Environment Agency’s Land Contamination Risk Management guidance.

1.4 Aims and Objectives

1.4.1 The principal aim of this report is to satisfy the brief outlined above and thereby provide information to facilitate the safe development of the project. The objectives of this report are outlined below:

i. Confirm if sufficient information is available to inform the remediation.
ii. Set out a site investigation scheme where further investigation works are required.
iii. State the relevant pollutant linkages which require remediation.
iv. Identify a feasible remediation option to break the pollutant linkages.
v. Set remediation objectives and criteria.
vi. Outline how the remediation will be implemented.
vii. Identify any monitoring and maintenance requirements.
viii. Establish a verification plan.
ix. Recommend any further works.

1.5 Limitations

1.5.1 Soiltechnics disclaims any responsibility to our Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence in accordance with the terms of our contract, taking account of the resources devoted to it by agreement with our Client. This report is confidential to our Client and Soiltechnics accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

1.6 Options Appraisal

1.6.1 In the context of the proposed development and the nature of the relevant pollutant linkages identified, an Options Appraisal is not considered necessary at this stage.

2 Site Conditions and Identified Contamination

2.1 Sources of information

2.1.1 Reference has been made to the following sources of information.

Author	Document Title	Date & Document Reference	Report Context
Ashdown Ground Investigation Limited	Combined Geotechnical and Ground Contamination Risk Assessment	December 2018 R18-13236	Preliminary geoenvironmental risk assessment, an assessment of ground conditions and a geotechnical appraisal
Soiltechnics	Ground Investigation Report	April 2021 STS5226-G01-Rev_A	The objective of this investigation was to undertake supplementary works to address outstanding geotechnical and contamination concerns at the site.

Table 2-1: Summary of previous reports

2.1.2 The recommendations made within this preliminary Remediation Strategy are based on ground investigations completed to date, detailed in the above reports. It is acknowledged that additional works are required as detailed within the Soiltechnics Ground Investigation Report (ref: STS5226-G01-Rev A, dated April 2021).

2.1.3 A reassessment to assess if any additional remediation measures is required upon completion of further works.

2.2 Ground Conditions Encountered

2.2.1 The ground conditions encountered are summarised in the table below.

Strata	Summary	Depth to Base (m)	Groundwater
Topsoil	Slightly gravelly very sandy CLAY (gravels of brick, pottery, and clinker within some parts of the site)	0.10-0.40	None observed
Made Ground	Orangish brown slightly gravelly clay (gravels of flint, brick, concrete, charcoal, clinker, chalk, glass and ash)	0.40-1.80	None observed
River Terrace Deposits	Firm to very stiff slightly gravelly clay and, medium dense to dense sands and gravels within the southern and western parts of the site	5.00-7.00 1.90-2.60	From 5.22
White Chalk Subgroup	Off-white clayey gravels with cobbles (eastern and western parts of the site)	4.40 - 4.80m	As above (saturated)

Table 2-2: Ground conditions encountered during Soiltechnics investigation

2.3 Groundwater

2.3.1 Groundwater was encountered within deep boreholes during the Soiltechnics ground investigation at depths of between 5.22m and 8.50m bgl.

2.4 Contamination Encountered

2.4.1 Both the Ashdown and Soiltechnics reports noted sporadic elevated levels of PAHs and metals within the Made Ground deposits following soil testing. In addition, asbestos fibres were identified in Made Ground local to the existing facilities maintenance compounds although given the variability of the Made Ground, its presence elsewhere could not be discounted.

2.4.2 The risk assessment concluded that while sporadic, due to the sensitivity of the development proposals, contaminant levels could pose an unacceptable level of risk to proposed end users, and therefore requires remediation.

2.5 Underground Tanks and Sub-stations

2.5.1 The site reconnaissance identified an interceptor tank in the south-western corner of the site. Samples from one borehole excavated adjacent to the interceptor did not contain any elevated concentrations of TPH or BTEX. However, the presence below the tank cannot be discounted.

2.5.2 Similarly, a sub-station was noted in the south-east of the site. Although no PCBs were detected in samples taken from a borehole adjacent to the sub-station, localised contamination in this area, particularly below the sub-station, cannot be fully discounted.

2.5.3 Above ground tanks were observed within the facilities maintenance area; however, limited access was available at the time of investigation. There is a risk that further tanks, and potentially underground tanks, may also be present.

2.6 Adjacent Gas Holder

2.6.1 Land to the immediate west of the site is currently disused but historical maps indicate a gas holder was present until around 2010. Excavations undertaken along the western boundary did not identify any associated contamination within the soils although these boreholes were relatively shallow and did not extend into groundwater. Limited groundwater testing more distant to the gas holder did not identify any contamination but further investigations in this area to refine the risk from vapours is recommended.

2.7 Ground Gas Conditions Encountered

2.7.1 No ground gas or radon protection measures are required.

2.8 Sufficiency of Information

2.8.1 Due to the access limitations at the time of the previous investigation, there are a series of data-gaps which require further investigation. These works should be completed post-demolition and prior to the enabling and construction works phases.

2.8.2 It is recommended to conduct the ground investigation works in a single phase, which incorporates the following:

- Additional boreholes within the area of the facilities maintenance area (including beneath tanks) to determine whether any localised contamination is present. Investigations should be deep enough to allow for groundwater samples to be collected for testing.
- Further deep borehole along the western site boundary to allow for groundwater sampling to be undertaken to confirm or otherwise the absence of contamination associated with the adjacent (off site) former gas holder. Shallow boreholes should also be undertaken to allow shallow vapour monitoring along the site boundary.
- A watching brief should also be kept during removal of the interceptor tanks, the maintenance facility and sub-stations with some additional testing undertaken to confirm or otherwise the absence of associated contamination.

2.8.3 As with any site investigation works, the requirement for additional phases of investigation cannot be ruled out. For instance, gross contamination may be identified during planned works which requires delineating and characterising fully within a return visit to site.

2.8.4 Any subsequent contamination identified must be addressed in a supplementary Remediation Strategy

3 Site Considerations

3.1 Unexploded Ordnance

3.1.1 Worthing was subject to a moderate level of bombing during WWII and at least one highly explosive bomb strike was recorded on land to the west of the site. A UXO specialist attended site during intrusive investigations.

3.1.2 It is recommended that a Detailed UXO Risk Assessment Report is obtained for the site to determine the risk for the construction phase. UXO specialist attendance may be required during the construction phase.

3.1.3 All stakeholders must be made aware of the risk and the potential impact on the project, and UXO Safety Induction Training should be provided for all site workers.

3.1.4 A medium risk classification applies to any drilling, sampling, bulk excavations or piling works occurring in post war unworked ground.

3.1.5 For drilling, sampling and bulk excavation works, a UXO safety 'watching brief' should be in place during excavations, provided by a specialist EOD Engineer.

3.1.6 All piling positions should be tested using a specialist 'Mag Cone' and be UXO safety certified prior to the commencement of piling.

3.2 Adjacent Residents

3.2.1 Residential and commercial properties are present adjacent to the east, south and west of the site. Whilst they are not currently considered to be put at an unacceptable risk by the development of the site, dust suppression measures should be maintained throughout all demolition and construction phases.

3.2.2 No significant odours are anticipated to be generated as a result of the works.

3.3 Dust Control Measures

3.3.1 Standard dust control measures should be always maintained across the site, including the dampening down of roadways, materials stockpiles, and any screening or crushing areas.

3.3.2 Stockpiles should be bladed down to reduce infiltration and minimise dust infiltration.

3.3.3 Routine dust monitoring is not considered necessary, except for any crushing activities; however, the Principal Contractor may wish to conduct such monitoring for reassurance and due diligence purposes.

3.4 Wastewater Disposal

3.4.1 Wastewater generated from site operations will require off-site disposal via tankers, or to sewer. Any disposal to sewer must be made under prior consent with the water authority by the operator.

3.4.2 The sewage operator must be consulted prior to mobilisation to obtain a discharge consent, along with establishing any compliance and monitoring targets.

3.5 Soil Resources

3.5.1 Due to extensive hardstanding present across the current site and the requirement to raise development levels, there is considered to be limited soils present which would be suitable as a growing medium in proposed soft landscaping. Therefore, suitable growing mediums will require importing to support the landscaping scheme.

3.5.2 A Materials Management Plan is anticipated to be undertaken to facilitate the transfer of suitable soils from off-site developments.

4 Outline Remediation Strategy

4.1 General

4.1.1 This Remediation Strategy only considers the process of remedial action in terms of addressing contamination recognised to date.

4.1.2 If, following the recommended further ground investigation or during development, contamination not previously identified is found to be present, then further assessment and a supplementary strategy will be required.

4.1.3 Sampling and laboratory analysis associated with the recommended remediation will be undertaken following nationally recognised guidelines and standards that are appropriate at the point of investigation.

4.1.4 Laboratory analysis must be commissioned with testing houses that are suitably experienced and are MCERTS accredited with a quality assurance system.

4.2 Relevant Pollutant Linkages

4.2.1 The relevant pollutant linkages identified within the previous Ground Investigation Report are as follows:

Source	Pathway	Receptor
Asbestos fibres within the Made Ground	Disturbance and inhalation of dusts	Construction workers during demolition /development End users
Elevated metals and PAHs within the Made Ground.	Dermal contact, inhalation and ingestion of soils and dusts.	Construction workers during demolition /development End users

Table 4-1: Established relevant pollutant linkages from previous reports.

4.3 Outline Remediation strategy

4.3.1 The remediation strategy has been determined in view of the previous ground investigation report findings and the proposed development scheme. It can be summarised as follows:

i. Prepare a discovery strategy in the event of encountering unexpected or previously unencountered contamination.

ii. Installation of barrier pipe for underground drinking water infrastructure where they are in contact with the Made Ground.

iii. Importing of soils for use as fill and in the proposed soft landscaped areas.

iv. Install a cover system in proposed soft landscaped areas to prevent end user exposure to identified contamination.

v. Provide a scope of works for further investigation

5 Discovery Strategy

5.1 General

5.1.1 With the development of any site, there is a residual risk of contamination being found that is unexpected or has not been previously encountered.

5.1.2 As a precaution, the Principal Contractor should adopt the contamination Discovery Strategy, contained within Appendix B, for dealing with unexpected contamination.

5.1.3 Accompanying the Discovery Strategy is a procedure to follow in the event of encountering any underground storage tanks.

6 Asbestos Controls for Construction Workers

6.1 General

6.1.1 Further works are required to refine the risks posed by asbestos in soils to construction workers.

6.1.2 The risks posed to human health during the construction phase and any associated mitigation measures required must be detailed within follow-up report (see Section 11), prior to commencement. The report must be submitted to the Local Authority for approval.

7 Drinking Water Infrastructure

7.1 General

7.1.1 Protective barrier pipe is recommended for all new below-ground water supply pipes (Protectaline or similar) where in contact with Made Ground.

7.1.2 Where existing water pipes are to remain in use, these should be upgraded to ensure the same level of protection is in place across the site.

7.1.3 The local water authority (Southern Water) should be consulted to inform them of the risk assessment, and to obtain their approval.

7.2 Verification Strategy

7.2.1 This is to be validated by the Contractor through the provision of delivery tickets showing protective barrier pipe has been delivered to site and by providing photographs showing the subsequent installation.

7.2.2 Southern Water should also be consulted to determine any further verification requirements.

8 Soils and Material Compliance

8.1 Material Sourcing

8.1.1 A clean cover system is required within the development and limited suitable soils are present on site. Therefore, soils will require importing to support the proposed landscaping scheme.

8.1.2 It is understood that as part of the development site levels are to be raised by approximately 1m. Therefore, fill materials are expected to be imported to site facilitate construction.

8.1.3 Site-won natural and Made Ground materials are also likely to be utilised as general fill. However, they are considered unsuitable for use as a growing medium within soft landscaping areas and require capping.

8.2 Contractor Pre-delivery Compliance Checks

8.2.1 The Contactor should confirm the origin of all imported materials and request available chemical testing results from suppliers prior to delivery, to provide confidence of suitability.

8.3 Contractor Requirements Upon Delivery

8.3.1 The source and volume of all imported fill and soil materials used in the development must be clearly documented, with records provided for inclusion in the Verification Report.

8.3.2 The contractor should take and provide a series of site photographs to evidence the laying of clean soils on site.

8.3.3 For all imported materials, the Principal Contractor should maintain records sufficient to evidence the following:

- The supplier
- Material source (address)
- Material origin (e.g. virgin material, recycled, manufactured)
- Material type (e.g. topsoil, subsoil, recycled aggregate, 6F2, etc.)
- The overall volume of each material type imported.
- Delivery dates.
- The overall volume of each material type imported, as part of each batch.
- Inspection records of the materials to confirm the physical, visual, and olfactory suitability of the material, at the following frequencies:
  - **Clean cover soils:** An inspection of every other delivery of landscaping soil (1 in 2).
  - **Fill materials:** An inspection of each “batch” of fill materials.

8.3.4 A ‘batch’, in the context used above can comprise of multiple deliveries from the same source, delivered over consecutive days for a period of no more than one working week.

8.4 Material Suitability Criteria

8.4.1 All imported soils and fill material should be inspected and tested to confirm they are chemically and physically suitable for use, in terms of the risks to human health.

8.4.2 The physical composition of materials must be free of harmful and injurious artefacts (such as sharps), over-sized materials (such as cobbles and boulders) and show no visual or olfactory evidence of contamination.

8.4.3 Materials should also be chemically suitable, with concentrations of contaminants falling within widely recognised and published soil guideline values (such as the C4SLs and S4ULs), with the following model being applied.

- Residential with plant uptake, at 2.5% SOM.

8.4.4 No bulk ACM materials should be present. Asbestos fibres, if present, should be quantified and be found at concentrations of less than 0.001%.

8.5 Unsuitable Materials

8.5.1 If an inspection of a materials proves or suspects it to be unsuitable, the load should be quarantined on site, pending collection or off-site disposal. The Consultant should be notified, and a record made for inclusion into the Verification Report.

8.5.2 Alternatively, the Consultant should undertake an investigation and risk assessment to delineate the areas of impacted soils and/or to identify a possible alternative use for the materials.

8.6 Inspection Verification Strategy

8.6.1 Site visits by a geoenvironmental consultant are required during the placement of fill materials to inspect and photograph the works being undertaken.

8.6.2 The visual inspection strategy for the clean cover system is outlined in the following report section.

8.7 Chemical Verification Strategy

8.7.1 All verification sampling must be undertaken by the Consultant. In addition, an inspection of the soils at the time of sampling must confirm the physical, visual, and olfactory suitability of the material. The following table summarises the sampling and chemical verification requirements.

8.7.2 Where the material is sourced from a brownfield, remediated, or unknown source, the testing frequency should increase to 1 sample per 50m^3 and include TPH CWG analysis.

8.7.3 A ‘batch’, can comprise of multiple deliveries from the same source, delivered over consecutive days for a period of no more than one working week.

Material Type	Sampling Frequency	Sampling Timing	Testing Schedule
Topsoil and Subsoils	1 per 100m^3, Minimum of 3 per batch Minimum of 3 per type	After placement. Reassurance sampling prior to placement is recommended.	Metals Suite, Cyanide (free and complex) Asbestos screen, PAHs (USEPA 16) Banded TPH
Fill Soil Materials	1 per 250m3, Minimum of 3 per batch Minimum of 3 per type	Before, during or after placement	
Recycled Aggregate	1 per 500m3, Minimum of 2 per batch		
Virgin Quarried Materials	2 per source	Before, during or after placement	Metals Suite, Asbestos screen

Table 8-1: Verification Sampling Plan

8.7.4 A metals suite must include arsenic, beryllium, boron, cadmium, chromium (total and VI), copper, lead, mercury, nickel, selenium, and zinc.

8.8 Exceptions

8.8.1 Where the Made Ground is removed entirely from the areas of soft landscaping, this removes the source of contamination and therefore negates the need for a clean cover system in that area. However, all imported soil materials for use within soft landscaping areas will still require the same level of physical, visual, and chemical verification to demonstrate suitability.

8.8.2 Where bulk removal of the Made Ground occurs, a site visit must be completed by a geo-environmental consultant to inspect the reduced-dig excavation and exposed natural soils.

9 Soft Landscaping Clean Cover

9.1 Scope

9.1.1 Where present, the provision of hardstanding areas will negate the requirement for a clean cover system, and no action is considered necessary.

9.1.2 In proposed landscaped areas, a cover system of 'clean' suitable soils should be placed to sever the pathway between contaminants in the Made Ground and end-users, thus breaking the pollutant linkage and reducing the risk to acceptable levels.

9.1.3 All soils used within the clean cover system should be inspected and tested to confirm they are chemically and physically suitable for use, in terms of the risk to human health.

9.1.4 Limited soils, as a suitable growing medium, are present on site. Therefore, soils will require importing to support the proposed landscaping scheme.

9.2 Clean Cover Design

9.2.1 For this development, soft landscaping areas comprise private garden areas, and managed areas of public open space (POS) within the park, care home and apartment blocks, and parcels of road-side public open space. Hand-excavations and planting is anticipated in garden areas; whereas following development the maintenance of public open space areas will largely be limited to superficial works on grassed areas and hedgerows. Excavations in such areas would be minimal and of very short duration.

9.2.2 The following overall depth requirements can therefore be applied:

- Private garden areas: 600mm minimum cover
- Planted areas of public open space: 600mm minimum cover
- Grassed lawn areas of public open space: 300mm minimum cover

9.2.3 The cover system should comprise of topsoil between 150mm and 300mm thick, with the remainder of the cover comprising of loosened subsoil.

9.2.4 It should be noted that in large areas of the site, substantial fill materials will be placed below the cover system to raise site levels. Where such materials are a suitable growing medium and have been proven to be chemically and physically suitable, they can be considered as part of the 'subsoil' component and count towards the minimum depth requirement.

9.3 Additional Design & Suitability Considerations

9.3.1 BS 3882:2015 states that at least 450mm of suitable soil is required to provide a sufficient rooting depth for grass. This increases to a minimum depth of 600mm for shrubs, and 900mm for the planting of trees.

9.3.2 The suitability of soils as a growing medium (irrespective of the risk to human health) could be evidenced through sampling and analysis in accordance with BS:3882 (2015).

9.3.3 Whilst desirable, these recommendations do not form part of the remedial strategy and have been included for reference. Site specific advice should be sought from the landscape designer regarding the suitability of soils as growing mediums and any requirements for deepening the cover system to accommodate the planting scheme.

9.4 Contractor Requirements

9.4.1 In addition to the requirements outlined in the Soils and Material Compliance report section, the contractor must provide photographic evidence demonstrating the laying of the clean cover system.

9.5 Verification Strategy

9.5.1 The verification of the chemical and physical suitability of soils is outlined within Soils and Material Compliance report section.

9.5.2 Upon completion of the cover system, a site visit will be required by the Consultant to undertake a series of hand pits to visually inspect, document, photograph, and sample the soils to verify adherence to this Remediation Strategy.

9.5.3 Based upon the development proposals, the following number of inspection pits are required. Each pit much penetrate the full depth of the cover system.

- Private gardens (~139 plots): 1 pit every 5 plots. Total of 28 pits.
- Park and general POS: 3 pits in total.
- Care home POS: 2 pits in total
- Flat blocks (6 No. blocks): 3 pits in total
- Total pits within scheme: 36

9.5.4 The hand pits should demonstrate an adequate thickness of cover, confirm physical suitability, and obtain samples so the chemical suitability can be confirmed through laboratory analysis.

9.5.5 Verification must be completed by a competent geoenvironmental consultant, with a record of each visit made for inclusion in the Verification Report.

10 Verification Report

10.1 General Requirements

10.1.1 The verification requirements discussed above should be compiled into a Verification Report, which is to be produced on completion of the remedial works.

10.1.2 As part of the Verification Report, any imported materials should be clearly documented, including source certificates, delivery notes, and site plans. The results and frequency of verification testing undertaken should also be documented, along with confirmation of the materials suitability for use.

10.1.3 Records of the on-site inspections must be included within the Verification Report, and include a hole location plan, logs of the excavation and photographic record as a minimum.

10.2 Client / Contractor Requirements

10.2.1 Supporting information will be required from the client and their contractors. This includes the following:

- Appropriate site plans confirming location of remediated areas.
- Photographic evidence of the clean cover system installation.
- Photographic evidence of the drinking water 'barrier pipe' installation.
- Signed delivery tickets, or an alternative reference system to track imported loads, including a statement on the type and volume of materials imported.
- All waste transfer documentation, including a statement on the type and volume of materials taken off-site.
- Details on any unexpected ground conditions encountered and contingency arrangements that had to be implemented.

10.3 Report Requirements

10.3.1 The Validation Report will include the following, where appropriate:

- A summary of remedial requirements.
- A summary of any supplementary risk assessments.
- A concise summary of material types, sources and volumes imported.
- Lines of evidence to demonstrate compliant and effective material management, including confirmation of source, volumes and suitability of all site-won and imported materials, delivery notes, waste transfer and consignment notes and chemical testing records.
- Details demonstrating the chemical and physical suitability of the capping materials.
- Details of any unexpected or unencountered materials encountered, along with further investigative and remedial action undertaken.
- Statements confirming if the remedial objectives have been met, and if the site is suitable for its proposed use.

11 Supplementary Further Works

11.1 General

11.1.1 A supplementary phase of investigation works is recommended to improve our understanding of ground conditions at the site and to refine our understanding of the potential risks posed by asbestos, hydrocarbons, vapours, and other potential contaminants.

11.1.2 So access for the investigation is not restricted, it is recommended to undertake the ground investigation post demolition, and prior to construction.

11.2 Current Data-Gaps

11.2.1 The facilities maintenance area was inaccessible during previous ground investigation works. Intrusive ground investigation works will be required in this area to characterise the Made Ground and underlying soils, both in terms of the human health risk and controlled waters risk. It is noted that previous works immediately around this area did identify elevated concentrations of lead and asbestos fibres within the Made Ground, and it is considered possible they are associated with this area. Various tanks and a chimney are also present in this area and are considered potential sources of contamination.

11.2.2 The site reconnaissance identified an interceptor tank in the south-western corner of the site and a sub-station in the south-east. Contamination below these features and associated with any pipework cannot be discounted.

11.2.3 Land to the immediate west of the site is currently disused but historical maps indicate a gas holder was present until around 2010. Although no soil contamination has been identified, none of the boreholes undertaken in close proximity to the western site boundary reached groundwater and therefore the risk from vapours requires further assessment.

11.3 Scope of Works

11.3.1 To address the data-gaps outlined above, it is recommended to undertake exploratory boreholes along the western boundary and within the facilities maintenance area to depths of between 2-10m bgl. A watching brief is also required during removal of the interceptor tank and the sub-station (if this is to be removed), along with undertaking verification sampling and testing. This should comprise a full-time presence during removal of any tank or interceptor, to help verify the works and aid in identifying areas of contamination. Further details on the verification of tank removal is presented in Appendix B.

11.3.2 An indicative proposed exploratory hole plan is provided in Appendix A.

11.3.3 The borehole locations, sampling regime and installation designs are provided in the table overleaf. The investigation strategy is indicative only and may be subject to change based upon visual observations of the ground conditions and any contamination encountered during the works.

11.3.4 The target depth of all holes varies; however, it is acknowledged that the presence of River Terrace Deposits may limit progression.

Location	Specific Objective	Target depth/installation response zone	In-situ Testing Regime	Sampling Regime
BH301	Vapours from contamination arising from former off-site gas holder	10m 1m – 6m installation	PID screening on soil samples	0.5m intervals throughout the Made Ground, commencing at ~ 0.25m depth. At 1m intervals within the natural soils
WLS301-303		2m No installations	PID screening on soil samples	
WLS304	Targeting unexplored areas (facilities maintenance area)	3m – 4m No installations	PID screening on soil samples	0.5m intervals throughout the Made Ground, commencing at ~ 0.25m depth. Sampling of natural soils only undertaken where visual/olfactory evidence of hydrocarbon contamination is notes.
WLS3.5-WS306		1m – 3m No installations	PID screening on soil samples	
BH302		10m 1m – 6m installation	PID screening on soil samples	
SP01-SP04	Samples for verification testing following removal of interceptor/sub-station if required.	Various	None	

Table 3: Proposed Investigation Scope and Rationale

11.3.5 Groundwater analysis will be undertaken on samples taken from the two deep boreholes and will comprise:

- 2 No. general contamination suites (metals, PAHs, TPH CWG, SVOCs, VOCs)

11.3.6 Soil testing will be undertaken within the shallow boreholes in the facilities maintenance area.

11.3.7 Soil analysis should include the following:

- 5 No. asbestos screens
  [within the facilities maintenance area]
- Quantification of asbestos
  [In any and every sample identified as asbestos containing]
- 3 No. general contamination suites (metals, PAHs, TPH CWG, SVOCs, VOCs)
  [Within the facilities maintenance area]

11.3.8 The results of the fieldworks will be presented in a standalone report, which must include appropriate contaminated land risk assessments to address the data-gaps highlighted within this report. Further phases of investigation may be required if significant uncertainty remains.

11.3.9 Following satisfactory completion of the risk assessment report, this Remediation Strategy must be updated to incorporate the findings and any recommendations made. Both reports must be submitted to the Local Authority for approval.

11.4 Vapour Assessment

11.4.1 The following triggers have been set to aid in the assessment of the risk from vapour intrusion.

- Detection of volatiles in excess of 100ppm on a PID soil screen on soils.
- 'Strong' hydrocarbon odours in any materials
- Oil saturated or heavily stained soils in veins or zones in any materials, primarily comprising of hydrocarbons with a carbon banding <EC16.

11.4.2 Should vapour trigger levels be exceeded, one of the following actions must be undertaken, as appropriate:

i. Vapour protection measures incorporated into proposed houses within the contaminated area as a precaution; or,

ii. Submission of a robust risk assessment to the Local Authority which updates the CSM and incorporates all other site data to de-risk the vapour intrusion contaminant linkage;

iii. Where significant uncertainty still remains, the submission of an additional proposed scheme of works to the Local Authority for the undertaking of a further supplementary phase of investigation. For instance, to delineate and characterise a hydrocarbon plume encountered, or to obtain site specific parameters to inform a Detailed Quantitative Risk Assessment and vapour intrusion model.

12 Recommendations

12.1 Further Ground Investigation and Watching Brief

12.1.1 The following table summarises the additional works which should be undertaken post demolition, and prior to the enabling works and construction of the site.

Aspect	Delivered By	Description
Supplementary Investigation Works	Soiltechnics	A supplementary phase of ground investigation works to be undertaken following demolition of the site, as detailed in Section 11. A supplementary Remediation Strategy is anticipated to be required as part of these works.
Consultation on Protective Barrier Pipe	Principal Contractor / Developer	Liaison with Southern Water to confirm the use of barrier pipe and determine any additional verification requirements.
UXO Detailed Risk Assessment	Specialist	The Preliminary Risk Assessment identified that bombing occurred in the vicinity of the site and the site is at Medium Risk. A Detailed UXO Risk Assessment should be undertaken in accordance with CIRIA C785.
UXO Pile Testing	Specialist	Mag Cone testing of all pile locations prior to commencement. Unless a Detailed Risk Assessment is produced down-grading the preliminary UXO risk.
Piling Risk Assessment	Soiltechnics	At the request of the Environment Agency: Piling and the use of penetrative construction methods shall not be carried out unless a full piling risk assessment and method statement, including consideration of contaminants, groundwater and aquifers and methods to minimise risk of contamination, has been submitted to and approved in writing by the Local Authority.
Material Management Plan	Soiltechnics	To facilitate the sustainable use of soils in the development, an MMP is recommended to control the import of soil fill materials from other development sites and for the reuse of Made Ground on site. Verification Works

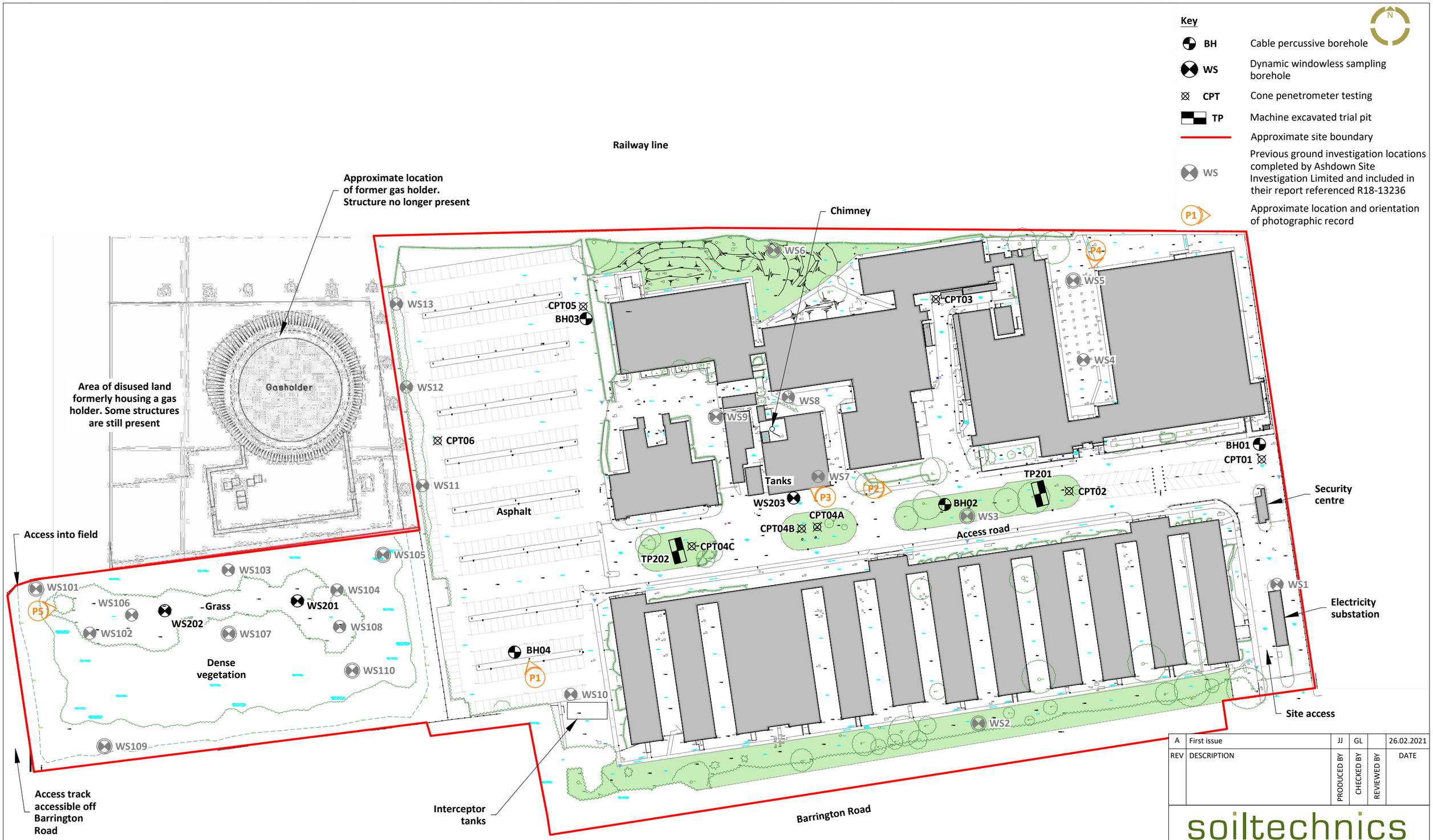
Table 12-1: Recommended Further Works (Post demolition, prior to enabling works)

12.1.2 The following table summarises the additional works which should be undertaken during the main enabling and construction works phase, and prior to occupation of the site.

Aspect	Delivered By	Description
UXO Risk	Specialist	Provision of UXO Safety Induction Training for all site workers. EOD supervision during all bulk excavations and drilling works. Unless a Detailed UXO Risk Assessment states otherwise.
Installation of barrier pipe	Principal Contractor	Provide delivery certificates and photographic evidence demonstrating installation of drinking water barrier pipes, along with any other verification works as stated by Southern Water.
Verification of imported soils and fill materials and material management	Soiltechnics	Chemical and physical verification of all imported soft landscaping soils and fill materials. Verification of material management in accordance with the MMP.
Verification of the clean cover system	Soiltechnics	Chemical and physical verification of the installed clean cover system.
Verification Report	Soiltechnics	Undertaking a report to draw all necessary lines of evidence together, to demonstrate the effective remediation of the site.

Table 12-2: Recommended Further Works (Construction Phase)

Appendix A Drawings



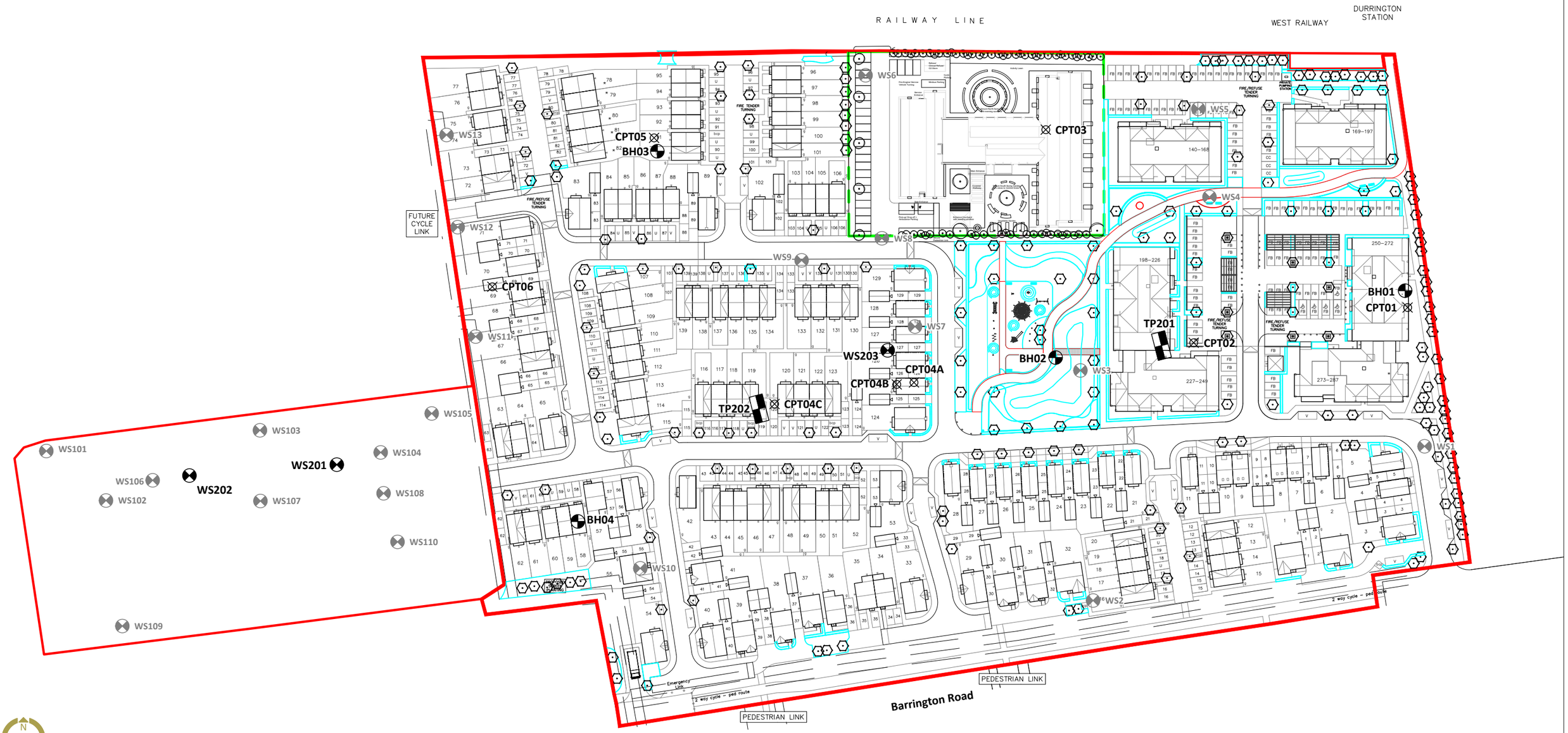
REV	DESCRIPTION	PRODUCED BY	CHECKED BY	REVIEWED BY	DATE
A	First issue	JJ	GL		26.02.2021

soiltechnics
environmental ▪ geotechnical ▪ building fabric

PROJECT
Barrington Road, Worthing

TITLE
Exploratory hole plan (current layout)

PROJECT NO.	SCALE AT A3	DRAWING NO.
STS5226	1:1250	02



N

Key

BH	Cable percussive borehole
WS	Dynamic windowless sampling borehole
CPT	Cone penetrometer testing
TP	Machine excavated trial pit
WS	Previous ground investigation locations completed by Ashdown Site Investigation Limited and included in their report referenced R18-13236
	Approximate site boundary

REV	DESCRIPTION	PREP	DATE
A	First issue	AM	13.02.2023

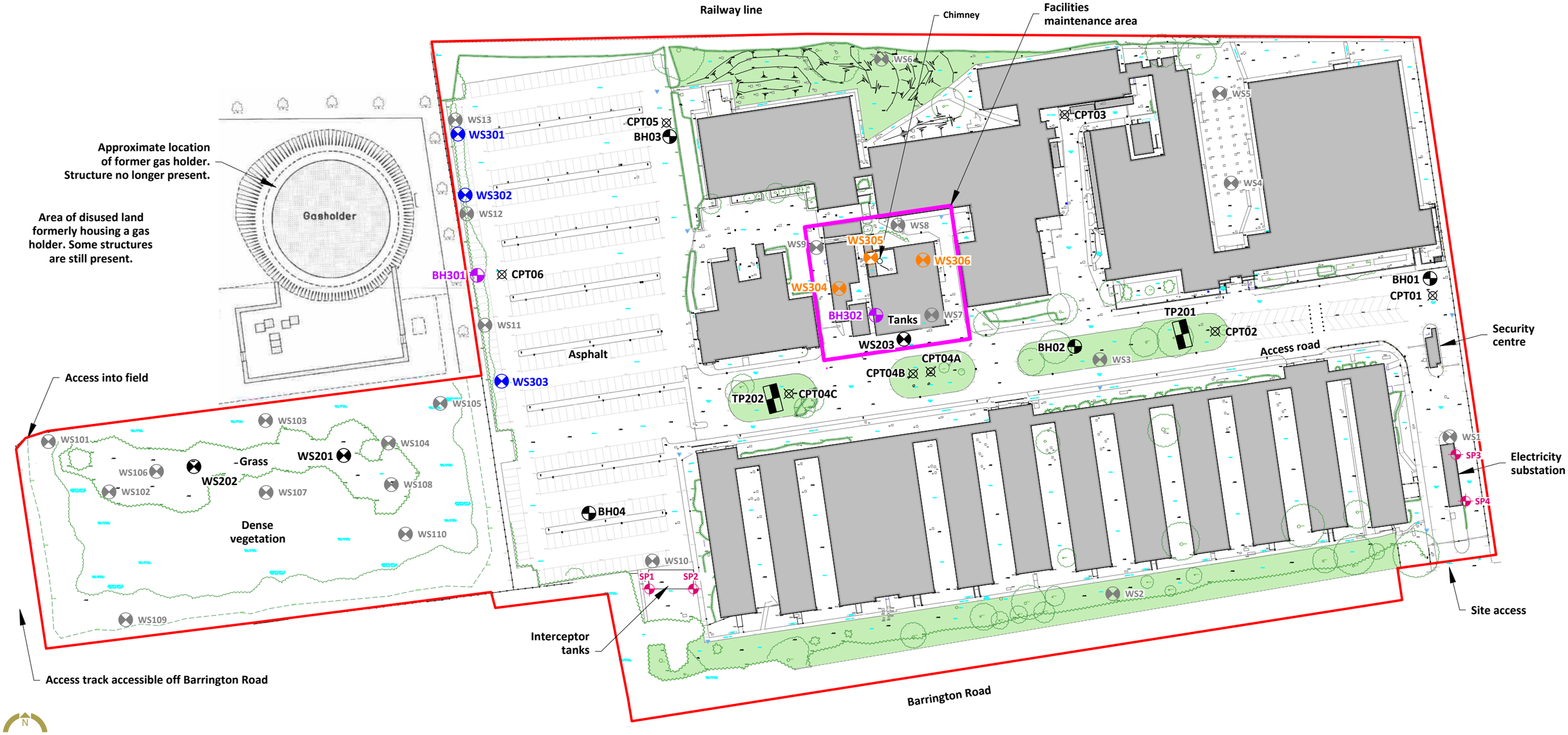
soiltechnics
environmental ▪ geotechnical ▪ building fabric

PROJECT
Barrington Road, Worthing

TITLE
Exploratory hole plan (proposed layout)

DRAWING NO.
STV5959-D03-A

SCALE AT A3
1:1250



Key

BH	Cable percussive borehole
WS	Dynamic windowless sampling borehole
CPT	Cone penetrometer testing
TP	Machine excavated trial pit
WS	Previous ground investigation locations completed by Ashdown Site Investigation Limited and included in their report referenced R18-13236
	Approximate site boundary
BH	Proposed deep borehole to assess groundwater
WS	Proposed shallow borehole for vapour monitoring
WS	Proposed shallow borehole to determine presence of shallow soil contamination
SP1	Proposed sampling position

REV	DESCRIPTION	PREP	DATE
A	First issue	AM	13.02.2023

soiltechnics
environmental ▪ geotechnical ▪ building fabric

PROJECT
Barrington Road, Worthing

TITLE
Further testing plan (current layout)

DRAWING NO.
STV5959-D02-A

SCALE AT A3
1:1250

Appendix B Contamination Discovery Strategy and Underground Storage Tank Procedure

Contamination Discovery Strategy: Procedure

1 General

1.1 With the development of any site, there is a residual risk of contamination being found that is unexpected or has not previously been identified.

1.2 As a precaution, the Principal Contractor should adopt this Contamination Discovery Strategy for dealing with unexpected contamination.

1.3 The Principal Contractor should also ensure it is distributed and communicated appropriately to all relevant ground workers.

2 Step 1: Halting Works

2.1 Should any previously unidentified contamination be encountered, works should be made safe then temporarily halted in the affected area and Soiltechnics (The Consultant) informed within 24hrs.

2.2 If, due to site constraints, the contaminated materials need to be excavated prior to being assessed, the Contactor should segregate the material as best as is reasonably practicable, based upon visual and olfactory observations. The contaminated materials should then be stockpiled on an impermeable surface and covered with impermeable sheeting.

3 Step 2: Initial Assessment

3.1 The Consultant must liaise with the contractor and undertake an initial assessment within 48 hours of notification to determine if the event represents "*potentially significant unexpected contamination*".

3.2 Where the initial assessment does not consider the contamination to be potentially significant and unexpected, works can recommence.

4 Step 3: Contamination Assessment and Remedial Strategy

4.1 Where *potentially significant unexpected contamination* is confirmed, the Consultant must produce a standalone report which includes a description and risk assessment of the contamination.

4.2 A phase of intrusive investigation works may be required to inform the risk assessment.

4.3 Where remediation is required, the report must also include a remedial and verification strategy.

4.4 The report must also make it clear whether remediation, and the subsequent submission and approval of an event-specific Verification Report to the Local Authority is required prior to recommencement.

4.5 Within 24 hours of completion, the report must be provided to the Local Authority for their approval, and a copy held for appending to the project Verification Report.

5 Step 4: Recommencement and Implementation

5.1 Works can only recommence upon specific instruction from the Consultant and once the event-specific Remediation Strategy has been submitted to, and approved in writing by, the Local Authority.

5.2 All remedial works must be implemented and verified in full. The event-specific Verification Report (if required) must be submitted to the Local Authority for approval.

Contamination Discovery Strategy: Contractor Site Guide

Discovery Event

- Previously unidentified contamination is encountered.
- This inculdes encountering underground storage tanks (UST).

Halt Works in Area

- Make the area safe.
- Halt works in the affected area.
- Stockpile any contaminated arisings on an impermeable surface and cover with impermeable sheeting.
- Works to recommence only upon instruction from the Consultant (Soiltechnics Ltd).

Inform the Consultant

- Contact Soiltechnics (the Consultant) within 24 hours.
- Tel: 01604 781 877
- E-mail: enquiries@soiltechnics.net

Assessment

- An initial assessment must be carried out by Soiltechnics to determine the appropraite course of action.
- A detailed assessment and a sampling exercise may be required.
- If remediation is necessary, the Local Authority will need to approve a Remediaion Strategy prior to recommencement.

Remediation

- All remedial works must be implemented and verified in full, in accordance with the Remediation Strategy.
- Once remedial works are complete, the event-specific Verification Report must be submitted to the Local Authority.

Encountering & Decommissioning of Underground Storage Tanks

1 General

1.1 The following expands on the general procedures outlined within the Contamination Discovery Strategy to provide a detailed process that must be followed in the event of encountering an underground storage tank (UST).

1.2 Any UST encountered and associated pipework shall be decommissioned and removed from site following the current guidance within the APEA document "Design, Construction, Modification, Maintenance And Decommissioning Of Petrol Filling Stations", April 2015.

1.3 The purpose of this report is to provide a Remediation Strategy for the site contractors and Consultant to work to in the event of encountering underground storage tanks.

2 Step 1: Halting Works

2.1 Should any USTs be encountered, works should be made safe then temporarily halted. A tank decommissioning specialist and Soiltechnics (The Consultant) should be informed within 24hrs. Efforts should be made, under the guidance of the specialist, to inspect and confirm the contents of the tank and identify any special precautions which may be required.

3 Step 2: Bottoming

3.1 Before the removal of a UST, all residual fuel/oil should be removed from the tank, so far as is reasonably practicable. This is referred to as 'bottoming' and should be carried out by a specialist contractor.

3.2 Where present, pipework carrying fuel should be drained back to the tank before bottoming takes place.

4 Step 3: Inerting

4.1 Due to the potential for explosive atmospheres to be present, any tanks containing flammable substances, such as petrol or solvents, should be 'inerted' prior to excavation. Where tanks contain substances with a low flashpoint, inerting is not required.

4.2 Inerting operations can include filling with gases or cleaning and de-gassing followed by carrying out oxygen testing, or the filling of the tank with water or foam.

4.3 The operation should be carried out by a specialist and a certificate provided ensuring the tank is safe to remove.

5 Step 4: Pipework Removal

5.1 All pipework connected to the tank should, as far as is reasonably practicable, be removed.

5.2 The removal of pipework should not be carried out until it has been drained and isolated from fuel sources.

5.3 Residual fuels may be present in pipework and a precautionary measure of flushing with water should precede the removal and dismantling work.

5.4 Care should be taken to ensure that no fuel or contaminated water is allowed to enter any drainage system, watercourse or the ground. Water used to flush out the pipework should be collected for safe disposal. It may be possible, with appropriate approval, to discharge this water through the on-site oil/water separator.

6 Step 5: Tank Lifting and Excavation Works

6.1 Prior to lifting a tank from an excavation, a risk assessment should be prepared by the specialist contractor responsible for the works.

6.2 During the excavation and removal of a UST it should be assumed that contaminated soils are likely to be encountered in the area immediately surrounding the underground tank and pipework. Excavations should continue until all grossly contaminated soils have been removed. The sides and the base of the excavation must then be sampled by a Geoenvironmental consultant to verify the satisfactory removal of contaminated soils.

7 Step 6: Dismantling and Disposal

7.1 Uplifted redundant tanks may be broken up on-site prior to disposal, providing such works can be undertaken without endangering workers of the environment.

7.2 To minimise the risk of fire or explosion only cold cutting techniques should be used.

8 Watching Brief and 3rd Party Verification

8.1 A Geoenvironmental Consultant should be present during all UST tank removals to undertake verification sampling of the excavation prior backfilling and to aid in the identification and segregation of grossly contaminated soils for off-site removal.

8.2 The overall frequency of verification sampling will be dependent upon the scale of the excavations and extent of contamination.

8.3 As a minimum, sampling must comprise one sample from each pit side and two samples from the base (6 No.). Additional side-wall and base samples will be required for every 10 linear metres of excavation.

8.4 For fuel oils, the testing scope will comprise of a speciated TPH CWG, PAH and BTEX suite per sample. Tanks storing solvent shall be subject to a TPHCWG, SVOC & VOC testing suite.

8.5 Any remaining soils or imported backfill materials must meet published UK-specific generic assessment criteria produced under the ‘commercial/industrial’ scenario. Such as C4SLs, S4ULs, SGVs, and ATRISKsoil SSVs.

8.6 All tank removal and remedial works undertaken must be documented and submitted to the Local Authority within a Verification Report

9 Contractor Records

9.1 The contractor should maintain all records associated with the decommissioning and removal of fuel/oil tanks, and provide them to the geo-environmental consultant for inclusion into the Verification Report. As a minimum, the records should include:

i) A plan showing the location of the tank(s) encountered and removed.

ii) The approximate volume, contents and state of each tank upon inspection.

iii) Who undertook the specialist decommissioning works.

iv) Records confirming the bottoming out and inerting of tanks has taken place, along with the provision of any disposal records for the oil and contaminated water.

v) Off-site disposal records for the tank carcass and grossly contaminated soils .