

IGE

consulting

Pilch Lane, Liverpool

Remedial Strategy Report and Earthworks Strategy

For: Breck Homes Ltd



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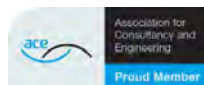
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1.0 INTRODUCTION

This Remedial Strategy Report has been prepared at the request of Breck Homes Ltd. Instructions to proceed with this report were received in February 2026. This report primarily follows the findings and recommendations of the IGE Consulting *Phase 2 Geo-Environmental Investigation Report* (Ref. 4399-02, Rev A, February 2026).

This report pertains to a c. 0.70 Ha site located to the south of Pilch Lane, Liverpool, c. 7.00km east of Liverpool City Centre, at the approximate post code L14 0JG. The National Ordnance Survey Grid Reference for the centre of the site is 341850E, 391139N.

The site currently comprises a vacant plot of land which is predominantly grassed with the exception of an area of hardstanding in the northern site section. The site is bound by Pilch Lane to the north, St Margaret Mary's Church to the west, open land to the south and residential properties to the east. Access to the site is off Pilch Lane along the northern site boundary. A drone image of the site is included below, and a site location plan is contained in Appendix 2.



Figure 1: Drone image of the site dated August 2025, taken from the south, looking north. The site boundary is highlighted in pink.

1.1 Scope

This Remedial Strategy Report has been undertaken to determine the remedial requirements of the site based upon the site investigation works. It is the client's intention to develop the site into a low-rise residential development comprising 34 No. semi-detached, terraced and maisonette dwellings with associated private gardens, soft landscaping and access roads.

A proposed development plan is contained in Appendix 2 and as an extract below.

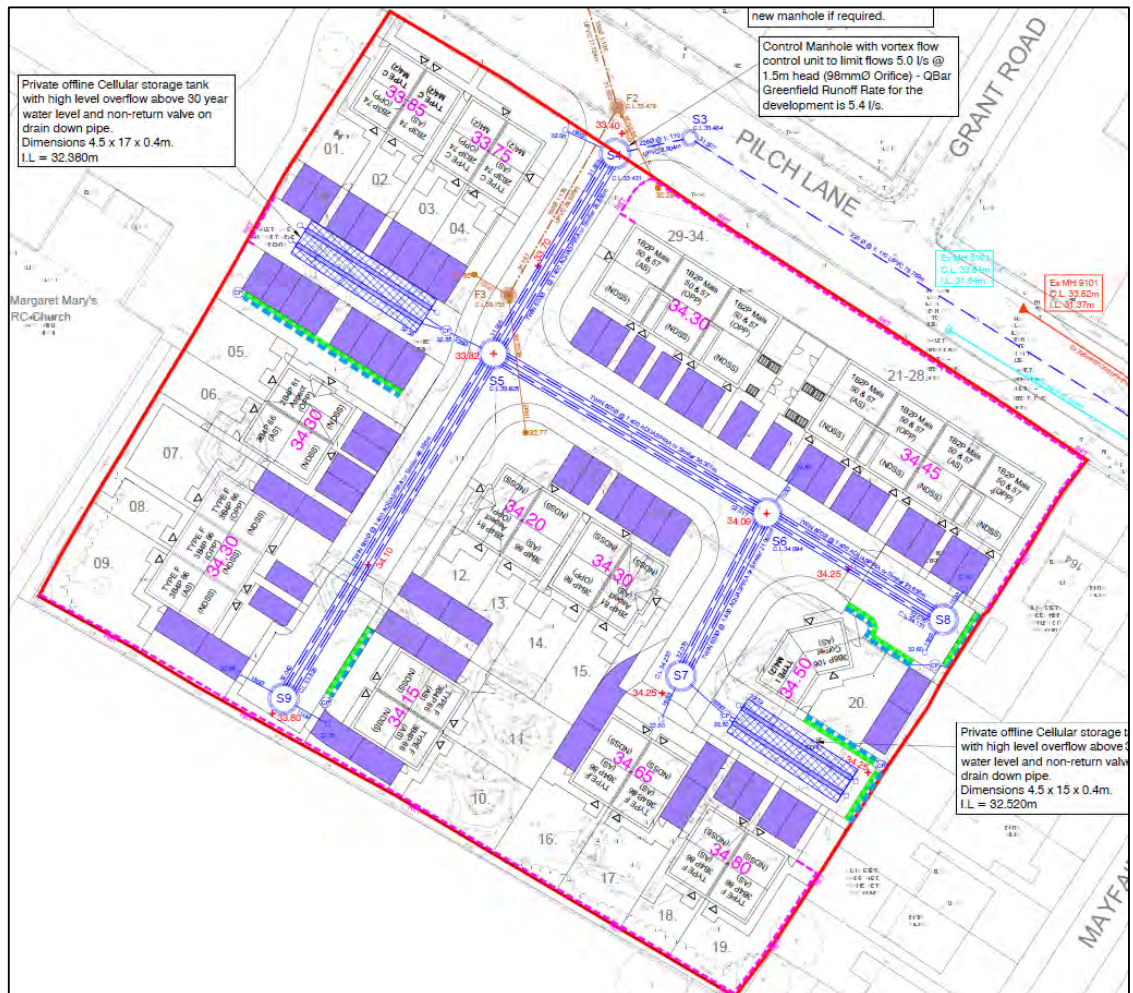


Figure 2: An extract of the proposed development plan '30686_100C Preliminary Drainage Layout'

1.2 Brief

This report has been undertaken following the findings and recommendations of the IGE Consulting *Phase 2 Geo-Environmental Investigation* (4399-02A, February 2026). Based on the ground investigation findings, this report will outline the

remedial strategy with regard to human health, controlled waters and ground gas risk on site.

The limitations of the report are contained in Appendix 1.

1.3 Summary of Phase 2 Geo-Environmental Investigation Findings

IGE have undertaken 3 No. stages of intrusive ground investigation of the site between August 2025 and January 2026.

The first phase of works comprised 7 No. trial pits (TP01 to TP07) and 6 No. dynamic sample boreholes undertaken spatially across the site. The trial pits were undertaken to depths of between 2.90m and 3.60m bgl (30.90m and 29.69m AOD). The dynamic sample boreholes were undertaken to 5.45m bgl (26.90m to 26.26m AOD). 1 No. dynamic borehole, DS02, was terminated prematurely at 1.38m bgl (32.62m AOD) due to an obstruction within the footprint of the former Boundary Hotel public house building.

During the second phase of ground investigation, 9 No. trial pits were undertaken to depths of between 1.80m and 3.20m bgl (32.25m and 30.28m AOD) targeting the former Boundary Hotel in the northern site section as well as in the southwestern corner of the site to delineate the extents of the deep Made Ground. 2 No. BRE 365 soil infiltration test pits were also constructed during the second phase of ground investigation within areas where Sustainable Drainage Systems (SuDS) may be feasible.

The third stage of ground investigation works were undertaken in January 2026 and comprised 2 No. cable percussive boreholes (CP01 and CP02) constructed to depths of between 17.45m and 20.95m bgl (13.22m to 15.97m AOD).

1.3.1 Ground Conditions

The typical ground conditions encountered across the site are as follows:

- **Made Ground** (northern site section only) comprising asphalt and concrete to a depth of between 0.15m and 0.30m bgl (33.69m to 33.46m AOD), underlain by:

- **Made Ground** comprising soft, dark brown, slightly gravelly, slightly sandy CLAY with cobbles of red brick to a depth of 0.30m to 2.00m (32.99m to 31.32m AOD), or:
- **Made Ground** comprising brown, gravelly, clayey, fine to coarse, occasionally ashy SAND to a depth of between 0.30m and 1.38m (33.60m to 32.59m AOD), underlain by:
- **Glacial Till** comprising firm to stiff, brown mottled grey, slightly gravelly slightly sandy CLAY with occasional gravel to cobble sized inclusions of brown silty, fine to coarse SAND to a depth of between 9.60m and 13.10m bgl (24.57m to 20.32m AOD), underlain by:
- **Glacial Till** comprising brown, slightly gravelly, clayey, fine to coarse SAND with occasional coarse gravel-sized pockets of slightly gravelly, slightly sandy CLAY to a depth of between 12.30m and 15.20m bgl (21.87m to 18.22m AOD), underlain by:
- **Glacial Till** comprising stiff, brown, slightly gravelly, slightly sandy CLAY with occasional coarse gravel-sized pockets of slightly gravelly, clayey, fine to coarse SAND to a depth of between at least 17.45m and 20.95m bgl (15.97m to 13.22m AOD).

1.3.2 Notable Exceptions

The following notable exceptions to the aforementioned typical ground conditions were recorded and are highlighted in the plan below:

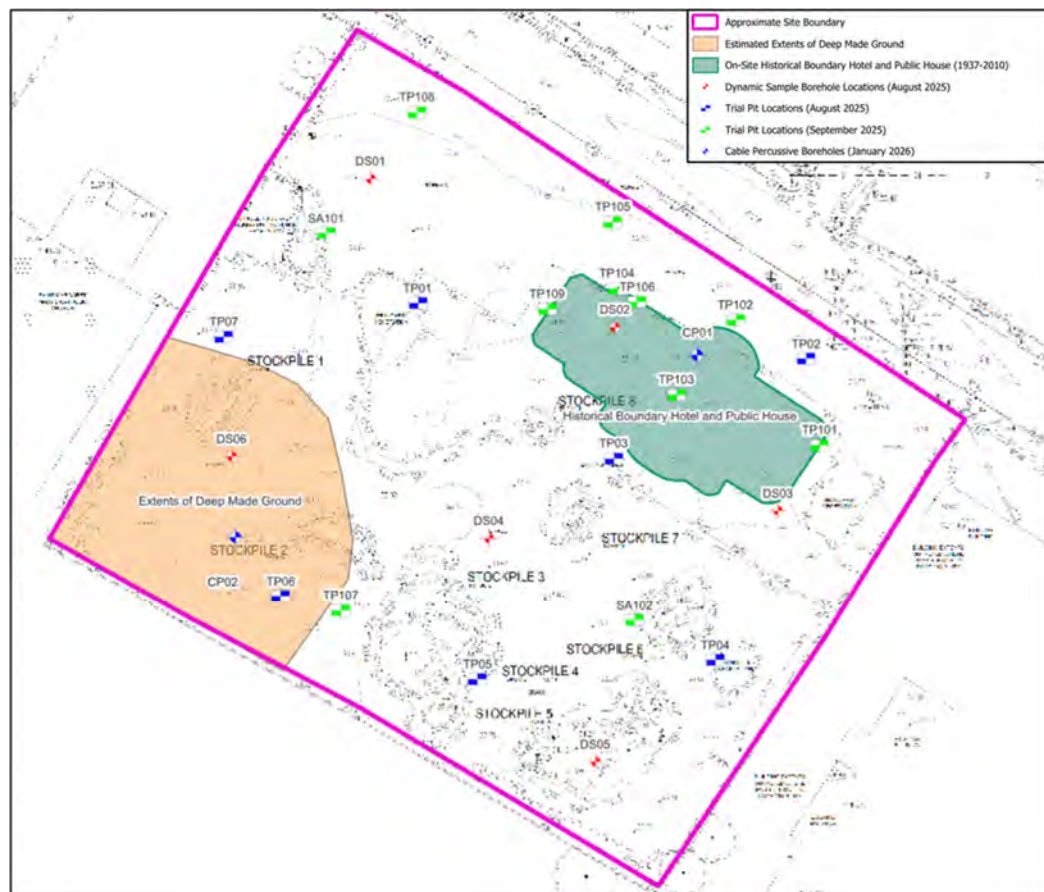


Figure 3: QGIS extract detailing the exploratory hole locations and notable exceptions encountered within the ground conditions.

Southwestern Corner of Site – Orange Area

Within DS06 and TP06 only, **Made Ground** comprising firm, orangish brown mottled grey, slightly gravelly slightly sandy CLAY was encountered to a depth of 2.00m and 2.10m bgl (31.32m and 31.19m AOD) respectively, underlain by soft, dark brown, slightly gravelly, sandy CLAY with occasional plant remains to a depth of 3.00m bgl (30.29m and 30.32m AOD). The Made Ground encountered between 2m and 3m bgl may be associated with the construction of the Former Boundary Hotel, installation of associated services in the northeastern site section or construction of the bowling greens in the southern site section.



Figure 4: Deep Made Ground with plant remains encountered within TP06 and DS06 only.

Former Boundary Hotel – Blue Area

Within the vicinity of the former Boundary Hotel, Made Ground comprising slightly clayey, very gravelly ashy fine to coarse SAND or sandy, angular to subangular, fine to coarse GRAVEL of red brick, concrete, yellow brick, metal shards, glass and ceramic was encountered. An obstruction was encountered within DS02 at a depth of 1.38m bgl (32.62m AOD) within the former building footprint. TP103 was undertaken in the centre of the building footprint and rebar was encountered at a depth of 2.10m bgl (32.14m AOD). As a result, the base of the Made Ground associated with the former public house was not encountered in the centre of the building footprint. Footings associated with the former building were encountered within TP101 to a depth of 1.40m bgl (33.35m AOD). The footing was underlain by firm Glacial Till, as encountered across the remainder of the site.



Figure 5: Footing feature encountered in TP101 in the footprint of the former boundary hotel.

Stockpiles

A number of stockpiles were encountered in the southeastern site section, with an estimated total volume of c. 360m³, based on an average height of 1.50m. The stockpiles were noted to contain **Made Ground** comprising dark brown, gravelly, clayey, fine to coarse SAND. 3 No. samples from the stockpiles were obtained by combining material from throughout the stockpile before sampling, ensuring a representative sample.

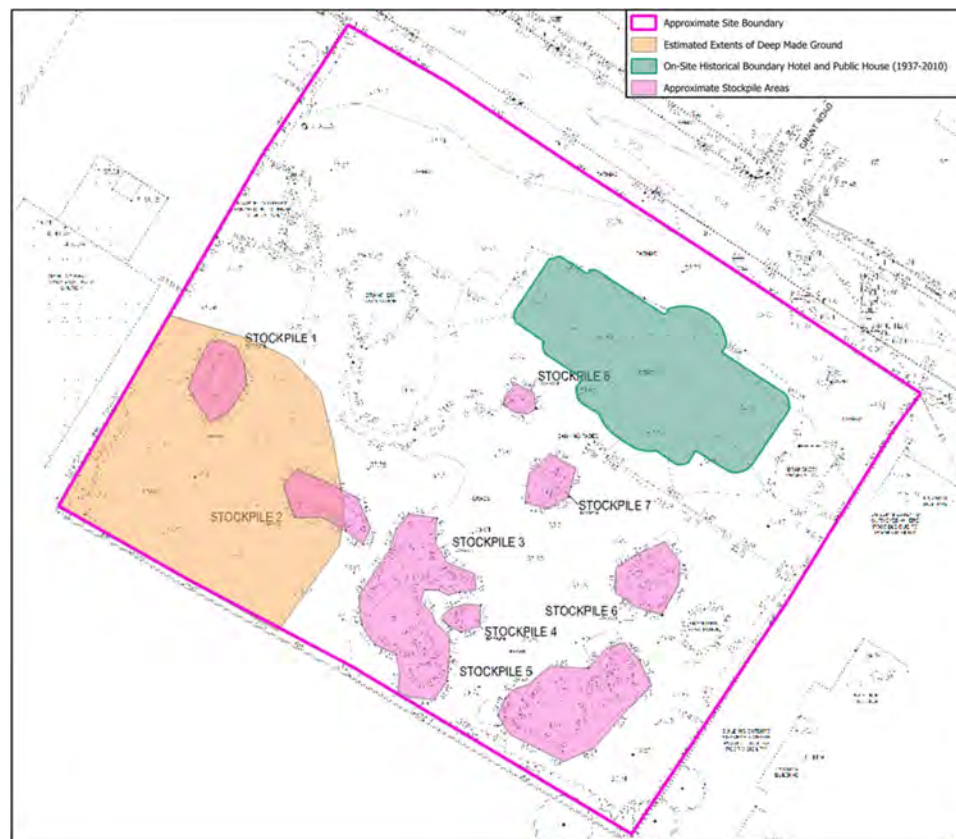


Figure 6: QGIS Extract showing the location of the stockpiles on site.

1.3.3 Chemical Testing

10 No. samples of Made Ground including 3 No. samples obtained from the southeastern corner of the site, and 3 No. samples of Glacial Till were submitted for environmental analysis. The following exceedances were recorded within the Made Ground.

Polycyclic Aromatic Hydrocarbons (PAHs)				
Determinand	Location	Depth of Sample (m bgl)	GAC (mg/kg)	Result (mg/kg)
Benzo(a)anthracene	DS06	1.30	11	20
Benzo(b)fluoranthene	DS02	0.75	3.30	5.80
	DS06	1.30		18
Benzo(a)pyrene	DS02	0.75	3.20	4.90
	DS06	1.30		19
Dibenz(a,h)anthracene	DS02	0.75	0.28	0.89
	DS06	1.30		2.00

Metals and Metalloids				
Determinand	Location	Depth of Sample (m bgl)	GAC (mg/kg)	Result (mg/kg)
Arsenic	SP01	N/A	37	53
	SP03			40
Lead	DS06	1.30	200	250
	SP01	N/A		270
	SP03			230

The locations of the exceedances recorded on site are shown in the plan below.

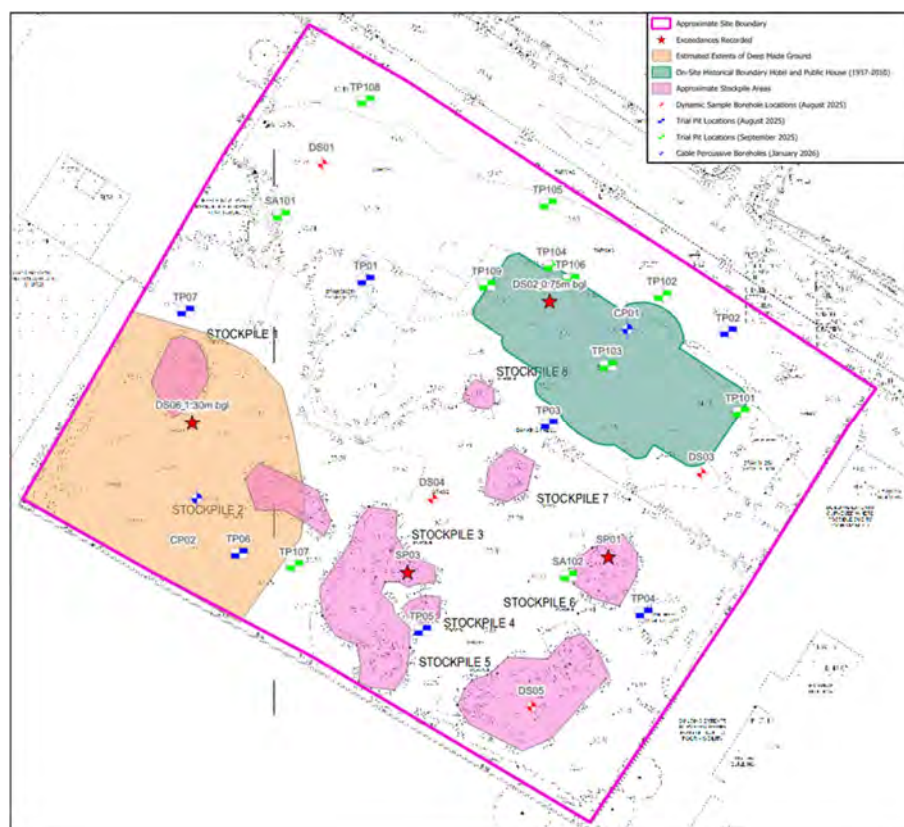


Figure 7: QGIS Extract detailing areas of exceedances: former Boundary Hotel (green), Stockpiles (pink) and area of deeper Made Ground (orange). Red stars indicate the location of exceedances encountered on site.

No asbestos was recorded in any of the Made Ground samples submitted for analysis. The risk of volatile / VOCs is regarded as negligible due to the lack of evidence for the potential sources of VOCs on site, consequently contaminative pathways for vapours are not considered.

Within the stockpiles, exceedances of lead and arsenic were encountered and therefore the material within the stockpiles is not deemed suitable for reuse on site in areas of private gardens or soft landscaping.

A number of GAC exceedances for PAHs were recorded within the Made Ground associated with the former Boundary Hotel. Within the vicinity of DS06 in the southwestern corner of the site, localised deep Made Ground was encountered and black staining and a hydrocarbon odour was observed. Exceedances of GACs for PAHs and heavy metals were recorded within this Made Ground.

No other visual or olfactory evidence of contamination was present across the site. No GAC exceedances for the '*residential with home grown produce*' land use scenario were recorded for any of the natural samples (Glacial Till) sent for laboratory chemical testing. No asbestos was detected in any of the samples tested.

Given the recorded exceedances within the Made Ground, remedial measures are required for the proposed soft landscaped areas to negate exposure pathway risks with existing site materials. Therefore, a clean cover system is required in areas of private gardens and soft landscaping to break contaminative linkages between the Made Ground.

1.3.4 Ground Gas Monitoring

The scheduled programme of 6 No. visits has been completed. It should be noted that the response zones of DS05 and DS06 were flooded during some visits. Consequently, the results for DS05 and DS06 during those monitoring visits are deemed unreliable in accordance with BS8485:2015 + A1:2019 and have been excluded from the ground gas results below. The results have been summarised below:

Gas Monitoring Well	Steady O ₂ Concentration (%)	Peak CO ₂ Concentration (%)	Peak CH ₄ Concentration (%)	Peak H ₂ S Concentration (ppm)	Atmospheric Pressure (mbar)	Steady Gas Flow (l/hr)
DS03	14.6 – 19.7	0.6 – 1.1	<0.1	1	992 - 1024	<0.1
DS05	20.1 – 20.2	0.6 – 0.7	<0.1	1	992 - 1023	<0.1
DS06	0.1 – 9.3	9.1 – 14.2	<0.1	1	992 - 1023	<0.1

Ground gas monitoring was undertaken utilising a GFM 4300 gas analyser.

The results highlighted in grey indicate that the readings were noted to be below instrument detection limit.

Although the GSV included within the Phase 2 report is in-line with a Characteristic Situation 1, due to the elevated concentration of carbon dioxide recorded in DS06, it is recommended that the south western site section is designated as a **Characteristic Situation 2** as a conservative measure. Therefore, it is recommended that ground gas protection measures are installed in **Plots 05 – 11 only**. The proposed houses are **Type A** buildings in accordance with BS8485 (2015) + A1 (2019), therefore, the ground gas protection measures must achieve a minimum of **3.5 points** in accordance with BS8485 (2015) + A1 (2019).

The remainder of the site is considered to be at low risk and in-line with a **Characteristic Situation 1**, as migration of carbon dioxide from the Made Ground in the south western site section is unlikely to occur due to the presence of low permeability Glacial Till. The ground gas monitoring results concur with this as no other elevated concentrations of carbon dioxide were recorded in other wells on site. Therefore, no ground gas protection measures are deemed necessary for the remainder of the plots.

1.3.5 Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies within a lower probability area, less than 1% of homes are above the action level. Consequently, no radon protection measures are necessary in the construction of new dwellings or extensions.

1.3.6 Floor Slabs

Given the presence of numerous trees along the site boundaries, low to medium volume change potential clays, and Made Ground in excess of 600mm across the site, it is envisaged that in line with NHBC Guidance, ground bearing floor slabs will not be suitable across the majority of the proposed development.

1.3.7 Foundations

Due to the variable ground conditions, foundations vary by plot locations. The below are general recommendations. A plot specific foundation zoning plan inclusive of levels and heave precaution has been completed for the site (SI-09 Rev A, dated January 2026) and should be referred to for detailed information regarding the foundation solutions. An extract of the proposed development plan is included below for reference.

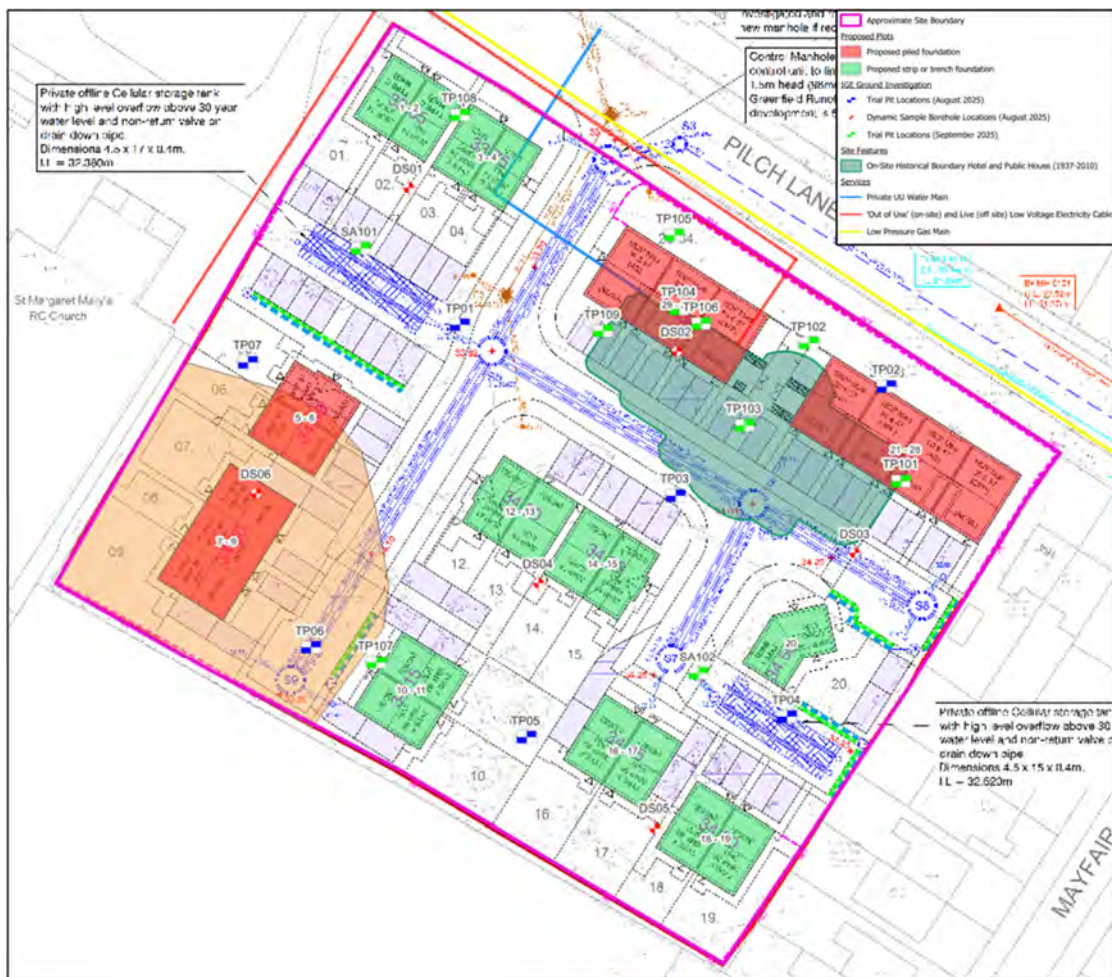


Figure 8: Extract of '30686_100C Preliminary Drainage Layout' including services and historical features including the former Boundary Hotel extents (blue). Orange indicates the approximate area of deep Made Ground in the southwestern section.

Plots 1 – 4 and 12 – 20 (Green on plan)

Made Ground was encountered within all exploratory holes typically to a depth of between 0.30m and 1.25m and was noted to comprise either soft clay or sand. Given the variability and low strength nature of the Made Ground, it is not considered a suitable founding stratum for even lightly loaded structures.

The underlying Glacial Till recorded firm to stiff clay with average N-values of 14 from 1.20m bgl and average undrained shear strength values of 133kPa from 1.40m bgl. Therefore, the Glacial Till at c. 1.40m bgl is considered a suitable founding stratum for proposed plots 1 – 6 and 11 – 21 (highlighted in green on the plan above). Given the depth of the Made Ground present across the site, mass-fill trench foundations are likely to be feasible for the aforementioned plots.

Assuming a traditional (shallow) mass fill foundation of 600mm width lain at least 200mm into the suitable founding strata, a minimum allowable net bearing pressure in excess of 125kN/m² with differential settlement less than 25mm should be readily achievable.

Plots 5 – 9 (Red on plan)

Deep Made Ground was encountered within the southwestern corner of the site to a depth of 3.00m bgl (30.29m and 30.32m AOD). N-values below 5 were recorded within this stratum. As a result, the Made Ground is not considered to be a suitable founding stratum for the proposed structures.

Given that the depth of the Made Ground extends beyond 2.50m bgl, a traditional foundation solution is unlikely to be suitable for plots 7 – 12 in the southwestern site section. The underlying Glacial Till was noted to be firm to stiff with an N-value of 14 at 3.00m bgl and undrained shear strength values from hand shear vane testing of 90kPa at 3.10m, increasing to 223kPa at 3.50m bgl in TP06. Therefore, the underlying Glacial Till is deemed a suitable founding stratum for a deep (piled) foundation solution (highlighted in red above).

Plots 21 – 34 (Red on plan)

Proposed plots 22 – 35 are located within the footprint of the former Boundary Hotel public house where brick footings to a depth of 1.40m bgl (32.65m AOD) were encountered around the perimeter of the former building. The extents of the former building are shown in blue on Figure 8. Deep coarse Made Ground to a depth of 3.10m bgl (31.07m AOD) was encountered in the centre of the building footprint and it is anticipated that the basement of the former building has been infilled with demolition material. The extents of this material should be proven as part of the site

preparation and any potential obstructions removed. Given that the variable depth and composition of the Made Ground associated with the former building extends to a depth of at least 2.40m bgl (31.84m AOD), a traditional strip or mass-fill trench will not be suitable for plots 22 – 35.

It is recommended that a piled foundation solution is utilised for these plots, extending into the underlying Glacial Till (highlighted in red above). Given the close proximity of adjacent properties along the eastern site boundary, consideration of the piling methodology should be given to reduce vibratory disturbance.

An arboricultural survey has been undertaken and a number of plots require heave precaution and foundation deepening in-line with NHBC Guidance given the presence of low volume change potential soils across the majority of the site and medium volume change potential soils in TP04 at 0.60m bgl.

It is recommended that any localised 'soft spot' areas encountered during excavation works should be removed and foundations extended down to suitable formation strata. To minimise issues with potential differential settlement of the foundation structure, it is recommended that foundations are not constructed upon more than one stratum type, as delineated within the exploratory hole logs.

Though not encountered during the ground investigation, the absence of any large cobbles or boulders within the Glacial Till should not be assumed at depth.

For detailed information regarding the foundation solutions, reference should be made to the separate Foundation Zoning Plan (SI-09 Rev A, dated January 2026).

1.3.8 Remedial Measures

The following remedial measures are based on the findings of the aforementioned Phase 2 Geo-Environmental Investigation and have been split into enabling works (i.e. remedial works undertaken during initial earthworks and site preparation) in Section 2 and build phase aspects in Section 3.

2.0 PREPARATORY AND ENABLING WORKS

2.1 Enabling Works

Existing site levels are noted to be between 33.1m and 34.1m AOD, and the proposed development plan indicates that the post earthworks ground level (FFL – 450mm) is noted to range from 33.75m and 34.80m AOD. As a result, the proposed level changes across site will include a slight upfill in areas, typically 500mm.

Therefore, enabling works will be required prior to development to physically prepare the site for the development, this will include the following:

- Clearance of any fly tipping and stockpiling of surface materials;
- Stripping of vegetation;
- Decommissioning of existing ground gas and groundwater monitoring wells (further detailed in Section 2.4 below);
- Removal of significant organic material / deleterious materials (trees / branches) within the Made Ground;
- Site turnover including removal of remaining subterranean obstructions associated with the former Boundary Hotel, as well as excavation, segregation, screening and sorting of material type (i.e. Made Ground and natural soils) as deemed necessary;
 - o to at least 2m below any proposed foundation and within a 2.0m plot envelope
 - o to 500mm below bedding level of any drainage feature and 1000mm finished garden and external levels.
- If appropriate, imported material to achieve proposed levels can be undertaken in-line with a CL:AIRE DoW:CoP Material Management Plan (MMP) as discussed in Section 2.2 and the earthworks specification included as Appendix 6;
- Testing of site won and general fill in-line with the general fill criteria outlined in Section 2.3 below;
- Geotechnical testing of any placed material to be undertaken inclusive of proving compaction / air voids;
- For plots where a piled foundation solution is proposed install a temporary working platform in line with BRE470 with appropriate in-situ testing

undertaken to validate the installation. The access of the piling rig onto site and its movement across the site should be considered within the design. It is recommended that plate incremental tests at appropriate pressures are completed following installation of the temporary working platforms to ensure that they have been installed correctly; and

- Backfilling of service runs with clean stone or proven (with chemical testing) inert fill materials.

In the vicinity of the former Boundary Hotel, Made Ground with medium cobble content was encountered to a depth of 3.10m bgl (31.07m AOD), anticipated to be a former basement feature infilled with demolition material. This will need to be removed and the materials re-graded. This feature will need to be backfilled inline with the earthworks specification noted below.

2.2 Definition of Waste: Code of Practice

Due to the recommended handling and re-use of excavated site-won materials, it is possible to avoid complex waste legislation by utilising the Definition of Waste: Code of Practice (2011, DoW:CoP). This allows assessment of whether or not excavated materials are waste, and when excavated and treated waste can be classified as 'no longer waste'.

In line with DoW:CoP, a robust, site-specific material management plan (MMP) inclusive of a tracing system will need to be undertaken and adhered to and verified in an appropriate verification report. This must be reviewed by a 'Qualified Person' who must provide a Declaration to the EA prior to works within the MMP being commenced. A **detailed DoW:CoP MMP cannot be undertaken until the remedial strategy has been approved** but this should include details of the source (including source testing) of all materials imported into site. The site should be zoned using a 50m x 50m grid and given a zone number (A1, B2 etc). Utilising this system, a record should be kept of all material imported onto site and its intended destination and use. All imported material should be recorded in a tracking document and the following information noted:

- Material Origin;
- Intended Destination (grid square);

- Material description / classification;
- Date imported;
- Quantity imported (no. of loads and volume);
- Temporary storage location (if applicable). Each stockpile on site should be numbered and its location recorded; and
- Testing results (chemical and geotechnical, report number noted). Testing should meet the below Acceptability Criteria outlined in Section 2.2.

This will ensure that all material on site is fully traceable, chemically validated and suitable for its intended use.

2.2.1 Export of Materials

Any soils to be removed from site must be classified in accordance with WM3 under the definition of waste and chemically tested to determine their destination, i.e. reuse or landfill. Waste ticket records must also be retained as proof of the export of materials from site.

2.2.2 Stockpile Management

A number of stockpiles were noted on site during ground investigation. Chemical testing of the stockpiles identified exceedances of the residential with homegrown produce scenario for arsenic and lead and therefore the material is not suitable for reuse within private gardens or areas of soft landscaping, but may be suitable for use elsewhere, such as beneath plots or highways.

During the course of the development there will also be areas of stockpiled soils intended for use within the proposed gardens. These will have been subjected to off-site testing and approved for use on site. It is imperative that the stockpiles are well managed to avoid inadvertent mixing or depositing of surplus or deleterious materials that would compromise the continued use. We would recommend that the site management reviews the proposed positions for placement of stockpiles and places either fencing or warning signs to ensure compliance.

2.3 General Fill Chemical Testing Criteria

The following targets for 'General Fill' are proposed to address any material imported onto site to achieve proposed levels. As noted above, the volumes of material is not significant. General Fill is material used primarily to raise levels, specifically not within areas of private gardens, public open space, or soft landscaping i.e. below -600mm finished levels. The following validity samples must be taken during the enabling works phase:

Soil	Testing Frequency	Testing Suite	Acceptability Criteria
Site-won aggregate	1 per 1000m ³ of crush	A	Asbestos <0.01%. Where placed within -1.0m of finished level, <0.001%
Imported aggregate	1 per 500m ³	A	Asbestos <0.01%. Where placed within -1.0m of finished level, <0.001%
Imported General Fill	1 per 500m ³	As below Acceptability Criteria for General Fill	General Fill
Stockpiles post processing (to determine whether they can be re-placed or the need for removal, if applicable)	1 per 50m ³	As below Acceptability Criteria for General Fill plus contaminants of concern based on hotspot removed	General Fill

- 1) 'General Fill' is material used primarily to raise levels, specifically not within areas of private gardens, public open space, or soft landscaping, e.g. 6F2.
- 2) Imported aggregate should also contain <1% deleterious anthropogenic materials (by eye).

Testing Suites:

- A. Asbestos ID, Asbestos quantification.
- B. pH, total and free cyanide, soluble sulfate, organic matter.
- C. Arsenic, Beryllium, Boron, Cadmium, Chromium (III and VI) Copper, Lead, Inorganic Mercury, Nickel, Selenium, Vanadium, Zinc.
- D. Speciated PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene.
- E. Total (non-speciated) PAHs.
- F. Speciated Total Petroleum Hydrocarbons (TPH): Aliphatic >EC5 - EC6, >EC6 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, and > EC35 - EC44, and Aromatic >EC5 - EC7, >EC7 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, > EC35 - EC44.
- G. Total Petroleum Hydrocarbons (TPH): TPH EC6 – EC40.
- H. BTEX: Benzene, Toluene, Ethylbenzene, p- & m-xylene, o-xylene. Methyl tertiary butyl ether (MTBE).

Once tested, the results are to be compared against the following Acceptability Criteria for General Fill:

Suite	Determinand (mg/kg unless stated)	Acceptability Criteria for General Fill
A	Asbestos (%)	See Above
B	pH	>5 - <10 ⁽³⁾
	Total Cyanide	0.5 ⁽³⁾
	Free Cyanide	0.5 ⁽³⁾
	Soluble Sulfate (mg/l)	500 ⁽³⁾
C	Arsenic	640
	Beryllium	12
	Boron	240000
	Cadmium	190
	Chromium (III)	8600
	Chromium (VI)	33
	Copper	68000
	Lead	2330 ⁽¹⁾
	Inorganic Mercury	1100
	Nickel	980
	Selenium	12000
	Vanadium	9000
	Zinc	730000
E	Total PAHs	200 ⁽⁴⁾
G	TPH > EC6 - EC40	1000 ⁽⁴⁾

LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015) used unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) CL:AIRE Soil GAC for Human Health Assessment (January 2010)
- 3) In-house screening criteria used as no GAC methodology currently exists
- 4) This limit only applies to imported material, not to in-situ soil.

Assumed 1% SOM (most conservative) for those values dependent upon SOM.

ND = Not Detected

LOD = Limit of Detection

*Exceeds vapour saturation limit

**Exceeds solubility saturation limit

A cut and fill calculation has yet to be undertaken, however, there will likely be a net fill requirement. Based on the proposed site levels, the site levels are anticipated to be raised between c. 0.20m and 1.00m (average 0.50m)

The site won Glacial Till is deemed suitable for re use on site as general fill and within garden areas. There is no Topsoil on site and given that a net fill requirement is anticipated, it is likely that imported topsoil and subsoil will be required on site. Any material imported onto site must be chemically suitable for its intended use. Consequently, a distinction should be made between material intended for use in garden areas within 600mm of finished garden level and any soils intended for use as general fill outside of garden areas of below 600mm of finished garden level. Materials intended for use within 600mm of finished garden level within proposed gardens must meet the requirements detailed in Section 4.0 below. Materials intended for use as general fill (outside of within 600mm of finished garden level in proposed gardens) must meet the requirements for general fill detailed above.

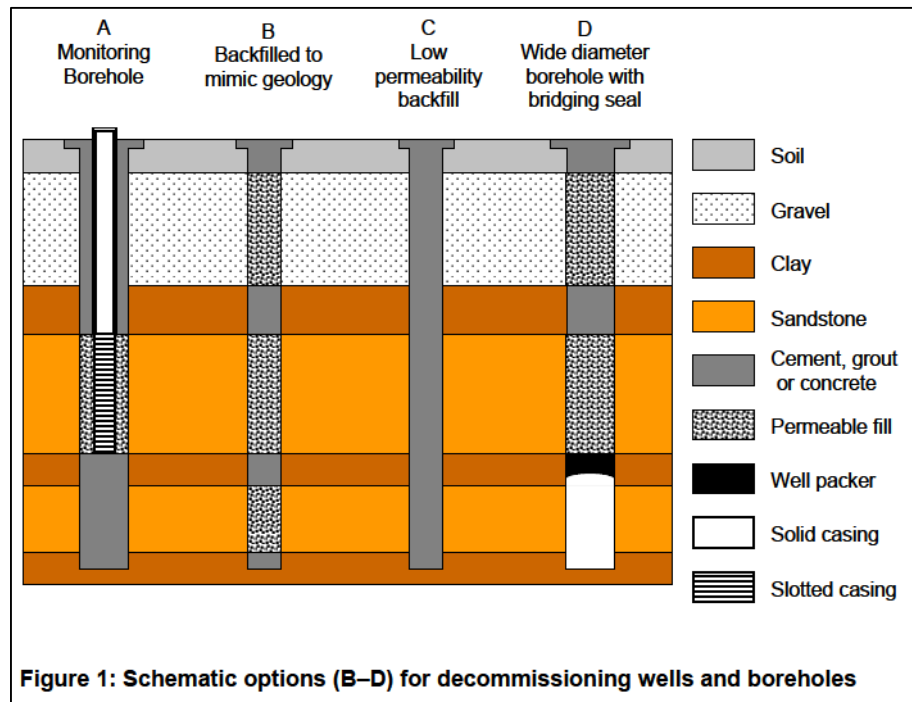
The general fill will also be subject to geotechnical testing as detailed within the Earthworks Specification included as Section 3.0 below.

There will be a need to import recycled aggregate material for use in construction which will need to demonstrate compliance with the Waste Framework Directive and comply with the following:

- The aggregate will be produced under a WRAP/Factory Production Control as required by the European standards;
- It will conform to the requirements of the appropriate specification for the use for which it is destined (considered likely to be 6F5 produced in accordance with Table 6/1 of the Specification for Highways Works);
- It will not require further processing, including size reduction, prior to final use;
- It must contain less than 1% of cohesive materials, metals, wood, plastic, rubber and gypsum plaster, in line with the limits set within the aggregate's standards; and
- It must contain asbestos at < 0.001%.

2.4 Decommissioning of Boreholes

It is imperative that all boreholes drilled into the site are located and appropriately grouted to negate any possible preferential ground gas pathways. Utilising guidance provided in the Environment Agency's '*Good practice for decommissioning redundant boreholes and wells*' (October 2012), it is prudent to secure redundant borehole to ensure that no groundwater pollution can occur. The Environment Agency (EA) offer advice on the methods of sealing wells to ensure that the preferential pathway is removed. The following diagram taken from the EA guidance shows a monitoring well (A) and 3 No. options for decommissioning (B, C and D):



It is considered prudent to utilise Option C – low permeability backfill, shown in the diagram above, to adequately seal the borehole. The guidance recommends that ‘the backfill materials must be clean, inert and non-polluting’, e.g. bentonite. It is recommended to remove the standpipe and seal with bentonite to ground level. This will be sufficient to prevent contaminant transport.

2.5 Enabling Works Verification Report

Following completion of the above enabling works, a verification report will need to be produced to demonstrate compliance with the MMP, earthwork specification (section 3.0) and above general fill acceptability criteria.

3.0 EARTHWORKS SPECIFICATION

The proposed level changes across site include an upfill of less than 600mm based on the existing site levels compared to the post earthworks ground level (FFL-450mm). It is still advised that all upfill is undertaken with NHBC Chapter 6.4. An outline earthworks specification is included within Appendix 6.

4.0 REMEDIAL STRATEGY FOR HUMAN HEALTH

The proposed development is to include private gardens and areas of soft landscaping. The *IGE Consulting Phase 2 Geo-Environmental Investigation report* recommended a clean cover system in these areas where Made Ground is present to break any pathways between the existing site soils and the end user.

4.1 Installation of a Clean Cover System

The following plan details the proposed private rear gardens (blue) and front garden and POS soft landscaping (Public Open Space / POS_{resi}) (purple) which require a clean cover system. The below remedial recommendations will refer to the landscaping designations detailed in the below extract.

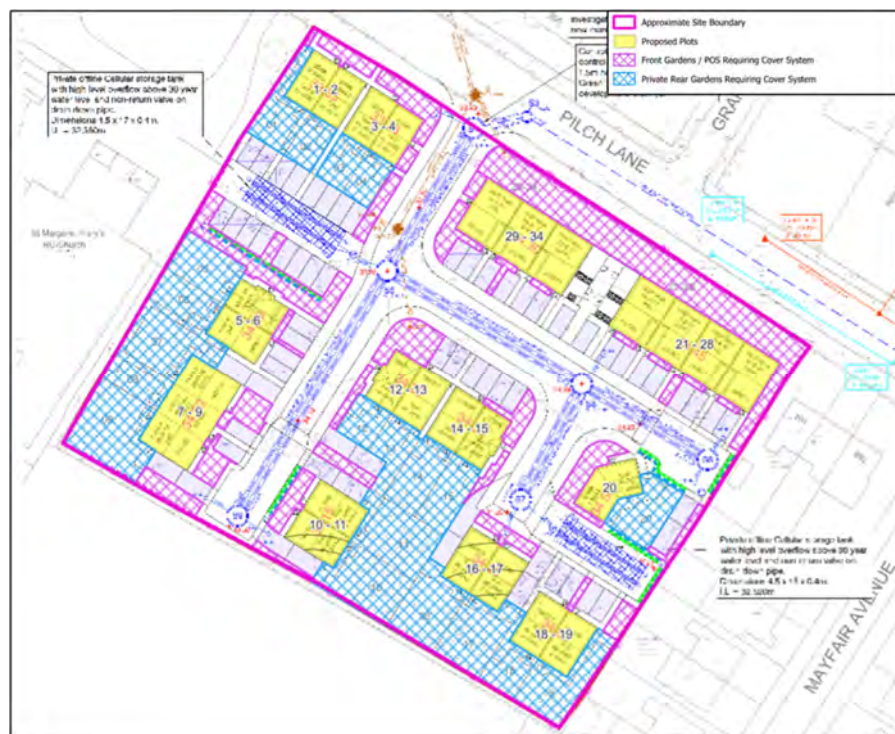
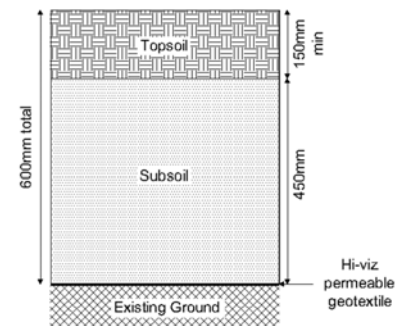


Figure 9: Extract of the Proposed Development Plan showing private gardens in blue and POS / front gardens in purple requiring a clean cover system.

The cover system for the private rear gardens is to be 600mm thick and consistent with the recommendation of the Liverpool City Council 'Requirements for Contaminated Land Validation' (2010), where Made Ground is present to greater than 600mm below finalised garden levels (300mm in areas of soft landscaping and

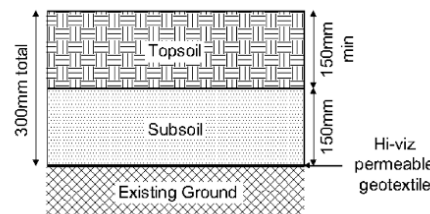
front gardens). The following procedure is outlined for use in private gardens and in areas of soft landscaping:

1. Excavate to 600mm bgl in private rear gardens (300mm in soft landscaping areas and front gardens).
2. A 600mm clean cover system is recommended to be added to the proposed private rear gardens (300mm in soft landscaping areas and front gardens). This is to consist of:
 - No less than 150mm and no more than 300mm suitable topsoil, underlain by:
 - Suitable subsoil to a total (topsoil + subsoil) depth of 600mm (300mm in areas of soft landscaping and front gardens), underlain by:
 - A high vis geotextile marker; and
 - Validated in line with the below strategy.



Where Made Ground is shallower than 600mm in private back garden areas or shallower than 300mm in soft landscaped areas / public open space / front gardens, excavating to the required depth for a cover system in these areas would constitute source removal. Therefore, where this is the case, the following procedure is proposed:

1. Excavate to the base of the Made Ground (<600mm in gardens and <300mm in soft landscaping areas public open space / front gardens). A clean cover system is not necessary.
2. Add suitable subsoil and topsoil to create a garden / soft landscaping to the client's specification.
3. Validate in line with the below strategy.



Examples of clean cover system requirements are included in Appendix 4.

4.2 Validation of Clean Cover System

Once the 600mm clean cover system is required to break contaminative linkages (300mm in areas of soft landscaping), validation requirements in line with Liverpool City Council 'Requirements for Contaminated Land Validation' (2010) include:

- Details of the source of the cover material;
- Chemical test results to demonstrate that the soil is free from contamination and 'suitable for use' in-line with the below chemical testing suites and rates;
- Waste transfer notes to provide evidence of source; and
- Confirmation of cover depth by either measurement tape or topographical survey with photographs at a frequency of:
 - o One pit per 25m grid within the POS_{resi} ('amenity space') and front gardens; and
 - o One pit per three plots across all private rear gardens.

No topsoil is recorded on site and therefore all topsoil will need to be imported. Based on the initial chemical test results, the underlying Glacial Till subsoils are deemed suitable for re-use subject to further testing in-line with the below, however, given that a net upfill is anticipated, there may be a requirement for imported subsoils.

Imported topsoil and subsoil is required to be tested at source prior to import to confirm suitability. Detailed information will also be required regarding the source of any imported topsoil and subsoil (i.e. site history, whether the site is greenfield or brownfield). At source testing will be provided by the supplier or haulage broker or will be based on an appropriate ground investigation report (if the material is a byproduct of an existing ground investigation) and the testing will be re-assessed against the below acceptability criteria by IGE to determine suitability prior to import. If no testing is available testing will be undertaken in-line with the below criteria

All topsoil and subsoil, whether site-won or imported is required to be tested at the following frequency:

Source	Material End Use	Sampling Frequency ¹	Testing Suites ³ (see below)
Greenfield Source:	Topsoil	1 per 200m ³	A, B, C, D, F
	Subsoil	1 per 200m ³	A, B, C, D, F
Brownfield Source:	Topsoil	1 per 50m ³	A, B, C, D, F, H
	Subsoil	1 per 100m ³	A, B, C, D, F
	General Fill ²	1 per 1000m ³	A, B, C, E, G

- 1) Minimum 3 samples regardless of volume.
- 2) 'General Fill' is material used primarily to raise levels, specifically not within areas of private gardens, public open space, or soft landscaping, e.g. 6F2.
- 3) In addition to the standard suites given, the laboratory testing suite should include any additional contaminants of concern based on the source of the samples.

Testing Suites:

- Asbestos ID, Asbestos quantification.
- pH, total and free cyanide, soluble sulfate, organic matter.
- Arsenic, Beryllium, Boron, Cadmium, Chromium (III and VI) Copper, Lead, Inorganic Mercury, Nickel, Selenium, Vanadium, Zinc.
- Speciated PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene.
- Total (non-speciated) PAHs.
- Speciated Total Petroleum Hydrocarbons (TPH): Aliphatic >EC5 - EC6, >EC6 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, and > EC35 - EC44, and Aromatic >EC5 - EC7, >EC7 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, > EC35 - EC44.
- Total Petroleum Hydrocarbons (TPH): TPH EC6 – EC40.
- BTEX: Benzene, Toluene, Ethylbenzene, p- & m-xylene, o-xylene. Methyl tertiary butyl ether (MTBE).

Once tested, the results are to be compared against the following Acceptability Criteria:

Suite	Determinand (mg/kg unless stated)	Acceptability Criteria for:	
		Private Gardens	Public Open Space (residential)
A	Asbestos (%)	ND	ND
B	pH	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾
	Total Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾
	Free Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾
	Soluble Sulfate (mg/l)	500 ⁽³⁾	500 ⁽³⁾
C	Arsenic	37	79
	Beryllium	1.7	2.2
	Boron	290	21000
	Cadmium	11	120
	Chromium (III)	910	1500
	Chromium (VI)	6	7.7
	Copper	2400	12000
	Lead	200 ⁽¹⁾	630 ⁽¹⁾
	Inorganic Mercury	40	120
	Nickel	130	230
	Selenium	250	1100
	Vanadium	410	2000
D	Zinc	3700	81000
	Naphthalene	2.3	4900
	Acenaphthylene	170	15000
	Acenaphthene	210	15000
	Fluorene	170	9900
	Phenanthrene	95	3100
	Anthracene	2400	74000
	Fluoranthene	280	3100

	Pyrene	620	7400
	Benzo(a)anthracene	7.2	29
	Chrysene	15	57
	Benzo(b)fluoranthene	2.6	7.1
	Benzo(k)fluoranthene	77	190
	Benzo(a)pyrene	2.2	5.7
	Indeno(1,2,3-cd)pyrene	27	82
	Dibenz(a,h)anthracene	0.24	0.57
	Benzo(ghi)perylene	320	640
E	Total PAHs		
F	TPH-CWG - Aliphatic >EC5 - EC6	42	570000
	TPH-CWG - Aliphatic >EC6 - EC8	100	600000
	TPH-CWG - Aliphatic >EC8 - EC10	27	13000
	TPH-CWG - Aliphatic >EC10 - EC12	130	13000
	TPH-CWG - Aliphatic >EC12 - EC16	1100	13000
	TPH-CWG - Aliphatic >EC16 - EC21	65000	250000
	TPH-CWG - Aliphatic >EC21 - EC35		
	TPH-CWG - Aliphatic > EC35 - EC44	65000	250000
	TPH-CWG - Aromatic >EC5 - EC7	70	56000
	TPH-CWG - Aromatic >EC7 - EC8	130	56000
	TPH-CWG - Aromatic >EC8 - EC10	34	5000
	TPH-CWG - Aromatic >EC10 - EC12	74	5000
	TPH-CWG - Aromatic >EC12 - EC16	140	5100
	TPH-CWG - Aromatic >EC16 - EC21	260	3800
	TPH-CWG - Aromatic >EC21 - EC35	1100	3800
	TPH-CWG - Aromatic > EC35 - EC44	1100	3800
G	TPH > EC6 - EC40		
H	Benzene	0.087	72
	Toluene	130	56000
	Ethylbenzene	47	24000
	p & m-xylene	56	41000
	o-xylene	60	41000
	MTBE (Methyl Tertiary Butyl Ether)	LOD ⁽³⁾	LOD ⁽³⁾

LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015) used unless stated:

- 5) Category 4 Screening Levels (March 2014)
- 6) CL:AIRE Soil GAC for Human Health Assessment (January 2010)
- 7) In-house screening criteria used as no GAC methodology currently exists
- 8) Hazardous waste thresholds. This limit only applies to imported material, not to in-situ soil.

Assumed 1% SOM (most conservative) for those values dependent upon SOM.

ND = Not Detected

LOD = Limit of Detection

*Exceeds vapour saturation limit

**Exceeds solubility saturation limit

The above acceptability criteria for PAHs for imported topsoil and subsoil are based on the published LQM/CIEH S4ULs (2015) for each individual PAH and not based on the Category 4 Screening Level using benzo(a)pyrene as a surrogate marker. This is as the source of the imported material is unknown therefore using the surrogate marker approach may not be suitable as the distribution of PAHs in the imported material may not be similar to those in the Culp et al. (1998)¹ study. Once chemical testing had been undertaken on imported soil and the distribution of PAHs compared to the distribution in the Culp et al. (1998) study, it may be suitable to use the surrogate marker approach / C4SL.

Clean Cover System Verification Report

The verification report shall include, as a minimum, the following:

¹ Culp et al. (1998), A comparison of the tumors induced by coal tar and benzo[a]pyrene in a 2-year bioassay, **Carcinogenesis**, vol.19, no.1, pp.117–124.

- Site Name / location, developer name, development use;
- Plot No / description of landscaped area (incl. plan of inspection areas) and National Grid Reference;
- Inspection visit date;
- Description of remediation (as per agreed Remediation Strategy including depths / thickness checks, topographical readings);
- Material tracking information (including way tickets etc.);
- Name of groundwork's remediation contractor;
- Name of supervising environmental consultant;
- Site Specific chemical analysis results;
- Verification Photographs (inc. remarks);
- Pass/fail and if material fails, how will this be managed i.e. removed, treated
- Detail any further remedial works and/or inspection; and
- 'Signed off'.

5.0 REMEDIAL STRATEGY FOR GROUND GAS PROTECTION

Based on the IGE Consulting Ltd. ground gas monitoring results, the majority of the site has been designated as Characteristic Situation 1, however, due to elevated carbon dioxide concentrations in the south western site section associated with an area of Made Ground, it is considered prudent to increase the designation of plots 5 – 11 to Characteristic Situation (CS2). The proposed houses are **Type A** buildings in accordance with BS8485 (2015) + A1 (2019), therefore, the ground gas protection measures must achieve a minimum of **3.5 points** in accordance with BS8485 (2015) + A1 (2019).

5.1 Design of Ground Gas Protection Measures

Due to the presence of more than 600mm of Made Ground, suspended floor slabs will be required in the proposed development; it is likely that they will be precast segmental (beam and block), however, two options for the proposed construction elements to achieve the required 3.5 points score are given below:

		BS:8485 (2015) + A1 (2019) Scores	Floor Slab Design Options			
			Pre-cast Beam and Block Suspended Slab		Cast In-situ Suspended Slab	
			Design Choice	Score	Design Choice	Score
Floor Slab	Precast suspended segmental subfloor	0	✓	0		
	Cast in-situ ground bearing floor slab (with only nominal mesh reinforcement)	0.5				
	Cast in-situ monolithic reinforced ground bearing raft or reinforced cast in-situ suspended floor slab with minimal penetrations	1 or 1.5*			✓	1.5
Ventilation	Pressure relief pathway	0.5			✓	0.5
	Passive sub-floor dispersal layer	1.5 or 2.5**	✓	2.5		
	Active dispersal layer	1.5 to 2.5				
	Active positive pressurisation	1.5 to 2.5				
Membrane	Ground gas resistant membrane***	2	✓	2	✓	2

Total Points Achieved	4.5	4.0
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* To achieve a score of 1.5 the raft or suspended floor slab should be well reinforced to control cracking and have minimal penetrations cast in.

** 2.5 points = very good performance. 1.5 points = good performance.

*** To achieve the 2 points the gas membrane must meet all criteria set out in BS:8485 (2015) + A1 (2019) Table 7.

5.2 Floor Slab Details

Beam and block suspended floor slabs (such as Litecast or Jetfloor) are to be utilised for this proposed residential development, as such construction is deemed adequate for the CS2 designation of plots 05-11. The below cross-section details the elements of construction required for the proposed floor slabs.

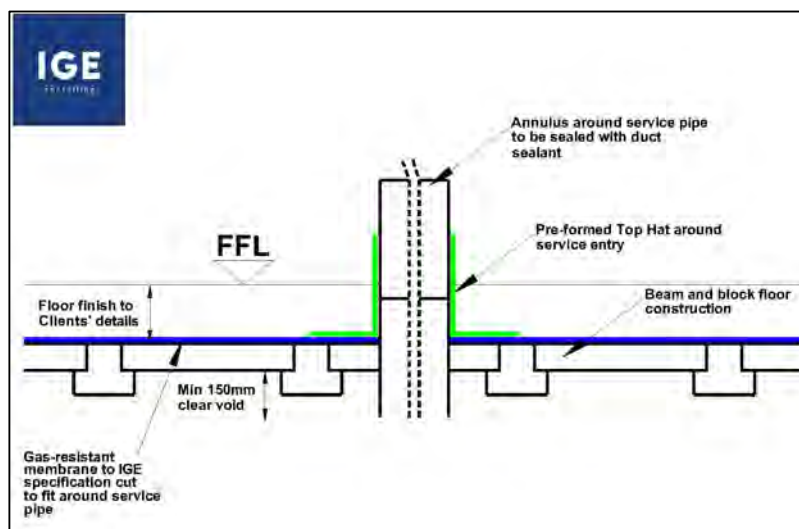


Figure 7 – Service entry detail including pre-formed top hat (green) and location of ground gas-resistant membrane (blue).

This drawing is not to scale. Use detailed dimensions only.

5.3 Ground Gas Membrane Installation Guidance

Some example membranes which meet the above required specification include:

- Visqueen 'Gas Barrier' or NF-400 (blue), NOT Visqueen 'Low Permeability Membrane' (yellow);
- Juta 'GP1';
- Alderburgh 'Alderprufe GRA'.
- Monarflex 'Reflex Super'; and
- Radbar 'Amber 2 Foil Barrier'.

Installation accessories will also be necessary, including:

- Jointing tape (double sided, gas resistant tape), or hand welding equipment;
- Pre-formed top hats;
- Jubilee clips;

- Although not essential, gas resistant 'detail tape' is an easy way to install complex joints such as corners and non-standard service entries.

All membrane installation must be undertaken to manufacturer's specification. An example of correct installation is shown in Appendix 5 – *it must be noted that this is a Visqueen information sheet, however, whilst this is considered a good example, IGE do not endorse any specific brand and the methods can be applied to any membrane brand.*

All service entry points should be fitted with pre-formed gas resistant 'top hats'. Top hats should be sealed to the pipe and gas membrane utilising double sided jointing tape and fixed with a jubilee clip. An example of the method of installation of these top hats is shown above.

Adequate ventilation through internal obstructions is to be installed in line with the above recommendations. Joints between sheets of gas membrane should be lapped (minimum overlap of 150mm) and taped between sheets with appropriate double-sided tape in accordance with the manufacturer's recommendations.

A set of example photographs of good practice installation are contained in Appendix 5.

It is unknown which construction company are appointed to install the gas protection measures. The installers should be appropriately trained and experienced in the installation of ground gas resistant membranes.

In line with CIRIA C735 (2014), an independent verifier should be appointed to verify the installation of the gas protection measures. A visual inspection method, including pick testing, should be undertaken and this is recommended to be carried out at every plot. This must be undertaken following the laying of the beam and block pre-cast floor units and laying of the gas membrane, but prior to laying insulation and finishes.

The independent verifier should:

- Identify that the correct membrane has been used, including sealing / jointing tape and pre-formed components e.g. tophats, corners.
- Inspect the general condition of the membrane for rips, tears and punctures.
- Check that all jointing has been carried out to the manufacturer's specification.
- Check that the membrane has been installed correctly across cavities, including correct jointing in these areas.
- Check that top hats have been correctly installed around service entries, including jubilee clips around the pipe and correct lapping and jointing to the membrane at the base.
- Check that vents have been installed around the perimeter of the building in sufficient number and in the correct locations, including inspecting the condition i.e., not blocked or otherwise restricted.
- Check the presence of a clear void or gravel layer, depending which of the above two options are chosen, including measuring that this is of a sufficient depth and the void / gravel layer has not been filled or otherwise compromised. Check that internal sleeper walls are also vented to provide adequate flow-through within the void so that none of the walls are blocking off unvented sections within the void.
- Take photographs to provide evidence of the above.

The verifier should make an appropriate record of the above information for inclusion within a validation report.

5.4 Verification Report

The verification report shall include, as a minimum, the following:

- Objectives of the verification.
- A brief overview of the site conditions and summary of the ground gas regime.
- A description of the installation, including gas-resistant membrane manufacturer and type used (including sealing / jointing tape and pre-formed components e.g. top hats, corners). The manufacturer specification / datasheet shall be included.

- Installer and verifier and credentials of such organisations, i.e. level of competency of installer – NVQ Level 2 or general groundworker.
- Detailed description of any deviations from the specification provided in this report, with explanation and justification of such deviations.
- As-built construction drawings and product specifications of components used.
- A description of the verification approach – in this case visual inspection, including pick testing, at a rate of one per plot.
- Verification evidence – in this case photographic evidence of each verified plot at the frequency outlined above.
- Any record of relevant communications with regulatory bodies.
- Verification conclusions, including any future monitoring or management requirements (anticipated none in this case due to passive approach), and limitations of the measures installed.

When the above has been completed and prior to occupation, this information should be compiled in a validation / completion report which should be submitted to and approved in writing by the local planning authority and insurer.

Radon

The UKRadon.org Indicative Atlas of Radon indicates that the site lies within an area where less than 1% of homes are above the Action Level, consequently, no radon protection measures are required.

6.0 OTHER REMEDIAL REQUIREMENTS

6.1 Discovery Strategy

In the event of unexpected contamination being discovered, the Discovery Strategy must be followed – this is contained in Appendix 3.

6.2 Design Variation

Following any variation in a finalised proposed development layout and / or detailed design including earthworks design it is recommended that the above conclusions are re-appraised to determine their suitability.

APPENDIX 1

LIMITATIONS OF INVESTIGATION WORK AND REPORT

LIMITATIONS OF REPORT

This consultancy report was compiled and carried out by IGE Consulting Limited ('IGE') for the client, as defined in the main report (the 'client'), on the basis of a defined programme and scope of works and the terms of a contract between IGE and the client. IGE undertook this with all reasonable skill and care, taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between IGE and the client. IGE cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices. This report may not be relied upon, or transferred to, by any other party without the written agreement of its author. If a third party relies on this report, it does so wholly at its own and sole risk and IGE disclaims any liability to such parties.

It is IGE's understanding that this report is to be used for the purpose described in the 'Brief' section of this report. That purpose was a significant factor in determining the scope and the services to be provided. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without IGE's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of IGE.

This report is a function of the date it was written and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of IGE. In the absence of such written advice of IGE, reliance on the report in the future shall be at the client's own and sole risk. Should IGE be requested to review the report in the future, IGE shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between IGE and the client.

The observations and conclusions described in this report are based solely upon the scope of works agreed between the client and IGE. IGE has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. IGE is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the agreed scope of works. For the avoidance of doubt, this report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species (e.g. Japanese Knotweed). It is recommended that the client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the suspected presence asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace full and proper surveys.

Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. The geo-environmental sections are written in broad agreement with BS 10175:2026

LIMITATIONS OF INVESTIGATION WORK

Desk Study References

This report is based upon IGE's observations of existing physical conditions at the site gained from a walkover survey of the site together with IGE's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. Reliance has been placed on this publicly available data obtained from the sources identified in the main report. When using the information, it has been assumed that it is correct. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst IGE have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report. IGE did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services. IGE is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to IGE and including the doing of any independent investigation of the information provided to IGE except when otherwise provided in the terms of the contract between the client and IGE.

Historical Mapping

Historical Ordnance Survey maps do not provide a comprehensive description of a site history. They provide details of the site from a date prior to the publication of the map (i.e. a snapshot in time). The period between map editions can be substantial (i.e. several decades). Not all map series are available for every date range in many areas of the UK and therefore there will be gaps in this mapped record for some sites. Potentially contaminative land uses could have been present and removed during such periods and may therefore not form a part of this particular record. In addition, there will be potentially contaminative land uses which are not identified on the map records such as small scale storage / use of hazardous materials, illegal / unlicensed waste disposal activities etc. Different map series identify different features utilising different symbols which can result in features that remain on-site being removed from maps. Some features are also not mapped for security reasons (e.g. airfields and other military installations). These areas are mostly shown as blank areas on historical maps.

Site Walkover

During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.

Flooding

Flooding in this report is defined as flooding caused by the sea, ditches, rivers, streams, ponds, lakes, reservoirs and the like. It does not extend to flooding caused by surcharged piped drainage systems and investigations into flooding of this nature are excluded from this report.

Extent of Contamination Studies

Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

The conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the reporting in full. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Intrusive Investigation

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 can also be variable and as investigation excavations 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. The explored extent of the site area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis 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.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Exploratory Holes

Where exploratory holes have been carried out as part of this investigation, the spacing has been determined to provide a reasonable indication of the general ground conditions across the site, but the number has ultimately been limited by commercial constraints. The findings of the exploratory holes relate specifically to the exploratory hole locations and are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations.

Extent of Contamination Testing

The extent of contaminated land testing carried out on samples obtained from the site has been determined in accordance with the latest legal guidance issued by the government to provide, with reasonable certainty, the probable general levels of contamination present on site that could pose a significant hazard to human health or waters. The extent of site investigation works including chemical testing has also been limited by reasonable commercial constraints. Although extensive testing of samples has been carried out, the volume of samples taken for testing are a minute fraction of the total volume of soils and groundwater present on site. Therefore, there is a residual risk that undetected pockets of contamination may be present on site, situated between testing locations.

When investigating or developing potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and temporally. The absence of certain ground, ground gas, contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Extent of Geo-Environmental Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species e.g. Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace a full and proper survey. If an Unexploded Ordnance (UXO) report has been obtained within the report, it has been so on the basis of Health and Safety concerns and no assessment has been made other than transcribing the

recommendations of the sub-contractor contained within the report. In terms of a potential contaminative source, unless ordnance has been manufactured / stored on site, UXOs will only be determined as a contaminative source following a positive identification on site.

PLANNING CONTEXT

Planning Policy Wales (PPW) sets out the national land-use planning framework for Wales, emphasising the central role of the planning system in delivering **sustainable development** and improving environmental, social and economic well-being. PPW forms part of the Welsh Government's national planning policy and is supplemented by Technical Advice Notes and related guidance.

PPW highlights that **sustainable management of natural resources** and **placemaking** are key principles guiding planning decisions. This includes ensuring that development protects Wales' natural assets, minimises pollution, and supports a resilient, low-carbon environment. Audit Wales emphasises that sustainability is central to Welsh planning policy, particularly in relation to reducing environmental impacts and making best use of land.

Previously Developed Land and Effective Use of Land

PPW recognises the importance of making efficient use of land and encourages the redevelopment of **previously developed (brownfield) land**, where this is suitable for the intended use. This aligns with wider Welsh policy objectives to regenerate degraded or underused land and contribute positively to sustainable place-making. Audit Wales notes that making best use of brownfield land is a key aspect of sustainable development in Wales.

In this context, PPW supports opportunities to address issues such as **despoiled, degraded or contaminated land** through appropriate remediation and redevelopment where necessary to ensure sites are suitable for future use.

Natural Environment and Pollution Considerations

PPW requires that new development must not cause, or be exposed to, **unacceptable risks from pollution**—including soil, air, water, and noise pollution—or from **land instability**. While PPW does not reproduce the NPPF's wording, it similarly emphasises that planning authorities must consider the environmental risks arising from ground conditions and ensure proposals protect human health, biodiversity, controlled waters, and the wider environment. Natural Resources Wales (NRW) identifies land contamination as a potentially significant risk to human health, ecosystems, property and water quality, requiring proper assessment and management during planning.

Contaminated Land, Suitability for Use and Regulatory Requirements

In Wales, responsibilities relating to contaminated land arise through both the planning system and **Part 2A of the Environmental Protection Act 1990**, implemented via the Contaminated Land (Wales) Regulations. The Welsh Land Contamination Working Group notes that local authorities must identify and assess potentially contaminated land, ensuring it is appropriately remediated to protect public health and the environment.

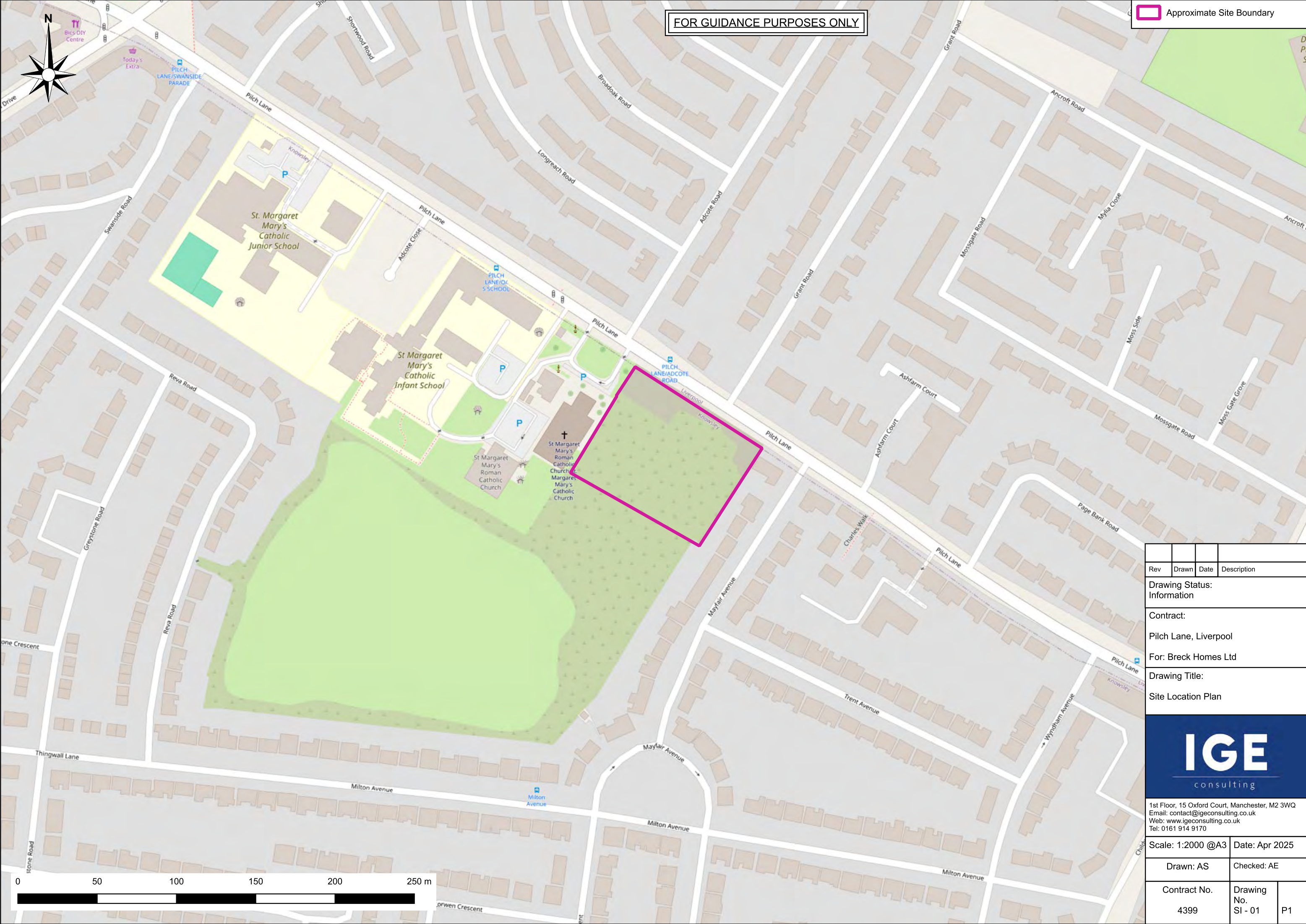
Guidance such as *Development of Land Affected by Contamination: A Guide for Developers* (WLGA & Environment Agency Wales) provides good-practice expectations for risk assessment, remediation and verification to ensure land is suitable for its proposed use. This guidance outlines the need for competent professionals to undertake site investigations and prepare the technical information required to support planning decisions.

Competency and Site Investigation Requirements

Planning submissions must be supported by **adequate site investigation information** prepared by competent and appropriately qualified professionals. Welsh guidance emphasises that developers are responsible for identifying the presence, scale and significance of contamination and undertaking necessary remediation so that the land is suitable for the proposed end use. This report has been prepared and authorised by personnel who are competent in accordance with recognised Welsh land contamination guidance and good practice.

APPENDIX 2

FIGURES AND DRAWINGS



FOR GUIDANCE PURPOSES ONLY

Approximate Site Boundary

Rev	Drawn	Date	Description
Drawing Status: Information			
Contract: Pilch Lane, Liverpool			
For: Breck Homes Ltd			
Drawing Title: Site Location Plan			
IGE consulting			
1st Floor, 15 Oxford Court, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:2000 @A3		Date: Apr 2025	
Drawn: AS		Checked: AE	
Contract No. 4399		Drawing No. SI - 01	P1

KEY

- S.W. Foul
- Proposed Sewer
- Proposed Disconnection Manhole
- Proposed Finished Floor Level
- Proposed Level
- Existing Level
- Existing Combined Sewer
- Existing Surface Water Sewer
- Permeable private driveway construction
- Denotes possible retaining wall locations (above 600mm).
- Denotes possible SUDs feature location (Filter Drain)
- Denotes possible SUDs feature location (Grass filter strip)

All individual private drives to have permeable construction. Drive areas have been included in impermeable areas/ hydraulic calculations

Ground conditions to be investigated for infiltration potential with testing in accordance with BRE 365

Current Drainage Drainage Hierarchy Considerations:

1. Site investigation confirms infiltration will not be suitable.
2. No known watercourses, ditches or waterbodies within vicinity of site. Nearest Main River is 770m to the South of the site.
3. SW Sewer in Pilch Lane is the most suitable discharge location for SW.

Proposed Surface Water Sewer connection to Ex MH 9106. Ex MH arrangement to be investigated and replaced with new manhole if required.

Existing Sewer depths to be confirmed on site to ensure proposed sewer crossings have sufficient clearance.

Proposed Foul Sewer connection to Existing 225mmØ Combined Sewer at Ex MH 8201. Ex MH arrangement to be investigated and replaced with new manhole if required.

Control Manhole with vortex flow control unit to limit flows 5.0 l/s @ 1.5m head (98mmØ Orifice) - QBar Greenfield Runoff Rate for the development is 5.4 l/s.

Private offline Cellular storage tank with high level overflow above 30 year water level and non-return valve on drain down pipe. Dimensions 4.5 x 17 x 0.4m. I.L = 32.380m

Private offline Cellular storage tank with high level overflow above 30 year water level and non-return valve on drain down pipe. Dimensions 4.5 x 15 x 0.4m. I.L = 32.520m

C	16/12/25	BK	Updated to latest Architects Layout.
B	16/09/25	BK	Drainage revised to suit UU discharge rate.
A	05/06/25	RDE	Drainage hierarchy note added
Rev	Date	Initials	Details

Drawing Revisions

North Point	Pilch Lane Liverpool	IronsidesFarrar
Quality Ass.	Client	Environmental Planners
UKAS 005	Breck Homes	Civil Engineers
Quality Assurance		Landscape Architects
ISO 9001:2015		Graphic Design
SCS Certificate GB02/54539		
Original Site	Copyright, Acknowledgment	Drawn
A1	Ordnance Survey®	NE
	© Crown Copyright.	Checked By
	All rights reserved.	RDE
	Licence No. AL100017966.	Date
		April 25
		Scale
		1:250
Drawing No.	Revision	
30686/100	C	

APPENDIX 3

DISCOVERY STRATEGY



DISCOVERY STRATEGY

1st Floor
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Manchester
M2 3WQ

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Web: www.igeconsulting.co.uk

What to Look Out For

Potentially contaminative material can be identified as follows:

- Appears oily / has an iridescent sheen
- Hydrocarbon odour e.g., oily or petroleum odour
- Solvent odour e.g., sharp or sweet odour
- Waste materials e.g., metals, plastic etc.
- Asbestos e.g., fibrous sheeting / roofing / board / lagging etc.
- 'Landfill' odour e.g., rotten / putrefying / leachate odour

Or any other material that looks man-made or does not match its surroundings – if in doubt, check.

Procedure for Discovery of Unexpected Contamination

If any of the above material is discovered, the following procedure must be carried out:

- a) Stop works in the area of the contamination discovery.
- b) Inform the Site Manager.
- c) Record the visual and olfactory evidence of contamination.
- d) Suitably qualified geo-environmental engineer to investigate the contamination; take samples, photographs and in-situ tests and discover the extents of the contamination, and to identify potential contaminants and specify chemical testing, if necessary.
- e) Either dig out the contaminated material and stockpile, on an impermeable membrane if necessary, or leave in-situ whilst awaiting chemical test results, if needed – whichever presents the least risk.



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- f) Suitably qualified geo-environmental engineer to re-visit the site's risk assessment, taking into account the newly discovered contamination and recommend remediation, if necessary, or other next steps.
- g) If the risk assessment and remediation strategy is changed as a result, the Local Authority and/or the Environment Agency should be informed and/or consulted.
- h) Lastly, undertake remediation of the affected area if this has been deemed appropriate.

Procedure for Discovery of an Unexpected Tank

Former industrial sites may contain unrecorded underground storage tanks (USTs).

Follow the below steps if a UST is found:

- a) Stop works in the area of the UST discovery.
- b) Inform the Site Manager.
- c) Suitably qualified geo-environmental engineer to investigate the tank, including measuring the size, contents, condition, and visual and olfactory evidence of contamination. Geo-environmental engineer to record the location of the tank on a site plan, take photographs, and sample the contents to send for chemical testing to determine the contents.
- d) Suitably qualified contractor to empty the tank and dispose of contents at a suitably licensed disposal facility.
- e) Suitably qualified contractor to undertake integrity testing in line with the 'Blue Book' method (APEA / EI '*Design, Construction, Modification, Maintenance and Decommissioning of Petrol Filling Stations*' 4th ed. (April 2018)), to determine whether the tank is intact or has been compromised.
- f) Suitably qualified geo-environmental engineer to undertake a risk assessment based on the contents of the tank and the results of the integrity testing, to determine whether to decommission the tank and leave in-situ or to remove the tank.
- g) Suitably qualified contractor to clean and 'inert' the tank, and provide a gas safe certificate, in line with the 'Blue Book' method.

- h) Suitably qualified contractor to either decommission the tank in-situ in line with the 'Blue Book' method or remove the tank and dispose of at an appropriate facility.
- i) If excavated and removed, suitably qualified geo-environmental engineer to investigate the base and the sides of the resultant excavations and if any contamination is found, undertake the Procedure for Discovery of Unexpected Contamination above.

APPENDIX 4

EXAMPLE CLEAN COVER SYSTEM REQUIREMENTS

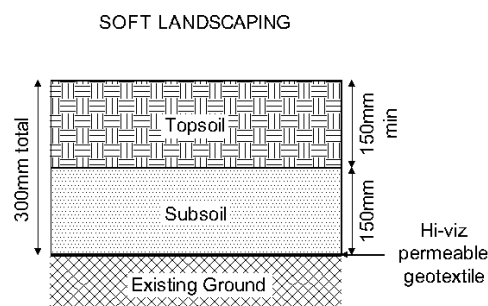
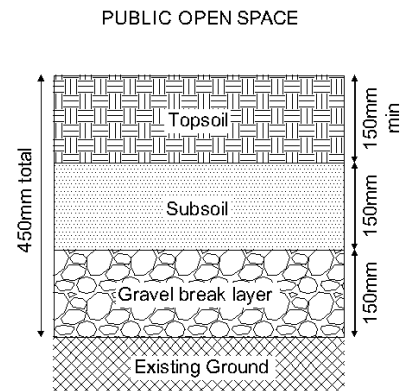
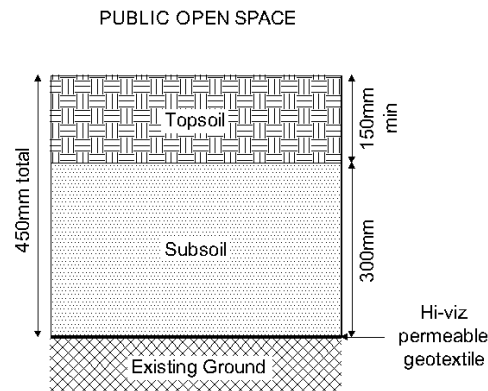
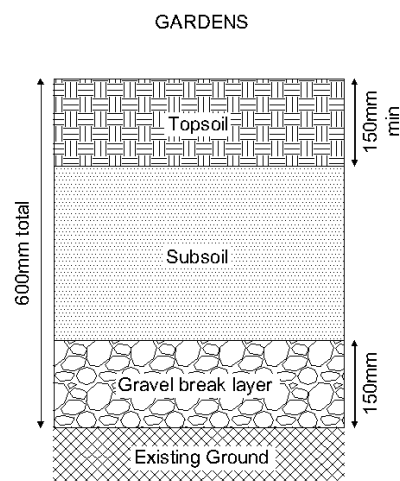
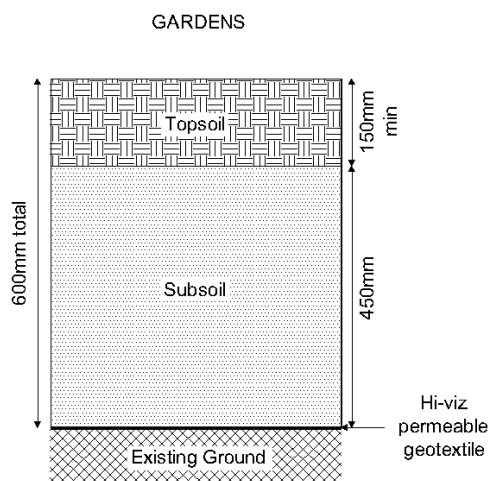
EXAMPLE CLEAN COVER SYSTEM REQUIREMENTS

The following diagrams show example clean cover system installations for gardens, public open space, and soft landscaping:



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Manchester
M2 3WQ

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Web: www.igeconsulting.co.uk



Refer to site specific Remediation Strategy for recommended installation.

EXAMPLE INSTALLATION OF CLEAN COVER SYSTEM

The following example shows the clean cover system installation in line with the following requirements:

- A 600mm clean cover system comprising:
 - A minimum of 150mm topsoil, underlain by
 - 300mm subsoil, underlain by
 - 150mm gravel break layer
 - A hi-viz geotextile marker

It should be noted that most cover systems require **either** a gravel break layer **or** a hi-viz geotextile marker, but the below example uses both:

Figure 1: First, the gardens are dug out to 600mm below FFL and lined with a hi-viz geotextile marker:



Figure 2: The geotextile is overlain by a 150mm clean stone break layer.



Figure 3: The break layer is overlain by 300mm sub-soil, seen here before spreading across the garden:



Figure 4: The sub-soil is overlain by 150mm topsoil to FFL:



Figure 5: The gardens are finished with turf. The overall cover system depth is 600mm:

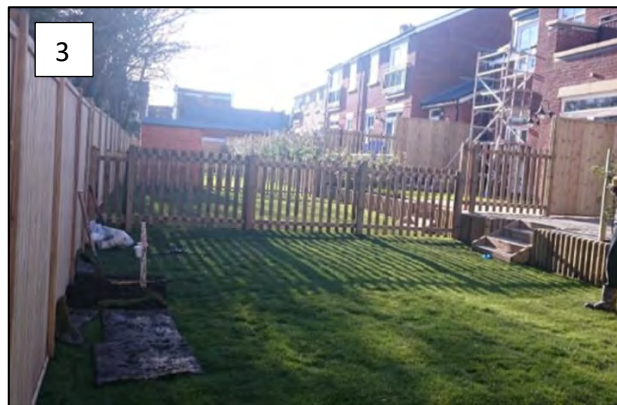


EXAMPLE CLEAN COVER SYSTEM VALIDATION

The following example shows validation of a clean cover system in line with the following requirements:

- A 600mm clean cover system comprising:
 - A minimum of 150mm topsoil, underlain by
 - 450mm subsoil

Best practice requires three photos as follows:



Photograph 1 – Identifies the plot number and shows the validation dig location in relation to the plot.

Photograph 2 – Shows the validation depth clearly, using a staff and a marker which crosses the hole. Shows the topsoil and subsoil, and the base of the hole.

Photograph 3 – Shows the validation hole in context. The plot being validated can be seen, along with nearby plots.

The validation should be written up into a Verification Log, shown below:



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email: contact@igeconsulting.co.uk
web: www.igeconsulting.co.uk

Verification Log

Project Name:

Project Number:

Location:

Client:

Remediation Requirements:

Validation Requirements:

Plot Number:

Grid reference:

Inspection date:

Engineer:

Photographs:

Photographs shows

This plot has PASSED / FAILED* verification (*delete as appropriate*)

*Proposed further remedial works (if FAILED):

An additional inspection IS / IS NOT required for this plot (*delete as appropriate*)

CLEAN COVER SYSTEM TESTING RATES

Soils intended for use in private gardens, public open space, and soft landscaping must be tested to confirm their suitability for use.

Imported topsoil and subsoil is required to be tested at source prior to import to confirm suitability. All topsoil and subsoil, whether site-won or imported is required to be tested at the following frequency:

Source	Material End Use	Sampling Frequency ¹	Testing Suites ³ (see below)
Greenfield Source:	Topsoil	1 per 200m ³	A, B, C, D, F
	Subsoil	1 per 200m ³	A, B, C, D, G
Brownfield Source:	Topsoil	1 per 50m ³	A, B, C, D, F
	Subsoil	1 per 100m ³	A, B, C, D, G
	General Fill ²	1 per 1000m ³	A, B, C, E, H

- 1) Minimum 3 samples regardless of volume.
- 2) 'General Fill' is material used primarily to raise levels, specifically not within areas of private gardens, public open space, or soft landscaping, e.g. 6F2.
- 3) In addition to the standard suites given, the laboratory testing suite should include any additional contaminants of concern based on the source of the samples.

Testing Suites:

- A.** Asbestos ID, Asbestos quantification.
- B.** pH, total and free cyanide, soluble sulphate, organic matter.
- C.** Arsenic, Beryllium, Boron, Cadmium, Chromium (III and VI) Copper, Lead, Inorganic Mercury, Nickel, Selenium, Vanadium, Zinc.
- D.** Speciated PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene.
- E.** Total (non-speciated) PAHs.
- F.** Speciated Total Petroleum Hydrocarbons (TPH): Aliphatic >EC5 - EC6, >EC6 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, and > EC35 - EC44, and Aromatic >EC5 - EC7, >EC7 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, > EC35 - EC44.
- G.** 3-band Total Petroleum Hydrocarbons (TPH): TPH EC6-10, EC10-25, EC25-40.
- H.** Total Petroleum Hydrocarbons (TPH): TPH EC6 – EC40.

Once tested, the results are to be compared against the following Acceptability Criteria:

CLEAN COVER SYSTEM ACCEPTABILITY CRITERIA

Soils intended for use in private gardens, public open space, and soft landscaping must be tested at the rates outlined above and compared to the following acceptability criteria, to confirm their suitability for use:

Suite	Determinand (mg/kg unless stated)	Acceptability Criteria for:			
		Private Gardens	Public Open Space (residential)	Soft Landscaping or Public Open Space (Park)	General Fill
A	Asbestos (%)	ND	ND	ND	<0.001 – 0.01%
B	pH	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>5 - <10 ⁽³⁾
	Total Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Free Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Soluble Sulphate (mg/l)	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾
C	Arsenic	37	79	170	640
	Beryllium	1.7	2.2	63	12
	Boron	290	21000	46000	240000
	Cadmium	11	120	560	190
	Chromium (III)	910	1500	33000	8600
	Chromium (VI)	6	7.7	220	33
	Copper	2400	12000	44000	68000
	Lead	200 ⁽¹⁾	630 ⁽¹⁾	1300	2330 ⁽¹⁾
	Inorganic Mercury	40	120	240	1100
	Nickel	130	230	800	980
	Selenium	250	1100	1800	12000
	Vanadium	410	2000	5000	9000
	Zinc	3700	81000	170000	730000
D	Naphthalene	2.3	4900	1200	
	Acenaphthylene	170	15000	29000	
	Acenaphthene	210	15000	29000	
	Fluorene	170	9900	20000	
	Phenanthrene	95	3100	6200	
	Anthracene	2400	74000	150000	
	Fluoranthene	280	3100	6300	
	Pyrene	620	7400	15000	
	Benzo(a)anthracene	7.2	29	49	
	Chrysene	15	57	93	
	Benzo(b)fluoranthene	2.6	7.1	13	
	Benzo(k)fluoranthene	77	190	370	
	Benzo(a)pyrene	2.2	5.7	11	
	Indeno(1,2,3-cd)pyrene	27	82	150	
	Dibenz(a,h)anthracene	0.24	0.57	1.1	
	Benzo(ghi)perylene	320	640	1400	
E	Total PAHs				1000 ⁽⁴⁾
F	TPH-CWG - Aliphatic >EC5 - EC6	42	570000	95000	
	TPH-CWG - Aliphatic >EC6 - EC8	100	600000	150000	
	TPH-CWG - Aliphatic >EC8 - EC10	27	13000	14000	
	TPH-CWG - Aliphatic >EC10 - EC12	130	13000	21000	
	TPH-CWG - Aliphatic >EC12 - EC16	1100	13000	25000	
	TPH-CWG - Aliphatic >EC16 - EC21	65000	250000	450000	
	TPH-CWG - Aliphatic >EC21 - EC35				
	TPH-CWG - Aliphatic > EC35 - EC44	65000	250000	450000	
	TPH-CWG - Aromatic >EC5 - EC7	70	56000	76000	
	TPH-CWG - Aromatic >EC7 - EC8	130	56000	87000	
	TPH-CWG - Aromatic >EC8 - EC10	34	5000	7200	
	TPH-CWG - Aromatic >EC10 - EC12	74	5000	9200	
	TPH-CWG - Aromatic >EC12 - EC16	140	5100	10000	
	TPH-CWG - Aromatic >EC16 - EC21	260	3800	7600	
	TPH-CWG - Aromatic >EC21 - EC35	1100	3800	7800	
	TPH-CWG - Aromatic > EC35 - EC44	1100	3800	7800	

G	TPH > EC6 - EC40				5000 ⁽⁴⁾
H	Benzene	0.087	72	90	
	Toluene	130	56000	87000*	
	Ethylbenzene	47	24000	17000*	
	p & m-xylene	56	41000	17000**	
	o-xylene	60	41000	17000*	
	MTBE (Methyl Tertiary Butyl Ether)	LOD ⁽³⁾	LOD ⁽³⁾	LOD ⁽³⁾	

LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015) used unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) CL:AIRE Soil GAC for Human Health Assessment (January 2010)
- 3) In-house screening criteria used as no GAC methodology currently exists
- 4) Hazardous waste thresholds. This limit only applies to imported material, not to in-situ soil.

Assumed 1% SOM (most conservative) for those values dependent upon SOM.

ND = Not Detected

LOD = Limit of Detection

*Exceeds vapour saturation limit

**Exceeds solubility saturation limit

APPENDIX 5

EXAMPLE OF CORRECT GAS RESISTANT MEMBRANE INSTALLATION

Product Installation

How to lap and joint a membrane above a floor slab



Remove loose debris from the surface of the floor slab and unroll the first sheet of membrane. The surface of the slab should be smooth and free from projections or indentations – if very rough, apply a sand blinding.



Remove the protective paper from one side of the appropriate jointing tape and apply it to the first sheet, starting about 50mm from the edge. Ensure that all surfaces are dry for maximum adhesion.



Unroll the second sheet along the joint, overlapping the first by at least 150mm. Press firmly onto the double sided tape, gradually removing the protective paper.



Seal the edge of the overlap with appropriate sealing tape.

How to joint the cavity tray to the membrane at the floor perimeter



Install the DPC starting from the outside of the external wall, over the inner masonry leaf and finishing at least 200mm from the wall.



Just before the floor topping is applied (or floor slab is cast), clean any mortar droppings, or other debris from the DPC. Remove the protective paper from the appropriate jointing tape and apply the tape to the DPC, starting about 50mm from the edge.



Lay the membrane over the floor slab (or subfloor blinding), overlapping the DPC by at least 150mm. Press firmly onto the appropriate jointing tape, gradually removing the protective paper.

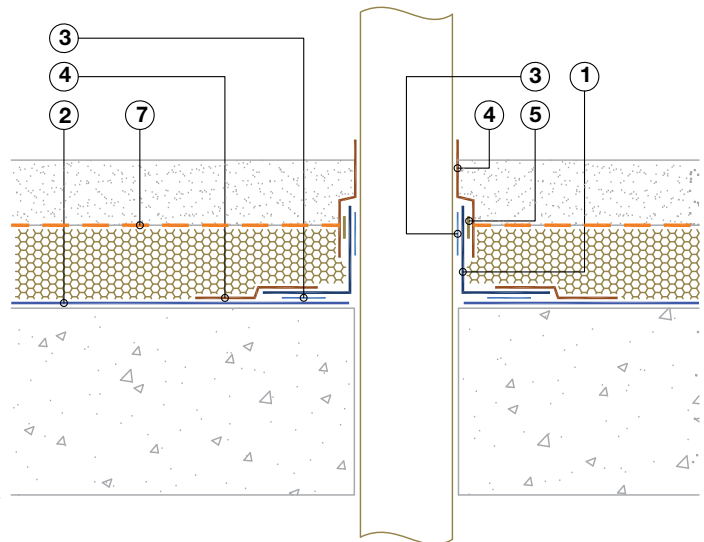


Seal the edge of the overlap with appropriate sealing tape.

Service Pipe Penetrations

Damp proof and airtight seals should be formed around all service entry points. Visqueen Top Hat Units are available for sealing around pipe units. The full system consists of:

- Rigid preformed pipe sleeve (top hat) unit – available for either 110mm, 135mm or 160mm
- External diameter pipes.
- Flexible preformed pipe sleeve (Top Hat) unit – supplied to suit pipe.
- External diameter as required.
- Double sided jointing tape.
- Girth lap tape.
- Foil lap tape – for gas applications.

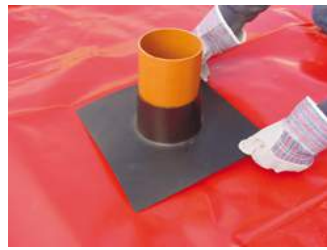


Key			
1	Preformed Pipe Sleeve	5	Jubilee Clip
2	Visqueen Gas Barrier	6	Visqueen TreadGUARD 1500
3	Visqueen Double Sided Tape	7	Visqueen Vapour Barrier
4	Visqueen GR Lap Tape	8	Smooth Sand Blinding Layer

How to install a top hat



Cut a circular hole in the membrane as close as possible to the pipe, or pipe socket. Ensure that pipe penetrations do not occur at joints in the membrane.



With the pipe in position, slide the Visqueen Preformed Top Hat Unit over the pipe (various diameters are available – 110mm being the most common).



Mark the extent of the square horizontal skirt over the membrane and also mark the line of the top of the top hat unit around the pipe.



Raise the top hat unit and cut four lengths of Visqueen Double Sided Jointing Tape, one for each side of the horizontal skirt. Allowing for an overlap at each corner. Cut one length to go round the pipe.



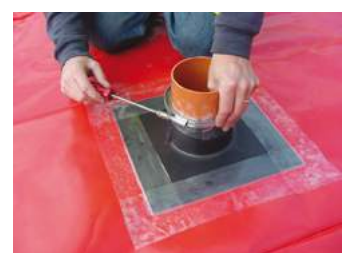
Start to remove the protective paper from the double sided tape around the pipe and raise it up at an angle so that it will project above the top hat unit when it is stuck to the membrane.



Release the protective paper from each of the four lengths of double sided tape. Lower the top hat unit, ensuring that the free end of the protective paper around the pipe is reachable, and seal the horizontal skirt to the membrane.



Gradually remove the remainder of the protective paper from the double sided tape around the pipe.



Seal the junction of the horizontal skirt and the membrane with the appropriate sealing tape and secure the top hat unit to the pipe with a jubilee clip.

APPENDIX 6

OUTLINE EARTHWORKS SPECIFICATION

EARTHWORKS SPECIFICATION

An Earthworks Specification has been undertaken for the site in line with NHBC Chapter 4.6 and based on finalised proposed levels. A DoWCoP Materials Management Plan should also be produced for the site in conjunction with the below earthworks specification. However, a Materials Management Plan cannot be undertaken until this remediation strategy is approved.

The earthworks specification shall include relevant conditions to be satisfied during construction to ensure the following are met:

- materials are chemically suitable for the project and the surrounding environment;
- materials should be durable, and not prone to deterioration or non-biodegradable;
- earthworks should provide a stable finished surface that will limit post-construction settlement or movement within the engineered fill; and
- the earthworks should provide a surface of sufficient stiffness and/or shear strength for the intended use.

The earthworks specification is based on industry guidance such as the Specification for Highway Works, BS EN 16907 'Earthworks', ICE Publishing – Earthworks: A Guide '2nd Edition', and previous experience. Once agreed with NHBC, the earthworks specification should not be amended on site without prior agreement with NHBC.

3.1 Geotechnical Site Classification

Geotechnical design is covered in BS EN 1997, with earthworks specifically covered by the requirements set out in BS 6031 (Code of practice for earthworks) and BS EN 16907 (Earthworks). Based on the nature of the site, the scale and extent of the earthworks and utilising Table 4 of NHBC Chapter 4.6, the site is classified as a **Geotechnical Category 1 (Geo Cat 1)** in accordance with BS EN 1997-1 and are required to be designed by an appropriately qualified and experienced person.

3.2 Site Preparation

Prior to the placement of any soils the following steps should be undertaken for the wider site:

- The site should be prepared in accordance with the earthworks specification with all vegetation, topsoil, fly tipped, stockpiled and unsuitable materials (see Section 3.2.1 below) removed prior to filling;
- The formation should be prepared by proof rolling with any hard or soft spots identified and remediated in accordance with the earthworks specification. Temporary drainage may be required to keep the formation dry;
- Relic structures, for example old foundations and hard standings associated with the former Boundary Hotel, should be removed from below engineered fill areas in their entirety wherever practicable. As a minimum, relic structures and obstructions should be removed to at least 2m below any proposed foundation. All structures or uncharacteristic elements (including boulders) greater than 1.0m in diameter/length left in the ground at formation should be surveyed and their positions recorded;
- Site constraints and features to be preserved (for example monitoring wells, public rights of way, watercourses and trees to be retained) must be clearly identified and all necessary protection and safety measures must be implemented; and
- Where the sub-formation is sloped, the sides should be stepped at a maximum height of 600mm to allow the engineered fill to be benched into the existing natural ground.

3.2.1. Unsuitable Ground Conditions

Prior to the execution of earthworks filling, unsuitable materials should be removed from the formation level including:

- topsoil, tree roots, highly organic matters, or other degradable materials;
- frozen soils;
- excessively wet or soft soils such as silty soils or clays with an undrained shear strength of less than 40kPa, where not treated to adjust their soil properties; and
- contaminated soils and soils containing slag or combustible materials.

Unsuitable materials may be treated, in some circumstances, to adjust and improve the soil properties. Further assessment would be required to determine their suitability after treatment and prior to any subsequent placement as engineered fill.

3.3 Classification Testing

Details of considerations regarding the acceptability of materials for reuse as engineered fill are provided in NHBC Chapter 4.6 Table 3 below:

Material description	Examples of material	Details on acceptability for reuse as fill
Suitable sources for fill materials	- natural sands and gravels - clays with a plasticity index of less than 40% and undrained shear strength in excess of 40kPa - chalk (structured chalk of grades C5 to A1 only) - crushed rock - crushed concrete, brick or stone	Typically, the material would be acceptable to NHBC for engineered fill, provided that it complies with appropriate classification criteria. For material that is solely crushed brick, further assessment of strength will be required to ensure its durability.
Hazardous materials	- reactive materials - materials that include sulfides or sulfates, eg gypsum - organic materials - materials that cause noxious fumes, rot, undue settlement or damage to surrounding materials	Appropriate testing required to demonstrate their suitability.
Fill material requiring NHBC acceptance	- unburnt colliery spoil or shale (carbonaceous mudstone) with excessive coal or pyrite content - colliery shale (ie, burnt shale or red blaze) - steel slags - furnace ashes and other products of combustion - material obtained from demolition without screening, crushing and processing - soils with a silt content greater than 20% and where it will alter the behaviour of the overall engineered fill - highly variable materials - on wet sites, or sites with a high-water table, crushed or broken bricks which have no limit on their soluble salt content (as defined in BS EN 771) - high plasticity site won clays with a plasticity index of 40% or greater - PFA (excluding lagoon PFA)	Not to be used as engineered fill unless a written agreement has been obtained from NHBC (appropriate testing and supporting technical report to be provided to demonstrate their suitability). Sulfate-resisting cement to be used where PFA fill ⁽¹⁾ are present.
Unsuitable fill materials	- soils containing topsoil or significant organic matter (such as leaves or wood) greater than 6% by volume - degradable, reactive or non-durable materials - expansive materials, (ie, steel slag and gypsum containing materials) where testing has not determined their risk - materials capable of releasing contaminants or hazardous gases - combustible materials (ie, materials with a high calorific value greater than 7MJ/kg) placed within the top 1m of the finished development platform - materials containing significant amounts of plaster, plastic or rubber over 2% by weight - materials containing harmful substances which pose a risk to human health and the environment - structureless chalk (with grades Dm and Dc) - materials that are not generally used as engineered fill on residential sites - Lagoon PFA and other saturated materials like tailings and sludges	Fill containing these constituents are NOT acceptable for use.

All earthworks materials should comply with Clause 601 of the Specification for Highway Works and shall fall into the Classes of Material determined by testing and defined in Table 6/1 of Manual of Contract Documents for Highway Works (MCDHW): Volume 1: Specification for Highway Works (SHW) and NHBC Chapter 4.6 (2026).

A testing frequency of **1 per 500m³** of material is considered suitable for the proposed earthworks in line with Table 6/1 and should be completed prior to any earthworks.

If different strata are encountered across the site that fall into different classes as defined above, then an approximate volume of each strata will be calculated and the sampling frequency altered to suit.

The Contractor shall be responsible for classifying earthworks materials and for ensuring that all materials incorporated in the permanent works are acceptable. Contract-specific Classification and Acceptability Criteria are as given in SHW Table 6/1. It is currently anticipated that all noncontaminated material arising from the site will conform to one or other of the classes once sorting crushing and screening has taken place.

However should materials excavated not conform to the classification and acceptability Criteria given in the tables it should be classified as Class U1A material. Class U1A material shall be dealt with in accordance with SHW Appendix 6/1. Any contaminated material: Class U1B and U2 shall be dealt with in accordance with SHW Appendix 6/2.

3.3.1 Processing of Unacceptable Material (Class U1A)

Unacceptable material Class U1A arising from excavations on site shall as far as practicable be processed to render it acceptable for use as General Fill of Classes 1A, 1B, 2A, 2B, 2C, 4 or 6F2 as appropriate to the grading of the material being treated.

3.4 Treatment of Fill Materials

The following techniques may be used to modify the moisture content of materials to render them suitable for use as engineered fill:

- placement in windrows or layers with mechanical turning as required for drying purposes;

- the addition of lime and/or cement, typically up to 2% by weight to reduce the moisture content to nearer the optimum moisture content (OMC) for maximum dry density; and
- the addition of water by spraying or similar to increase the moisture content to nearer the OMC for maximum dry density.

The following techniques are not acceptable to NHBC for the treatment of materials for use as engineered fill:

- stabilisation to improve strength by the addition of over 2% lime or the addition of any cement or other hydraulic materials
- the addition of chemical binders or grouts.

3.5 Material Handling

Imported fill should be subject to periodic inspection from the donor site prior to arrival at the site and regular inspections once delivered. Classification testing should be undertaken as required prior to placement, particularly where the material is not provided with independent certification and where visual assessment suggests the material classification varies.

Engineered filling should not be undertaken in inclement weather conditions. Where the engineered fill is cohesive, placement and filling should be paused during extended periods of rain. For sensitive materials like chalk, care should be taken not to over-compact the fill further than specified.

Engineered fill must be placed and compacted in accordance with the specification, within a defined moisture content range close to the optimum moisture content as derived from relevant laboratory testing. For cohesive fill materials, the moisture content is critical in achieving the desired dry density. Engineered fill that is compacted too dry of the optimum moisture content (OMC) risks being vulnerable to collapse settlement or heave when wetted. Engineered fill that is compacted too wet of optimum moisture content risks being too weak to provide adequate support without excessive settlement.

3.6 Compaction Regime

Placement and compaction of engineered fill should be undertaken in layers of controlled depth using appropriate plant. Acceptable methods are considered to be those based on the recommendations from The Specification for Highways Works (SHW) Table 6/4.

The type and size of the compaction plant should be based on the volume or depth of engineered fill to be placed, the classification of the fill to be compacted, and the specification requirements.

Engineered fill should proceed in near horizontal layers (to assist in shedding surface waters) with each layer fully compacted before commencing the following layer. The maximum layer thickness for method compaction should be based on the type of fill material, the classification of the fill material, placement and the method and plant employed.

For **end product compaction**, an uncompacted layer thickness of up to 250mm subject to site-specific requirements would be acceptable. The maximum particle size should not be greater than 1/3 of the compacted layer thickness or 75mm, whichever is lower.

Filling activities should be planned and carried out so that:

- vibrations do not disturb existing or nearby properties, excavations, slopes, buildings, services or infrastructure;
- filling and earthwork machinery does not overload retaining features, slopes, buried services or infrastructure;
- ground movement including around the area of filling does not harm adjacent buildings, services or infrastructure;
- temporary slopes (filled or in cut) are safe and stable;
- under compaction and over-compaction are avoided; and
- the rate of placement of fill does not result in excess pore water pressure leading to failure of the underlying ground.

3.7 Supervision and Records

The developer or builder must arrange for a suitable site supervision and recording of the works, the recording of the site works should be in accordance with the requirements of the earthworks specification. Guidance on the level of information that is required to demonstrate the quality of the works is available in BS EN 16907-5.

3.8 Protection of Fill

Compacted engineered fill should be protected from deterioration due to trafficking, poor weather and pooling surface water. Suitable measures include laying the surface to falls to assist drainage or use of a durable granular sealing layer or sacrificial layer.

3.9 Specification Testing

The foundations on site will be constructed within natural deposits or piled (if significant fill is present or within areas of tree influence). No foundations will be constructed on placed engineered fill. Consequently, the earthworks specification on site applies solely to the proposed highways and external areas and gardens and not foundations. Consequently, the following specification options are deemed applicable based on the nature of the works:

Specification	Acceptance Criteria
End Product	>95% Maximum Dry Density (MDD) and <5% air voids.
Method	>90% Maximum Dry Density (MDD) and <10% air voids

An end product specification with an acceptance criteria of >95% Maximum Dry Density (MDD) and <5% air voids is deemed conservative given the nature of the proposed earthworks on site (most notably filling of <5m).

A method specification could be applied with an acceptance criteria of >90% Maximum Dry Density (MDD) and <10% air voids, in line with NHBC Chapter 4.6 where a method specification is recommended for a depth of fill <5m. In order to apply a method specification, the following would need to be known in line with Table 5 of NHBC Chapter 4.6:

- The thickness of fill layers to be compacted;

- Type of compaction plant; and
- Number of passes required.

The above should be determined based on the information contained in The Specification for Highways Works (SHW) Table 6/4 and the classification testing detailed in Section 3.3.

Fill compaction is most commonly established by comparing the in-situ dry densities and moisture contents with the laboratory determined maximum dry density and optimum moisture content. NHBC will normally accept engineered fill verified to achieve the criteria below:

The in-situ densities of engineered fill may be measured using sand replacement tests (SRTs), nuclear density tests (NDTs) or electromagnetic density gauges (EDGs). Where NDTs or EDGs are used, the results should be regularly calibrated against SRTs. Where there is variation in the fill materials, the use of NDT results to assess compaction may not be reliable.

3.10 Testing Frequency

The frequency of testing for classification, compliance and performance purposes should be determined according to site conditions, fill materials and their consistency, filling techniques and the proposed end use as stated in the earthwork's specification.

In situ testing should be based on a minimum number and grid with each and every layer tested, e.g. 1 per 25m x 25m grid per layer and a minimum of 3 per layer per day.

Based on Table 10 of NHBC Chapter 4.6 and the anticipated net fill, a minimum of **3 tests per 1,000m³** of placed engineered fill will be acceptable for end product compliance testing.

Variation to the above may be necessary where differing material types are to be used. Test types and frequencies should be reviewed according to the results

obtained and site conditions. Where there is greater variation in site conditions or results than anticipated, an increased frequency of testing will be required. Conversely and where agreed with NHBC, a decrease in test frequency may be acceptable where consistency in test results is being achieved.

3.11 Actions in Respect to Non-Compliant Fill

Where testing indicates compacted engineered fill does not fully comply with the requirements of the earthworks specification, appropriate action should be agreed as soon as possible with NHBC. Possible actions include:

- drying of engineered fill material prior to further placement of subsequent layers;
- excavation and replacement of the engineered fill represented by the test failure;
- additional compaction (if the failure is shallow or at the surface) and retesting;
- undertaking appropriate performance testing.

If the non-compliant engineered fill is regarded as a marginal outlier and represents part of a normal spread of test data, it may potentially be deemed acceptable without further action. It should be recorded in the Earthworks Verification Report.

The possible extent of non-compliant engineered fill needs to be carefully assessed, as well as whether the non-compliance may indicate unsuitable placement and compaction techniques, or poor site conditions, excessively variable fill or unsuitable material. Where there is a divergence from the earthworks specification, the designer should be notified and advice sought.

Remedial action needs to be carefully undertaken and recorded, avoiding disturbance to previously placed compliant engineered fill.

3.12 Verification Report

The earthworks verification report should give details as appropriate of the following:

- The contractors and personnel responsible for the filling work, including details of supervision and testing;
- Preparation works prior to earthworks filling;
- Reference to the earthworks specification and method statement(s);
- Sources of material used as engineered fill and their material classification;
- Any treatment, reconditioning or remediation of proposed engineered fill;
- Plant and methods used;
- As built survey records, including post-topsoil strip level or formation level for the earthworks, reduced levels following earthworks cuttings, final as-built or post-earthworks filling formation level, plan(s) and other drawings as appropriate that show the extent and depth of earthworks filling;
- All test results and certificates;
- Progress photographs and surveys;
- Progress reports and site diaries, with details of weather/site conditions and any agreed variations or changes to the specification;
- Graphical representation of the classification and compliance test data as show in Figure 7;
- Changes and amendments to design and earthworks specification;
- Records of remedial actions in areas of non-compliance;
- Problems experienced, and solutions and methods used to overcome the issues;
- Confirmation that the works comply with the earthworks specification and are suitable to support the proposed foundation types, where applicable (all non-compliances or departures from the earthworks specification should be clearly identified and suitably assessed);
- Drawings showing known obstructions and any relevant features under or within the engineered fill;
- Graphical representation of the load-settlement tests, surcharge trials or post-completion monitoring over time with plots of settlement versus natural and logarithm presented to demonstrate that primary settlements are complete, with a clear trend of any remaining creep settlement projected to allow for a satisfactory building performance over a 60-year design life; and

- Information required by the builder to safely undertake follow-on works in the ground, including any special precautions which should be undertaken or unusual constraints that exist, and any residual risks (for example further measures may be required where upfilling or an increase in ground levels post-remediation are likely to be proposed).

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