



Phase II Interpretive Report

Sperberry Hill Solar and BESS

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[1] Introduction

[1.1] Instruction

Ayesa was instructed by the Client, Brockwell Energy (BSSL Herts 2 Ltd.) to carry out an intrusive site investigation in order to assist in the discharge of contaminated land planning conditions for the development. Furthermore ground condition information and infiltration testing was requested to aid in the drainage design. The proposed development comprises a Solar and Battery Energy Storage System (BESS) site at Sperberry Hill, St Ippolyts, Hitchin, SG4 7NR, which is situated on farmland south of the existing National Grid Wymondley Substation.

[1.2] Objectives

The purpose of the report is to discuss the ground conditions encountered at the site during the investigation, in order to provide an informed risk assessment for the proposed commercial development, satisfying Part 2 of Condition 5 of North Hertfordshire District Council planning approval (Ref. 24/02455/FP).

This report has been devised to comply with the relevant principles and requirements of a range of guidance with regards to potentially contaminated land, including but not limited to:

- Part IIA of the Environment Protection Act, 1990;
- Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, April 2012);
- National Planning Policy Framework (HCA, February 2019);
- BS5930:2015+A1:2020 “Code of practice for site investigations”;
- BS10175: 2026 “Investigation of Potentially Contaminated Sites - Code of Practice”;
- The Building Regulations 2010. Part C (HM Government 2013);
- Environment Agency Online Guidance (October 2020): Land Contamination Risk Management Land Contamination (LCRM) (which replaced Report CLR11 (2004) Model Procedures for the Management of Land Contamination);
- Environment Agency (2011) Report GPLC1 “Guiding Principles for Land Contamination”; and,
- Environment Agency (2017) “The Environment Agency’s Approach to Groundwater Protection” November 2017 Version 1.1.

The ‘Service Constraints Report Limitations & Planning Requirements’ are presented as **Appendix A**, and a description of Environmental Risk Assessment Methodology and Terminology is presented in **Appendix B**.

[1.3] Development Proposals

The site is understood to cover an area of approximately 35.5 ha. The proposed development will comprise the following elements:

- Solar farm with associated battery energy storage site (BESS) and ancillary infrastructure.

- Construction of an access road running north to Stevenage/Blakemore End Road connecting to National Grid Wymondley Substation.

The proposed development will also include surface water drainage features and control rooms, CCTV, access tracks, palisade fencing, and landscape works. The red line site boundary is shown on Axis drawing ref. 3732-01-01 Site Location Plan, shown in Drawings.

The proposed site layout along with site boundary is shown on Axis drawing ref. 3732-01-03 Proposed Site Layout, shown in Drawings.

[1.4] Scope of the Investigation

In order to assess the ground conditions to aid the proposed drainage design and contamination assessment the following scope was designed by Ayesa:

- Excavation of up to 9no. trial pts to a maximum depth of 2.5m bgl to allow for infiltration assessment using data loggers.
- Excavation of up to 6no. further trial pits to a maximum depth of 3m bgl to increase general site coverage of the ground conditions.
- Drilling of up to 8no. boreholes to a maximum depth of 5.0m below ground level (m bgl) at/adjacent to locations of identified potential contamination sources as well as providing general coverage using dynamic sampling methods.
- Installation of ground gas monitoring wells in 8no. boreholes.
- Geo-chemical laboratory analysis of soil samples.
- Ground gas monitoring of 8no. monitoring wells over 4no. visits.

[1.5] Previous Investigations

Ayesa have previously been instructed to complete a Phase 1 Desk Study assessment of the site issued in December 2025 (ref. C57-2338-AYE-ENV-R-001) a review of which is included in Section 3 of this report.

No third-party reports relating to the site area have been made available for review to Ayesa prior to completion of this report and site investigation (SI).

[2] The Site

[2.1] Site Location

Table 2.1 below provides details of the location and size of the site, including site address and/ or nearest postcode, grid reference and current land use both on and in the vicinity. The site location and approximate site boundary are shown in **Figure 1**.

Table 2.1 Site Location

Site Location	
Site Address	Sperberry Hill, St Ippolyts, Hitchin, SG4 7NR
Site Access	North: via Sperberry Hill or Stevenage Road Southwest: via Tittendell Ln or Little Almshoe Ln
Nearest Town/City	St Ippolyts
Postcode (Nearest)	SG4 7NR
Grid Reference (centre)	TL 20633 26383
Size of Site (Approx.)	35.5 ha
Site Shape	Irregular, multi-lobed polygon narrowing along the north south orientation in the centre; thin boundary extending north from the site along the proposed/existing access route.
Topography	The site occupies gently rolling farmland on a gradual southward falling slope, with modest variations in elevation (97mOD in the north to ~85mOD in the south) and no pronounced irregular relief.
Current Land Use	The site is currently existing agricultural farmland.

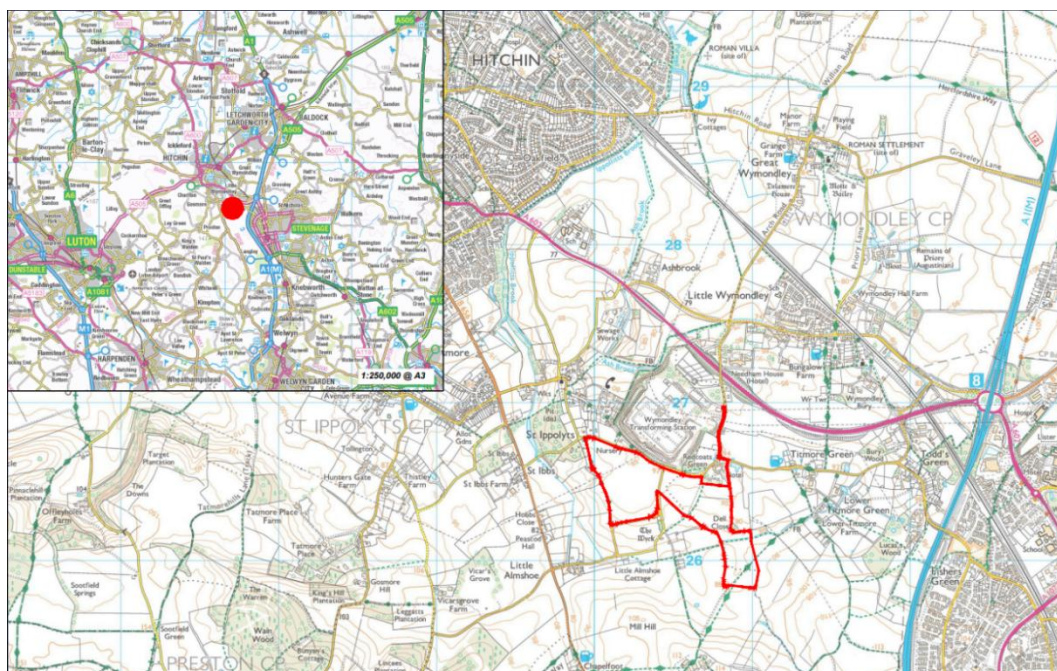


Figure 1: Approximate Site Location and Site Boundary (Source: Axis Drawing as provided by Brockwell Energy)

[2.2] Site Description

A description of the site surrounding land use is presented in **Table 2.2**, and a description of the site based on publicly available information is presented in **Table 2.3**.

Table 2.2 **Surrounding Land Use**

Surrounding Land Use	
North	The National Grid Wymondley Substation and the village of St Ippolyts lies immediately to the north of the site, beyond which are residential areas and local amenities, with Wymondley and Hitchin further north.
East	The land to the east comprises mainly agricultural fields and open countryside, with scattered farm buildings and the village of Titmore Green nearby.
South	To the south, the landscape continues as rural farmland with pasture and arable fields extending towards Little Almshoe and Mill Hill.
West	The western boundary adjoins further agricultural land and hedgerow field boundaries, leading towards St Ippolyts village centre and residential properties on the edge of the village.

Table 2.3 **Site Description**

Site Description
A site walkover was undertaken by Ayesa on 02 October 2025. Photographs from the walkover are presented in Appendix E. • The site comprised agricultural farmland. • The site spanned several agricultural land parcels, located to the south of St Ippolyts and accessed via local lanes (Sperberry Hill, Little Almshoe Lane, Tittendell Lane) connecting to London Road and Stevenage Road (and further to the A602). • The site was predominantly covered by improved grassland and arable fields, divided by established hedgerows and post-and-wire fencing. • The site was bounded by further agricultural land to the west and south, with residential properties in the village of St Ippolyts situated to the north, with The Farmhouse at Redcoats hotel and restaurant and residential land forming part of the northeastern boundary. • Scattered farm buildings and rural infrastructure, including barns and agricultural storage areas, were present on adjacent land, particularly around the Wyck Estate winery and Little Almshoe. • Overhead electricity lines traverse portions of the site, supported by either smaller wooden poles or larger metal tower structures. • A network of minor drainage ditches runs along some field boundaries, flowing generally northeast toward Ashbrook and Wymondley, with Ippolyts Brook flowing to the southeast of the site. • A cleared area in the southern corner of the central parcel of the site contained an smouldering fire. • A large tank marked as containing gas oil is located in the northeast of the site next to the proposed access road. • The surrounding area is predominantly rural in character, with open views across farmland and distant residential development visible toward Hitchin and Wymondley. • A gas pipeline marker was noted in the southern parcel of the site, and it was confirmed in the Groundsure Report that there is a high-pressure gas pipeline (National Grid Great Wilbraham to Whitwell) running northeast to southwest across the southern section of the site.

[2.3] Geology, Hydrogeology and Hydrology

A summary of the geology, hydrogeology and hydrology for the site is presented in **Table 2.3** below:

Table 2.3 Geology, Hydrogeology and Hydrology

Geology, Hydrogeology and Hydrology	
Geology	Small deposits of Made Ground are present on site on the west, south and east site boundaries, however the site is predominantly undeveloped agricultural land with no records of significant infilling or reworked ground. Superficial deposits comprising Glaciofluvial Deposits (Mid Pleistocene sand and gravel) and Lowestoft Formation (Diamicton) are recorded across much of the site. Head deposits are indicated close to the drain in the southeast of the site. The superficial deposits are underlain by the Chalk Group (Holywell Nodular Chalk Formation and New Pit Chalk Formation - Cenomanian), comprising hard white chalk with shell and flints.
Hydrogeology	Superficial: Mixture of Secondary A mainly in the west of the site (Glaciofluvial Deposits), and Secondary Undifferentiated across the centre and southeast of the site, with variable permeability (Lowestoft Formation). Bedrock: The underlying Chalk Group bedrock is designated as a Principal Aquifer, representing a highly permeable and regionally significant groundwater resource. High permeability fracture flow is identified on site. The Chalk Principal Aquifer is described as a highly productive water-bearing formation, capable of supporting baseflows to rivers and providing local and strategic water supply. Groundwater movement is generally through both matrix and fracture flow within the chalk. The Upper Bedford Ouse Chalk WFD groundwater body is identified on site. The site is located predominantly within an area of medium groundwater vulnerability, however the northwest of the site lies within an area of high groundwater vulnerability (superficial), as does the southern lobe (bedrock).
Hydrology	Two surface water features are identified as running across the site, both inland rivers not influenced by normal tidal action, and are located within the southern part of the site. A lake is present approx. 16m east of the proposed access road, and a watercourse is present approximately 50m to the northwest of the site boundary. There are 3 identified potable abstractions within 2km of the site, with the nearest being approx. 408m north. The Groundsure report indicates that areas within Flood Zones 2 and 3 extend into the southern part of the site, with a high risk of fluvial flooding. The site also lies within an area of high groundwater flood risk and 1-in-30-year surface water flood potential (>1.0 m depth within 50 m). No historical flood events or formal flood defences are recorded within the site boundary.

[2.4] Historic Coal Mining

The site is not located within a coal mining area. There are 5 records on the BritPits database, including gravel pits and surface ground workings identified within 500m of the site. No records of underground mining activity were identified within 500m.

[2.5] Environmental Designations

The site is located within the North Hertfordshire (London) Green Belt.

The site is located within a Nitrate Vulnerable Zone (NVZ), between the Great Ouse NVZ (surface water) and Anglian Chalk (groundwater).

[3] Previous Investigations

[3.1] Phase 1 Geo-environmental Report

Ayesa was commissioned by Brockwell Energy to undertake a Phase 1 Geo-Environmental Desk Study (REF: C57-2338-AYE-ENV-R-002)

The report conclusions have been summarised below:

Environmental

- The site is comprised of approximately 36ha of undeveloped agricultural farmland.
- Natural ground conditions at the site are indicated to comprise strata of glaciofluvial deposits (sand and gravel) and Lowestoft Formation (Diamicton) overlying Chalk Group (Holywell Nodular Chalk Formation and New Pit Chalk Formation – Cenomanian).
- Based on the information presented within this report and with due regard to the proposed development, it is the opinion of Ayesa that the site generally represents a **low** risk to human health, **moderate** risk to human health from ground gas, and a **moderate/low** risk to controlled waters. It should be noted that the identified sources of potential contamination should by no means be considered as sitewide and rather they are only likely to affect specific parts of the site in their vicinity.

Geotechnical

- Earthworks are likely to be required for the site development, to create suitable level development platforms. Cut is likely to generate a variety of materials, cohesive and possibly granular. Cut materials will need to be assessed to determine their suitability for re-use as engineered fill.
- Although chalk workings are shown to encroach on the site, they are highly localised in extent and unlikely to present significant geotechnical difficulties to the development. There is no evidence of underground workings at the site.
- The potential for ground instability principally comes from shrink swell clay risks. Foundations at the site should be designed to accommodate this.
- Although there is limited evidence to suggest that the site will suffer from difficult ground conditions with respect to the foundations of the proposed panels and BESS containers, a ground investigation is recommended to provide information to assist in the design and construction of the scheme.

[4] Investigation Methodology

[4.1] Investigation Strategy

The following scope of the intrusive investigation was proposed:

- 8no. dynamic samples boreholes to a maximum depth of 4m below ground level (m bgl) to obtain samples for geochemical and geotechnical analysis.
- Installation of ground water and gas monitoring wells in 8no. boreholes.
- Excavation of up to 6no. trial pits to a maximum depth of 3m bgl.
- Geo-chemical laboratory analysis of soil samples.
- Ground gas monitoring of 8no. boreholes on 4no. occasions.

The positions of the exploratory holes are shown on the exploratory hole location plan presented as **Drawing C57-2338-1001**.

[4.1.1] Infiltration Assessment

Infiltration testing was undertaken to the drainage engineer's requirements, including 3 runs of BRE 365 infiltration tests in each pit, the following scope was proposed:

- Excavation of up to 9no. trial pits to a maximum depth of up to 2.5m bgl
- Installation of monitoring pipes in gravel fill within the pits. Data loggers will be used to monitor water level fall, particularly overnight.

[4.2] Regulatory Authority Liaison

Ayesa have not held any discussions with the relevant authorities prior to and/or during the site investigation.

[5] Fieldwork

[5.1] General Observations

The investigation fieldwork was carried out between the 23rd and 27th February 2026. Ayesa personnel were present to supervise all work, describe the ground encountered and carry out in situ testing. Borehole locations were cleared for services by RSP personnel using Ground Penetrating Radar (GPR) and CAT and Genny prior to the commencement of drilling. Fieldwork procedures were undertaken in accordance with the relevant sections of:

- British Drilling Association “Guidance for Safe Intrusive Activities on contaminated or Potentially Contaminated Land” (2008);
- BS5930:2015+A1:2020 “Code of Practice for Site Investigations”; and,
- BS10175:2026 “Investigation of potentially contaminated sites – Code of practice.”

All locations were logged by a suitably qualified geo-environmental engineer from Ayesa in accordance with the recommendations of BS5930:2015+A1:2020, which incorporates the requirements of BS EN ISO 14688-1:2017, 14688-2:2017 and 14689:2017. Methods of formation and geological descriptions, together with sample records, in situ test results and observations made during formation of the exploratory hole are given in the logs presented in **Appendix C** and should be read in conjunction with the Key included therein.

[5.2] Deviations from the Proposed Scope

TP15 in the southwest corner of the southern parcel of the site could not be completed due to guidance from Cadent preventing the JCB excavator travelling over the high-pressure gas main. An alternative position marked as ‘TP’ in the northeast of the site (Drawing REF: C57-2338-1001) was completed as a replacement and named TP16. TP4 and TP9 were re-excavated as TP4A and TP9A adjacent to their original positions so the infiltration testing was undertaken in the most favourable ground conditions.

[5.3] Trial Pits

A total of 15no. machine excavated trial pits were completed across the site with TP1-9 excavated to between 1.5 to 2.5 mbgl to allow for infiltration testing and collect samples for geochemical analysis, and TP10-15 excavated up to 3.20m to obtain samples for geochemical analysis. 2no. samples were taken from each location, with the first sample taken in the top 0.50m of soil.

Table 5.1 Summary of exploratory holes by machine excavated trial pits

Location ID	Easting	Northing	National Grid Referencing System	Ground Level (m AOD)	Final Depth (m bgl)
TP01	520813.982	226201.026	OSGB	85.765	2.50
TP02	520848.973	226297.020	OSGB	92.975	1.50
TP03	520850.016	226413.979	OSGB	95.650	1.50
TP04/4A	520646.365	226420.559	OSGB	94.421	1.50

TP05	520581.960	226301.978	OSGB	88.776	1.55
TP06	520425.036	226452.030	OSGB	95.978	1.70
TP07	520337.982	226517.982	OSGB	97.241	1.50
TP08	520240.018	226421.963	OSGB	98.030	1.50
TP09/9A	520221.527	226588.265	OSGB	96.363	1.60
TP10	519979.586	226741.279	OSGB	96.023	2.80
TP11	520093.972	226523.951	OSGB	95.596	2.70
TP12	520351.032	226321.006	OSGB	94.138	3.00
TP13	520701.993	226287.012	OSGB	89.470	3.20
TP14	520833.981	226107.973	OSGB	84.817	3.00
TP16	520655.982	226511.987	OSGB	96.569	3.00

The trial pit photographs are presented in **Appendix D** and trial pits logs are presented in **Appendix C**.

[5.4] Dynamic (Window) Sample Boreholes

8no. dynamic sampling boreholes (WS01 to WS08) were carried out using a tracked Archway Competitor rig. The borehole positions were distributed across the site and carried out to depths of between 3.0 to 5.0m bgl. Dynamic sampler boreholes were advanced initially by hand excavation of an inspection pit.

Standard Penetration Tests (SPTs) were carried out at 1m intervals in the holes and logged by a suitably qualified geo-environmental engineer in general accordance with BS EN ISO 22476-3:2005. The dynamic sample logs and the SPT Calibration Certificate are presented in **Appendix C**.

Table 5.2 Summary of exploratory holes by dynamic/ windowless sampling

Location ID	Easting	Northing	National Grid Referencing System	Ground Level (m AOD)	Final Depth (m bgl)
WS01	519995.962	226590.012	OSGB	90.461	5.00
WS02	520103.994	226244.988	OSGB	87.113	5.00
WS03	520161.027	226701.031	OSGB	96.379	3.00
WS04	520476.002	226561.005	OSGB	96.867	3.00
WS05	520854.979	226469.512	OSGB	95.971	3.00
WS06	520850.958	226341.015	OSGB	94.226	5.00
WS07	520982.024	225985.048	OSGB	86.878	3.00
WS08	520826.191	225852.751	OSGB	86.887	3.00

[5.5] Infiltration Tests

9no. soil infiltration (soakaway) tests were carried out in accordance with BRE Digest 365 (2016) in trial pits TP01 to TP09 with the use of data loggers. Test depths were determined in line with the engineer's specification, amended slightly to target favourable ground conditions, to a depth of approximately 1.5m bgl, excluding TP01 which was tested to approximately 2.5m bgl, as requested. Trial pits were backfilled with gravel and two repeat tests were carried out. Results of the infiltration tests are presented in **Appendix J**.

[5.6] Samples and Sample Containers

Samples for geotechnical descriptions were taken during the drilling of the exploratory holes in general accordance with the specification, BS5930:2015 +A1:2020, BS 10175: 2026 and BS EN ISO 22475-1:2021.

Soil samples for chemical analysis each comprised a set of containers: a 500ml plastic tub for metals and inorganics, a 60ml amber glass jar for organics and two 30ml amber glass jar for VOCs. Soil samples were stored in a cool box and dispatched directly to the testing laboratory.

[5.7] Instrumentation and Monitoring

Monitoring wells were installed at all dynamic (window) sampled boreholes, the details of instrumentation installed is presented on the exploratory hole logs. A summary of the instrumentation installed is listed in the following table:

Table 5.3 Summary of installed instrumentation

Location ID	Instrument Type	Installation Date	Top of Response Zone (m bgl)	Base of Response Zone (m bgl)	Top of Response Zone (m OD)	Base of Response Zone (m OD)
WS01	SP	27/02/2026	1.00	5.00	89.461	85.461
WS02	SP	27/02/2026	1.00	5.00	86.113	82.113
WS03	SP	27/02/2026	1.00	3.00	95.379	93.379
WS04	SP	26/02/2026	1.00	3.00	95.867	93.867
WS05	SP	26/02/2026	1.00	3.00	94.971	92.971
WS06	SP	26/02/2026	2.00	5.00	92.226	89.226
WS07	SP	26/02/2026	1.00	3.00	85.878	83.878
WS08	SP	26/02/2026	1.00	3.00	85.887	83.887

After completion of the fieldwork, 4no. visits were made to the site to carry out monitoring of groundwater levels and ground gas concentrations. Ground gas monitoring was carried out in accordance with BS8576:2013 to measure gas flow rate, methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide.

The results of this monitoring are presented in **Appendix E**, and details of the monitoring wells can be found on the exploratory hole logs in **Appendix C**.

It should be noted that no free phase hydrocarbons were encountered in any of the monitoring wells.

[6] Laboratory Testing

[6.1] Chemical Laboratory Testing

The samples were submitted to Normec i2 Analytical in Watford who are UKAS accredited in accordance with ISO17025 and are also MCERTS accredited for soil analysis in accordance with the Environment Agency's scheme. The laboratory carries out Quality Assurance and Quality Control in accordance with BS ISO 17025 and participate in external laboratory comparison and quality control schemes. Details of the accreditation and the methods of analysis are provided on the relevant test reports.

The results of the laboratory analysis are presented in **Appendix F**. The various suites of analysis for the soil are presented in **Table 6.1** below:

Table 6.1 Suites of Analysis for Environmental Soil Samples

Suite	Number of tests
Metals	25
Inorganics	25
Organics	25
Petroleum Hydrocarbons (TPH)	25
Polycyclic Aromatic Hydrocarbons (PAH)	25
Asbestos ID	25

[7] Ground Conditions

[7.1] General

The site investigations have allowed the site-specific ground conditions to be described and this information was used to provide an improved conceptual ground model. The sequence of the strata encountered during the site investigations generally confirms the anticipated geology as interpreted from the desk study and geological map.

A summary of the general strata encountered across the site is shown in **Table 7.1** below, with more detailed description given in the following sub sections.

Table 7.1 Summary of Strata Encountered

Geological Strata		Description	Max, Below Level to Base of Strata (m)	Depth Ground to Base of Strata (m)
Topsoil		Soft dark brown sandy gravelly CLAY.	0.2 (WS03) – 0.35 (TP13)	
		Brown clayey silty gravelly fine to coarse SAND.	0.2 (TP06) - 0.5 (WS01)	
Fluvioglacial and Gravel	Sand	Orangish/ yellowish brown clayey gravelly fine to coarse SAND.	>5.0 (WS01)	
Lowestoft Formation - Diamicton		Firm/ stiff brown slightly sandy gravelly CLAY. Gravel of flint and chalk.	>5.0 (WS06)	
Bedrock – New Pit Chalk Formation		Creamish white structureless CHALK comprising a gravelly clay matrix and sub-angular to sub-rounded fine to coarse low to medium density intact chalk fragments (Grade Dm)	>5.0 (WS02)	

[7.2] Ground Surface

The site area is comprised of three arable fields, in varying states of cultivation and fallow. Topsoil was encountered in the majority of exploratory holes, to depths of between 0.20m bgl (WS08) and 0.50m bgl (WS01). Topsoil material typically comprised either a soft, dark brown clay with abundant roots and rootlets or a brown fine to coarse sand with gravels of flint and chalk present, depending upon the composition of the underlying material.

[7.3] Anthropogenic Materials

There was no discernible Made Ground encountered during the intrusive investigation.

[7.4] Natural Deposits (Superficial)

Superficial deposits were generally encountered underlying the topsoil, to a maximum depth of 5.0m below ground level and were identified as either Lowestoft Formation - Diamicton or Glaciofluvial sands and gravels deposits, or interbedded strata of the two..

The Glaciofluvial deposits comprised of sands and gravels which were encountered generally in the western parts of the site. Deposits were generally described as medium dense orangish brown clayey gravelly sand, commonly with cobbles present. Gravels and cobbles were angular to rounded, identified as flint and chalk.

The Lowestoft Formation deposits were generally encountered in the eastern parts of the site and comprising a firm to stiff slightly sandy, gravelly clay. Gravels were of angular to rounded, fine to coarse, flint and chalk..

[7.5] Natural Deposits (Bedrock)

Bedrock was encountered within five of the exploratory hole locations (WS02, WS03, WS07, WS08 and TP01) in the far west and southern parts of the site and was identified as the New Pit Chalk Formation. It was typically described as a creamish white structureless chalk comprising a gravelly clay matrix and sub-angular to sub-rounded fine to coarse low to medium density intact chalk fragments (Grade Dm). It was encountered beneath the topsoil or superficial deposits from depths of between 0.2m bgl (WS08) and 2.9m bgl (WS03) to the base of the exploratory holes.

[7.6] Groundwater

No groundwater was encountered during the intrusive site investigation works.

During the 4no. gas and groundwater monitoring visits, the monitoring wells were mostly dry with the exception of WS05, in which groundwater levels ranged between 2.43m and 2.47m bgl.

[8] Generic Quantitative Risk Assessment

[8.1] Introduction

The assessment of contamination has been carried out in accordance with the overall guidance presented in Land Contamination: Risk Management (LCRM) using the procedures as indicated in **Appendix B**.

Generic risk assessment is a two-stage process. Firstly, in the Risk Estimation stage, the measured contaminant concentrations are compared to the relevant GACs or C4SLs/S4ULs where they have been published. Where there is a suitable dataset, this is done after carrying out statistical analysis to determine the upper confidence limit on the true mean. Otherwise, maximum or specific data points are compared directly. The second stage, Risk Evaluation, comprises an authoritative review of the findings with other pertinent information, in cases where the C4SLs or GACs are exceeded, in order to consider if exceedance may be acceptable in the particular circumstances.

The aspects of risk from substances in the ground considered below are as follows:

- Human Health;
- Plant Life;
- Pollution of Controlled Waters;
- Water Supply Pipes;
- Below Ground Concrete; and,
- Ground Gases.

[8.2] Assessment for the Protection of Human Health

The Generic Qualitative Risk Assessment (GQRA) is based on a soil with a Soil Organic Matter of 1% was carried in accordance with the methodology for assessing soil samples set out in **Appendix B** based on a commercial end use. A full summary of the chemical test results is presented in **Appendix F** and a summary of chemical analysis of soils is presented in **Appendix G**.

[8.2.1] Metals

Of the 25no. samples analysed, no exceedances of metals were identified when comparing the concentrations against the relevant screening criteria for commercial end use. The maximum concentrations of the metals analysed were significantly below the commercial threshold, thus the risk of metals to worker human health is considered low.

[8.2.2] Polycyclic Aromatic Hydrocarbons (PAHs)

No exceedances of PAHs were identified in the twenty-five samples analysed. The maximum total PAH concentration of the samples analysed was 6.6mg/kg and the maximum concentrations of individual PAHs were well below the screening threshold for commercial land uses. As a result, the PAH concentrations do not represent a significant risk to human health.

[8.2.3] Petroleum Hydrocarbons (PHC)

Of the 25no. samples analysed, aliphatic and aromatic TPH fraction concentrations were generally less than or slightly above their limit of detection levels, and their respective screening values were not exceeded. No BTEX compounds were detected above the laboratory limit of detection, and therefore the applicable threshold values were not exceeded and no significant risk is posed to human health.

[8.2.4] Asbestos

Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g., asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments of asbestos and discrete fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork, no suspected ACMs were identified.

Laboratory assessments of 25no. samples to identify asbestos were carried out in order to confirm the site assessment that ACMs were absent. Of the 25 samples analysed, no asbestos fibres were identified.

[8.2.5] Risks to Human Health (Construction Phase)

During the construction works there is unlikely to be a risk from contaminated soil dust to on-site workers and people occupying adjacent properties. However, appropriate risk assessments should be carried out by the contractor to allow appropriate controls for the mitigation of the general risks to health of construction workers to be put in place. This risk can be controlled to within acceptable limits by:

- Control of dust generation (see below);
- Workers wear suitable Personal Protective Equipment (PPE);
- Having adequate site hygiene facilities allowing staff to keep a good level of personal hygiene;
- All groundworkers should have been trained in asbestos awareness and should keep a look out for this being encountered during excavations. The earthworks contractor should have a contingency plan in place before any works commence in case the presence of asbestos is suspected in groundworks;
- Only permitting smoking or eating on site in appropriate pre-designated areas.

As a minimum it is anticipated the works will be undertaken in accordance with BRE best practise guidance and that the following measures will be introduced to assist with control of dust generation:

- Access roads and stockpiles should be regularly damped down with water;
- All vehicles entering and leaving the site during the construction period should pass through a wheel wash facility;
- Vehicles used to transport materials and aggregates should be enclosed or tarpaulined;
- Local roads should be regularly cleaned;
- Drilling and grouting machinery should be sheeted to minimise dust dispersion

- Vehicle movements and speed should be kept to a minimum within the site;
- Dust generating equipment (e.g., mobile crushing and screening equipment) should be located to minimise potential nuisance impacts to receptors as far as practicable; and,
- Minimising drop heights of all loading and unloading activities that involve the transfer of soils and demolition materials.

Due to the very low recorded ground gas concentrations, there is a minimal additional risk during the re-development works for personnel entering excavations. Entry into all below ground excavations should be carried out in accordance with The Confined Spaces Regulations (1997) and The Management of Health and Safety Regulations (1999).

It is recommended that the appointed Contractor consult with the Local Authority Air Quality Officer to determine whether a programme of particulate and nuisance dust monitoring is required for the duration of the works.

[8.3] Assessment for the Protection of Controlled Waters

The risk to Controlled Waters has been undertaken on a qualitative basis as shallow groundwater within the made ground soils was largely absent and, where encountered (WS05), it is considered an isolated perched pocket.

As there were limited detections of potential soil contaminants, particularly mobile hydrocarbons such as lighter end TPH fractions and BTEX compounds, the likelihood of soil contamination leaching and migrating into controlled waters is considered low.

Considering that the regional groundwater aquifer is indicated to be at significant depth beneath the site within the chalk, together with low permeability glacial deposits encountered on site acting as a barrier, the likelihood of vertical migration of potential contamination is also considered low.

As a result, the risk to controlled waters at the site is considered very low and therefore no remediation measures in this regard are envisioned.

[8.4] Risk to Plant Life

The concentrations of the phytotoxic metals copper, chromium, nickel and zinc have the potential to be harmful to plants. However, the measured concentrations of these metals are lower than the guideline values for the protection of plants as presented in the MAFF document "Code of Good agricultural practice for the protection of soil". Therefore, there is no risk to plants at the site due to phytotoxicity should any be planted in the ground as part of the proposed development.

[8.5] Water Supply Pipe Material Assessment

Plastic pipe materials are potentially vulnerable to attack from elevated levels of hydrocarbons, which can potentially lead to contamination of potable water supplies and water supply companies also require the risk to their workers from other contaminants in the ground to be assessed. The assessment has been completed in accordance with the current UK Guidance for the Specification of Water Supply Pipes to be used in Brownfield Sites (UK Water Industry Research Ltd. UKWIR, 2014) together with guidance from United Utilities. This guidance provides threshold concentrations for different pipe material for various chemical groups.

The default recommendation for water supply pipes is to use PE with other types of pipework only used if the limits for PE pipes are exceeded. When assessing the ground for water supply pipes the suite of potential contaminants to be tested only needs to be those contaminants that are potentially present on site based on the desk study. At this site the desk study did not identify there to be a risk from SVOCs (including chlorinated phenols, cresols), aldehydes, ketones, ethers, nitrobenzene and amines so no analysis was carried out for these compounds.

The available data indicates no exceedances for the PE water supply pipe are present and as such the use of PE pipe is deemed permissible with the following caveats:

- Should areas of unexpected contamination be found during construction and any water supply pipes are routed through those areas, additional sampling and testing will be required.
- Following confirmation of the water supply pipe route, the water supplier for the area should be contacted and written approval sought. They may require additional chemical data along any proposed potable water supply pipe routes.

[8.6] Permanent Ground Gasses

[8.6.1] Measured Gas Concentrations

4no. gas monitoring visits were carried out by Ayesa between the 4th March 2026 and 28th April 2026 Atmospheric pressure within gas monitoring wells varied from 1003 to 1012 mbar over the visits. The range of flow rates, methane, carbon dioxide concentrations and oxygen levels from the monitoring visits are summarised in **Table 8.7** below:

Table 8.7 Summary of Ground Gas Monitoring

Borehole	Response Zone (m bgl)	No. of Monitoring Occasions	Steady State Flow (l/hr)	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (% v/v)	Carbon Monoxide (ppm)	Hydrogen sulphide (ppm)	Water Level (m bgl)	Atmospheric pressure readings mb
WS01	1-5.0m	4	0.0	0.0	1.0-1.9	17.9-19.4	0.0	0.0	Dry	1005-1012
WS02	1-5.0m	4	0.0	0.0	0.8-1.0	17.8-20.0	0.0	0.0	Dry	1005-1012
WS03	1-3.0m	4	0.0	0.0	0.1-0.6	18.6-20.7	0.0	0.0	Dry	1003-1011
WS04	1-3.0m	4	0.0	0.0	0.6-1.6	17.1-19.8	0.0	0.0	Dry	1004-1011

WS05	1-3.0m	4	0.0	0.0	0.1-0.4	18.1-20.3	0.0-10.0	0.0	Dry – 2.43	1003-1014
WS06	1-5.0m	4	0.0	0.0	1.2-1.9	17.9-19.2	0.0	0.0	Dry	1004-1014
WS07	1-3.0m	4	0.0	0.0	1.3-1.6	17.8-20.1	0.0	0.0	Dry	1004-1014
WS08	1-3.0m	4	0.0	0.0	0.2-0.4	18.8-20.3	0.0	0.0	Dry	1004-1014

[8.6.2] Ground Gas Assessment

Background information relating to the origin and production of bulk ground gases are presented in **Appendix H**, together with current guidance on their assessment. In accordance with this approach and the above measured ground gas levels, it is considered that the worst-case temporal conditions may not have been measured during the monitoring period. The gas flow rates measured across the whole of the site at all of the monitoring visits was less than the instrument detection limit of 0.1 l/hr. From Table 8.5 of CIRIA C665 the worst-case Characteristic Situation for the site is as follows:

Table 8.8 Characteristic Gas Situations worse case per borehole

Borehole Number	Steady State Flow l/h	% v/v	CH ₄		CO ₂		
			GSV (l/hr)	Characteristic Situation	% v/v	GSV (l/hr)	Characteristic Situation
WS01	0.1	0.0	0.0000	1	1.9	0.0019	1
WS02	0.1	0.0	0.0000	1	1.0	0.0010	1
WS03	0.1	0.0	0.0000	1	0.6	0.0006	1
WS04	0.1	0.0	0.0000	1	1.6	0.0016	1
WS05	0.1	0.0	0.0000	1	0.4	0.0004	1
WS06	0.1	0.0	0.0000	1	1.9	0.0019	1
WS07	0.1	0.0	0.0000	1	1.6	0.0016	1
WS08	0.1	0.0	0.0000	1	0.4	0.0004	1

The Ground Gas Assessment indicates that concentrations of methane and carbon dioxide are negligible; accordingly, the Gas Screening Value (GSV) classifies the site as Characteristic Situation 1 (CS1), for which no gas protection measures are required.

[8.7] Updated Conceptual Site Model

The conceptual site model has been updated using the findings of the Phase 2 site investigation.

The site investigation revealed the following general downward succession:

- Site surface: agricultural cultivation
- Topsoil (0.20m to 0.50m thick). Present in the majority of boreholes.
- Superficial deposits:
 - Lowestoft Formation – Diamicton (encountered to depths > 5.0 mbgl), interbedded with;
 - Glaciofluvial Sands and Gravels (encountered to depths > 5.0 mbgl);
- Bedrock deposits: New Pit Chalk Formation (encountered to depths > 5.0 mbgl)

The results of site investigation and laboratory analysis indicates that there are low concentrations of potential contaminants at the site that will affect the proposed commercial development. Therefore, considering the nature of the development there is a negligible risk to:

- i. Human health;
- ii. Controlled waters;
- iii. Property (existing or proposed) including buildings, crops, livestock, pets, woodland and service lines and pipes;
- iv. Adjoining land;
- v. Ecological systems; and,
- vi. Archaeological sites and ancient monuments.

No specific precautions are required with respect to landfill type ground gases, hydrocarbons or the potential risk from radon for the development. Protection measures will also not be required due to the potential risk from radon.

The updated contamination potential at the site has been assessed using the contaminant-pathway-receptor linkage approach. Following the site investigation, the plausible contaminant sources identified in **Table 8.9** have been updated or confirmed as follows:

Table 8.9 Updated Conceptual Site Model

Source	Pathway	Receptor	Con	Prob	Risk	Mitigation/Investigation
On-site: Generally, none except the following highly localised features: A historical chalk pit at the southern boundary of the south parcel of the site. Agricultural plant refuelling tank. Contaminants relating to the identified sources may include: Hydrocarbons (PAH/TPH); Heavy Metals/Phytotoxic Elements; Asbestos; and Hazardous Ground Gases. Off-site Potential Made Ground associated with historical coal mining activities (west of site) and infilled off-site ponds and ground workings. Contaminants relating to the identified sources may include: Hydrocarbons (PAH/TPH);	Dermal contact, ingestion, and inhalation	<u>Human Health:</u> - Construction workers. - Future site / commercial users.	Md	UI	L	Construction workers should employ appropriate PPE and standard site safety measures during construction. Due to the proposed development of the site, staff exposure to any possible in-ground contamination will generally be limited to the BESS area located away from the recognised sources of contamination. The intrusive investigation found no contamination on site exceeding the screening value for commercial developments and therefore the risk to human health is considered as low.
	Migration of contaminated groundwater (vertical/lateral).	<u>Controlled Waters:</u> - Superficial: Secondary A aquifer – moderately productive aquifer. - Bedrock: Chalk Principal aquifer – highly productive aquifer.	Md	Lw	L	No Made Ground was encountered during the site investigation, and soil sample analysis indicated that there was no significant soil contamination on site, particularly that that would readily leach. There was no significant shallow groundwater encountered at the site, the regional aquifer considered to be at significant depth. Therefore Ayesa considers the risk to controlled waters to be low.
	Direct contact	<u>Plant Life:</u> On-site flora and fauna.	Mi	UI	VL	Phytotoxic metals were analysed in 25no. samples taken across the site. None of the metals exceeded their respective trigger values therefore the risk to plant life is considered very low.
	Migration and accumulation of	<u>Human Health:</u>	Sv	UI	L	Gas monitoring data was obtained from the 8no. monitoring wells over 4no. visits. An

Heavy Metals/Phytotoxic Elements; Asbestos; and Hazardous Ground Gases.	hazardous ground gasses and vapours (vertical/lateral) leading to asphyxiation (carbon dioxide) or explosion (methane, hydrocarbons).	- Construction workers. - Future site users.				assessment of this data classifies the site as Characteristic Situation 1 (CS1) and therefore no specific protection measures are required.
	Direct contact	<u>Water Supply Pipe Material:</u> Proposed water supply pipes.	Mi	UI	VL	Laboratory analysis of 25no. soil samples taken during the site investigation indicates no exceedances for the PE water supply pipe thresholds are present and as such the use of PE pipe is deemed permissible
KEY: Consequence: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Probability: Hi = High, Li = Likely, Lw = Low Likelihood, UI = Unlikely Risk: VH = Very High, H = High, M = Moderate, M/L = Moderate/Low, L = Low, VL = Very Low						
Pollutant Linkage Assessment Summary: The pollutant linkage assessment has indicated that the site represents a Low risk to human health, a Very Low risk to plant life, a Low risk to controlled waters, and a Very Low risk to water supply pipe material in the context of the current site status. The site has historically been used as agricultural ground.						

The risk assessments have concluded that no remediation measures are required to address risks to any potential receptors. However, as with any project there is the possibility of encountering unexpected contamination. If this occurs then the procedures set out in **Appendix I** should be implemented.

[9] Conclusions and Recommendations

[9.1] Ground Profile

The site investigation revealed the following general downward succession:

- Site surface: agricultural cultivation
- Topsoil (0.20m to 0.50m thick). Present in the majority of boreholes.
- Superficial deposits:
 - Lowestoft Formation – Diamicton (encountered to depths > 5.0 mbgl), interbedded with;
 - Glaciofluvial Sands and Gravels (encountered to depths > 5.0 mbgl);
- Bedrock deposits: New Pit Chalk Formation (encountered to depths >5.0 mbgl)

[9.2] Environmental Risk Assessment

In order to make a more detailed assessment of the potential hazards, a Phase 2 intrusive investigation was carried out to develop a more comprehensive conceptual ground model of the site. This detailed the characteristic ground conditions and elements of the surrounding environment and has assisted with identifying the potential contaminants of concern, the potential receptors of the contamination and the potential pathways between them.

The results of the risk assessments indicate that there is no significant source of soil contamination present at the site, so there is a negligible risk to receptors including humans, controlled waters and ecology. Therefore no specific precautions or remediation are required as part of the proposed scheme. However, as with any project there is the possibility of encountering unexpected contamination. If unexpected contamination is encountered, the procedures set out in **Appendix I** should be implemented.

[10] References

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[11] Drawings

List of Drawings

- C57-2338-1001 Rev02 – Ground Investigation Location Plan

A1



GENERAL NOTES

- SITE BOUNDARY
- TRIAL PIT LOCATIONS
- ⊗ WINDOW SAMPLE LOCATIONS

TP1	520814	226201
TP2	520849	226297
TP3	520850	226414
TP4	520650	226419
TP5	520582	226302
TP6	520425	226452
TP7	520338	226518
TP8	520240	226422
TP9	520221	226591
TP10	519990	226742
TP11	520094	226524
TP12	520351	226321
TP13	520702	226287
TP14	520834	226108

WS01	519996	226590
WS02	520104	226245
WS03	520161	226701
WS04	520476	226561
WS05	520852	226470
WS06	520851	226341
WS07	520982	225985
WS08	520826	225853
WS	520559	226379

PO2	28/04/26	FOR REVIEW	PP	GH	BF
PO1	02/26	FOR REVIEW	PP	GH	BF
Rev	Date	Description	By	Chk	App



PROJECT
SPERRBERRY HILL SOLAR AND BATTERY
ELECTRIC STORAGE SITE (BESS)

DRAWING TITLE
GROUND INVESTIGATION LOCATION PLAN

STATUS FOR REVIEW					SUITABILITY —
Date: 02/26	Scale: N/A	Drawn: PP	Chk: GH	App: BF	
Project No: C57-2338	Dwg. No: C57-2338-1001	Rev:			P02

Appendix A – Service Constraints Report Limitations & Planning Requirements

Service Constraints, Report Limitations & Planning Requirements

This consultancy contract, report, and the site investigation (together comprise the "Services") were compiled and carried out by ByrneLooby Partners UK Limited (ByrneLooby) for the client named at the front of the report (the "client") on the basis of a defined programme and scope of works and the terms of a contract between ByrneLooby and the "client." The Services were performed by ByrneLooby with all reasonable skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by ByrneLooby 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 ByrneLooby and the client. ByrneLooby Partners UK Limited cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered out with the agreed scope of works.

Other than that, expressly contained in the above paragraph, ByrneLooby provides no other representation or warranty whether express or implied, is made in relation to the Services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of ByrneLooby. If a third party relies on this report, it does so wholly at its own and sole risk and ByrneLooby disclaims any liability to such parties.

It is ByrneLooby's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without ByrneLooby'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 ByrneLooby Partners UK Limited.

The report has been prepared at the date shown on the front page 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 ByrneLooby. In the absence of such written advice of ByrneLooby, reliance on the report in the future shall be at the client's own and sole risk. Should ByrneLooby be requested to review the report in the future, ByrneLooby shall be entitled to additional payment at the then existing rate, or such other terms as may be agreed between ByrneLooby and the client.

The observations and conclusions described in this report are based solely upon the Services that were provided pursuant to the agreement between the client and ByrneLooby. ByrneLooby has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. ByrneLooby is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, ByrneLooby did not seek to evaluate the presence on or off the site of electromagnetic fields or materials in buildings (i.e., materials inside or as part of the building fabric) such as asbestos, lead paint, radioactive or hazardous materials.

The Services are based upon ByrneLooby's observations of existing physical conditions at the site gained from a walkover survey of the site together with ByrneLooby's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst ByrneLooby Partners UK Limited 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. Further ByrneLooby was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. ByrneLooby 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 ByrneLooby and including the doing of any independent investigation of the information provided to ByrneLooby save as otherwise provided in the terms of the contract between the client and ByrneLooby.

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 extent of the limited 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 [as stipulated in the contract between the client and ByrneLooby 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.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site.

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 10175:2011+A2 2017. For the geotechnical aspects of the report, the general requirements of Eurocode 7 (BS EN 1997-2:2007) are to produce a Ground Investigation Report (GIR) which shall form part of the Geotechnical Design Report (GDR). The geotechnical section of this report is intended to fulfil the general requirements of the GIR as outlined in BS EN 1997-2, Section 6. The GIR contains the factual information including geological features and relevant data, and a geotechnical evaluation of the information stating the assumptions made in the interpretation of the test results. This report shall not be considered as being a GDR.

Planning Requirements

The National Planning Policy Framework (NPPF, 2019) emphasises the presumption in favour of sustainable development. Paragraph 11, which defines the presumption in favour of sustainable development, has two similar clauses which related to potentially contaminated land and sensitive receptors:

11) Plans and decisions should apply a presumption in favour of sustainable development.

*For **plan-making** this means that:*

b) strategic policies should, as a minimum, provide for objectively assessed needs for housing and other uses, as well as any needs that cannot be met within neighbouring areas, unless:

i) the application of policies in this Framework that protect areas or assets of particular importance provides a strong reason for restricting the overall scale, type or distribution of development in the plan area;

*For **decision-taking** this means:*

d) where there are no relevant development plan policies, or the policies which are most important for determining the application are out-of-date, granting permission unless:

ii) the application of policies in this Framework that protect areas or assets of particular importance provides a clear reason for refusing the development proposed

In accordance with the NPPF, areas or assets of particular importance are defined as:

Habitats sites (and those sites listed in paragraph 176 – potential Special Protection Areas and Possible Areas of Conservation; listed or proposed Ramsar sites; and sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites) and/or designated as Sites of Special Scientific Interest; land designated as Green Belt, Local Green Space, an Area of Outstanding

Natural Beauty, a National Park (or within the Broads Authority) or defined as Heritage Coast; irreplaceable habitats; designated heritage assets (and other heritage assets of archaeological interest referred to in footnote 63 (Non-designated heritage assets of archaeological interest, which are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.); and areas at risk of flooding or coastal change.

Paragraph 118 states that planning policies and decisions should:

- *give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land;*

Paragraph 170 clarifies that enhancing the natural environment includes:

Planning policies and decisions should contribute to and enhance the natural and local environment by:

- *protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);*
- *recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;*
- *maintaining the character of the undeveloped coast, while improving public access to it where appropriate;*
- *minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;*
- *preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and*
- *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.*

Paragraph 180 of NPPF states that planning policies and decisions should ensure the following:

- *Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.*

Paragraph 178 of NPPF states that planning policies and decisions for developments should also ensure that:

- a) *a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);*
- b) *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- c) *adequate site investigation information, prepared by a competent person, is available to inform these assessments.*

Paragraph 179 states that where a site is affected by contamination or land stability issues, responsibility for securing a safe development rest with the developer and/or landowner.

This report has been prepared and authorised by staff that are competent as defined in the NPPF.

Unexploded Ordnance

Clients have a legal duty under the CDM 2015 Regulations to provide designers and contractors with project-specific health and safety information needed to identify hazards and risks. This includes the possibility of unexploded ordnance (UXO) being encountered on the site. Further details are given in CIRIA Report C681 (Stone et al 2009). A non-UXO specialist screening exercise has been carried out for the site by considering any evidence of UK defence activities on or near the site evident from the gathered desk study information and the unexploded aerial delivered bomb (UXB) regional risk maps produced by Zetica. Other data sources are available, but as a first stage screening exercise the freely available Zetica maps have been used. The level of risk stated is that determined by Zetica, a company experience in the desk study, field investigation and clearance of UXO/UXB.

Appendix B – Environmental Risk Assessment Methodology & Terminology

Environmental Risk Assessment Methodology & Terminology

Legislation Overview

This report includes hazard identification and environmental risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. The contaminated land regime is the statutory regime for remediation of contaminated land that causes an unacceptable level of risk and is set out in Part 2A of the Environmental Protection Act 1990 (“EPA 1990”). The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- a) Significant harm is being caused or there is a significant possibility of such harm being caused;

or

- b) Pollution of controlled waters is being, or is likely to be, caused.”

In order to assist in establishing if there is a “significant possibility of significant harm” there must be a “contaminant linkage” for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of contaminant-pathway-receptor is termed a “contaminant linkage or CPR linkage.”

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations. Key implementing legislation of the Part 2A regime includes the Contaminated Land (England) Regulations 2006 (SI 2006/1380) as amended by the overarching legislation for the contaminated land regime, which implements the provisions of Part IIA of the Environmental Protection Act 1990 (as inserted by section 57 of the Environment Act 1995), came into force on 14th July 2000 together with recent amended regulations: Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263). Revised Contaminated Land Statutory Guidance was published by DEFRA in April 2012. Part IIA defines the duties of Local Authorities in dealing with it. Part IIA places contaminated land responsibility as a part of planning and redevelopment process rather than Local Authority direct action except in situations of very high pollution risk.

In the planning process guidance is provided by National Planning Policy Framework (NPPF) of July 2018 which requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. In practice, Planning Authorities require sites being developed to have a lower level of risk post development than the higher level of risk that is required in order to determine a site as being contaminated in accordance with Part IIA. This is to ensure that there is a suitable zone of safety below the level for Part IIA determination and prevent recently developed sites becoming reclassified as contaminated land if there are

future legislative or technical changes (e.g., a substance is subsequently found to be more toxic than previously assessed this increases its hazard).

The criteria for assessing concentrations of contaminants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

- a) to identify and remove unacceptable risks to human health and the environment;
- b) to seek to bring damaged land back into beneficial use;
- c) to seek to ensure that the cost burdens faced by individuals, companies and society as a whole are proportionate, manageable and economically sustainable.

These three objectives underlie the "suitable for use" approach to risk management and remediation of contaminated land. The "suitable for use" approach focuses on the risks caused by land contamination. The approach recognises that the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

- a) ensuring that land is suitable for its current use - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise ("remediating" the land); the contaminated land regime provides the regulatory mechanisms to achieve this;
- b) ensuring that land is made suitable for any new use, as planning permission is given for that new use - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and
- c) limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought - in other words, recognising that the risks from contaminated land can be satisfactorily assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of contaminants does not therefore necessarily warrant action, and consideration must be given to the scale of risk involved for the use that the site has and will have in the future.

Overall Methodology

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the EA online guidance: Land Contamination: Risk Management (LCRM) (Environment Agency, 2020), and BS10175:2011+A2 2017. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

The first stage of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011), often referred to as the Phase 1 Study, comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed which identifies potential geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of potential contaminant linkages (of contaminant source-pathway-receptor). Potential contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The scope of the Ground Investigation is based on the findings of the Preliminary Risk Assessment and is designed to reduce uncertainty in the geotechnical and geo-environmental hazard identification. The Ground Investigation comprises fieldwork, laboratory testing and usually also on-site monitoring. The Ground Investigation may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011+A2 2017. The results of the Ground Investigation reduces uncertainty in the geotechnical and geo-environmental risks. Depending on the findings more detailed investigations or assessments may be required.

Preliminary Risk Assessment

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby “risk” is defined as:

- “(a) The probability, or frequency, or occurrence of a defined hazard; and
- (b) The magnitude (including the seriousness) of the consequences.”

The UK’s approach to the assessment of environmental risk is set out in by the Department of the Environment Transport and the Regions (2000) publication “A Guide to Risk Assessment and Risk Management for Environmental Protection” (also called Greenleaves II). This established an iterative, systematic staged process which comprises:

- a) Hazard identification;
- b) Hazard assessment;
- c) Risk estimation;
- d) Risk evaluation;
- e) Risk assessment;

At each stage during the development process, the above steps are repeated as more detailed information becomes available for the site.

For an environmental risk to be present, all three of the following elements must be present:

- Source/Contaminant: hazardous substance that has the potential to cause adverse impacts;
- Receptor: target that may be affected by contamination: examples include human occupants/users of site, water resources (rivers or groundwater), or structures;
- Pathway: a viable route whereby a hazardous substance may come into contact with the receptor.

The absence of one or more of each component (contaminant, pathway, receptor) would prevent a contaminant linkage being established and there would be no significant environmental risk.

The identification of potential contaminant linkages is based on a Conceptual Model of the site, which is subject to continual refinement as additional data becomes available. As part of a Preliminary Risk Assessment (Desk Study and site walk over) a Preliminary Conceptual Site Model (PCSM) is formed. Based on the PCSM, potential contaminant linkages can be assessed. If the PCSM and hazard assessment indicate that a contaminant linkage is not of significance then no further assessment or action is required for this linkage. For each significant and potential linkage, a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the Conceptual Site Model and assess the level of risk from each contaminant linkage.

Definition of Risk Assessment Terminology

CIRIA Report C552, Contaminated Land Risk Assessment A Guide to Good Practice, 2001 sets out a methodology for estimating risk. The methodology for risk evaluation is a qualitative method for interpreting the output for the risk estimation stage of the assessment. It involves the classification of the:

- Magnitude of the potential consequence (severity) of risk occurring.
- Magnitude of the probability (likelihood) of the risk occurring.

The classification of consequence and probability are set out in table B1 and B2 below:

Table B1 Classification of Consequence

Classification	Definition	Examples
Severe (Sv)	Short term (acute) risk to human health likely to result in “significant harm” as defined by the Environment protection Act 1990, Part IIA. Short term risk of pollution of controlled waters. Catastrophic damage to buildings / property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem	High concentrations of cyanide on the surface of an informal recreation area Major spillage of contaminants from site into controlled water. Explosion causing building collapse (can also equate to a short-term human health risk if buildings are occupied.)
Medium (Md)	Chronic damage to Human Health (“significant harm”). Pollution of controlled waters. A significant change in a particular ecosystem, organism forming part such ecosystem.	Concentrations of contaminants from site exceeding generic or site-specific screening criteria. Leaching of contaminants into a major or minor aquifer. Death of species within a designated nature reserve.
Mild (Mi)	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings / structures / services or the environment.	Pollution of non-classified groundwater. Damage to building, rendering it unsafe to occupy (e.g., foundation damage resulting in instability)
Minor (Mr)	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by measures such as protective clothing etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site work. The loss of plants in a landscaping scheme. Discolouration of concrete.

The classification of consequence does not take into account the probability of the consequence being realised. Therefore there may be more than one consequence for a particular pollutant linkage. Both a severe and medium classification can result in death. Severe relates to short term (acute) risk while medium relates to long term (chronic) risk. Mild relates to significant harm but to less sensitive receptors. Minor classification relates to harm which is not significant but could have a financial cost.

Table B2 **Classification of Probability**

Classification	Definition
High likelihood (Hi)	There is a pollutant linkage and an event that either appears very likely in the short term and almost inevitable in the long term, or there is evidence at the receptor or harm or pollution.
Likely (Li)	There is a pollutant linkage, and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood (Lw)	There is a pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the short term.
Unlikely (UI)	There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

The classification gives a guide as to the severity and consequence of identified risk when compared with other risk presented on the site. It should be noted that if a risk is identified it cannot be classified as “no risk” but as “very low risk”. Differing stakeholders may have a different view on the acceptability of a risk.

Once the consequence and probability have been classified these can be compared using a matrix (**Table B3**) to identify an overall risk category. These categories and the actions required are categorised in **Table B4**.

Table B3 Risk Evaluation Matrix

		Consequence			
		Severe (Sv)	Medium (Md)	Mild (Mi)	Minor (Mr)
Probability	High likelihood (Hi)	Very High Risk (VH)	High Risk (H)	Moderate Risk (M)	Mod/Low Risk (M/L)
	Likely (Li)	High Risk (H)	Moderate Risk (M)	Mod/Low Risk (M/L)	Low Risk (L)
	Low likelihood (Lw)	Moderate Risk (M)	Mod/Low Risk (M/L)	Low Risk (L)	Very Low Risk (VL)
	Unlikely (Ui)	Mod/Low Risk (M/L)	Low Risk (L)	Very Low Risk (VL)	Very Low Risk (VL)

Table B4 Risk Categorisations

Very High Risk (VH)	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk (H)	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer-term.
Moderate Risk (M)	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low Risk (L)	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk (VL)	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Generic Quantitative Risk Assessment

In the following sections the current UK guidance on risks to the following receptors are discussed: human health, plant life and controlled waters

Human Health

The overall methodology for assessing the risk to human health from potential contaminants in soil is set out in the Environment Agency's guidance "Using Soil Guideline Values" SC050021/SGV Introduction, March 2009 and using the CLEA 1.06 model software (and CLEA 1.071 for nickel). The generic assessment criteria are in accordance with the following:

- Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil;
- Science Report SC050021/SR3: Updated technical background to the CLEA model;
- Science Report SC050021/SR4: CLEA Software (Version 1.071, 2014) & Handbook;
- Toxicological reports and SGV technical notes;
- Toxicological data published by LQM/CIEH (2009) and CL:AIRE/EIC/AGS (2009);
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013);
- LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment; and,
- Toxicology review published by the European Food Safety Authority for nickel (2015).

In March 2014 six 'proposed' Category 4 Screening Levels (pC4SL) were issued by Defra. These screening values are considered to be within Category 4 as defined in the Contaminated Land Statutory Guidance and indicate safe levels for new developments passing through the planning system. The SGV for lead has been withdrawn, and the pC4SL for lead has been derived using current best practice. In January 2015 LQM/CIEH published S4ULs for 89 contaminants in accordance with the C4SL methodology.

Note that groundwater contamination may pose a risk to human health but that there are no relevant generic assessment criteria available for comparison. ByrneLooby has derived our own assessment criteria for this.

Phytotoxic Risks

Generic assessment of phytotoxicity is by comparison with guideline values presented in the British Standard for Topsoil and the MAFF document "Code of Good agricultural practice for the protection of soil", October 1998. This is in accordance with LCRM's reference to DEFRA notice CLAN 4/04.

Controlled Waters

Risks to controlled waters (groundwater and surface waters) from contaminants are assessed in accordance with the EA documents “The Environment Agency’s Approach to Groundwater Protection” (2017) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Environment Agency’s ‘limit’ pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). The risk posed to controlled waters from total soil concentrations cannot be directly assessed. The risk is assessed either by comparison of results of leachate tests carried out on soil samples, or from the direct testing of samples of groundwater to screening criteria. Leachate testing generally forms a conservative assessment and is not appropriate for organic contaminants.

CURRENT GUIDANCE ON INTERPRETATION OF CHEMICAL ANALYSIS OF SOILS

Contaminated land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995. This supports a 'suitable for use' based approach to the risk assessment of potentially contaminated land. The site-specific risk assessment is based upon assessment of plausible contaminant linkages, referred to as the contaminant-pathway- receptor model, based upon the current or proposed use of the site.

Before undertaking a risk assessment, a conceptual site model is devised in order to identify the potential contaminants, pathways and receptors. The individual contaminants, pathways and receptors then need to be further investigated in order to refine the initial assessment and risk assessment undertaken.

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents were withdrawn and the following documents have been published as revised guidance to the CLEA assessment:

- Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.
- Environment Agency : 2008: Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
- Environment Agency : 2008: Science Report SC050021/SR3: Updated technical background to the CLEA model.
- Environment Agency : 2008 : Compilation of Data for Priority Organic Contaminants for Derivation of Soil Guideline Values Science report SC050021/SR7
- Environment Agency : Science Report SC050021/SR4: CLEA Software (Version 1.071, 2015) & Handbook.
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels for Human Health Risk Assessment.

Additional guidance on statistical assessment replacing CLR 7 is partly provided in:

- CL:AIRE: 2009: Guidance on Comparing Data With a Critical Concentration

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to assess whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE: 2009 "Guidance on Comparing Data With a Critical Concentration".

The introduction of the Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) reassessed the CLEA Model and the derived SGVs (and associated GACs calculated using the model). This re-assessment concluded that the SGVs/GACs were conservative screening criteria for determining the suitability of soil with regard to the risk to human health under the planning regime and defined a new upper limit for planning purposes which is the boundary between the new Category 3 and 4. In March and September 2014 DEFRA issued guidance on these new Category 4 Screening Levels (C4SL) and these are discussed further below.

Soil Guideline Values

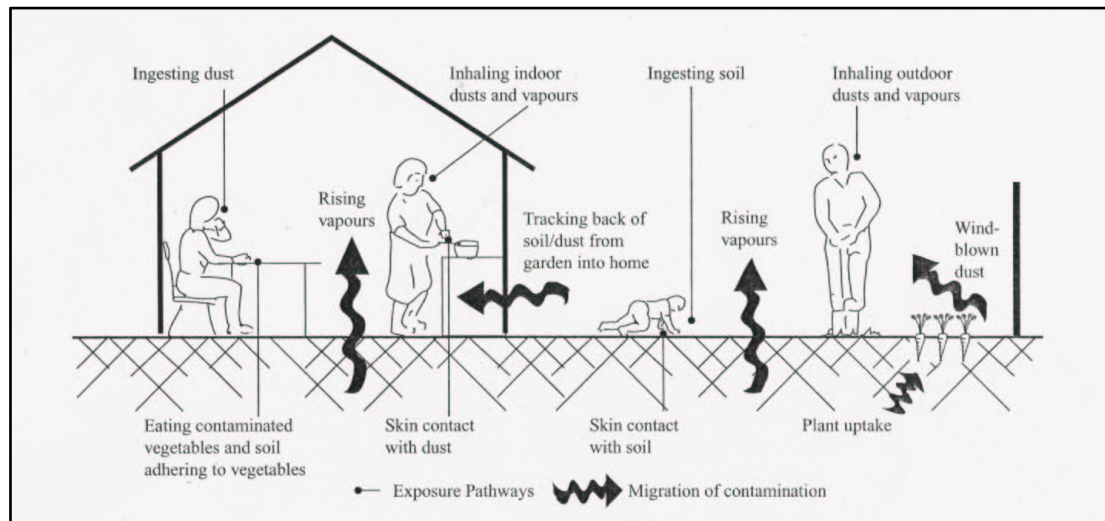
A program for the derivation of SGVs based on the above guidance is provided by the Environment Agency and is entitled “CLEA Software Version 1.06”. These reports, together with supporting toxicology reviews (“Tox” or Supplementary Information Reports) for individual substances (which will be gradually updated), Soil Guideline Value Reports and other guidance referred to in the above documents, provide guidance and the scientific basis for assessing the risk to human health from potential contaminants. Soil Guideline Value Reports (SGV Reports) have been published for a number of contaminants and these are published on the Environment Agency website. Eventually the reports will include SGVs for:

- heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury nickel (now withdrawn), and selenium;
- benzene, ethylbenzene, toluene, and xylenes;
- phenol;
- dioxins and dioxin-like polychlorinated biphenyls (PCBs);
- polycyclic aromatic hydrocarbons (PAHs) – 11 substances.

In September 2015, CLEA was re-issued as ‘CLEA Version 1.071’. Currently, the software has been used to produce an in-house GAC for nickel, following with withdrawal of the SGV.

In addition, CIEH through LQM and the EIC have published generic assessment criteria (GACs) for a wide variety of other parameters including metals, hydrocarbons, chlorinated aliphatic compounds, PAHs and explosive substances for three standard land uses. These have been produced to supplement the Environment Agency guidance. These GACs will be replaced by SGVs when or if the Environment Agency publishes any more SGVs.

The CLEA model has been developed to calculate an estimated tolerable daily soil intake (TDSI) for site users given a set ‘default’ exposure pathways. Ten human exposure pathways are covered in the CLEA model as presented below:



- Ingestion:
 - ingestion of outdoor soil;
 - ingestion of indoor dust;
 - ingestion of home-grown vegetables;
 - ingestion of soil attached to home grown vegetables.
- Dermal Contact:
 - dermal contact with outdoor soil;
 - dermal contact with indoor dust.
- Inhalation:
 - inhalation of outdoor dust;
 - inhalation of indoor dust;
 - inhalation of outdoor soil vapour;
 - inhalation of indoor soil vapour.

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g., certain organic compounds can pass through plastic water pipes into drinking water supply.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principle 'default' land use types and makes a series of 'default' assumptions with regard to human exposure frequency, duration and critical human target groups for each land use considered:

- residential land use;
- allotments;
- commercial and industrial land use.

The land use categories defined in the CLEA are detailed below.

Residential: This land use category assumes that people live in a variety of dwellings including terraced, detached and semi-detached houses up to two storeys high. The structure of buildings varies. Default parameters for building materials and building design are included in CLEA documents to calculate the relevant multi-layer diffusion coefficients for vapour intrusion and to model indoor vapour intrusion. The CLEA model assumes that regardless of the style of housing the residents will have access to either a private garden or community open space nearby, and that soil tracked into the home will form indoor dust. It allows for the ingestion pathways from home grown vegetables.

Allotments: The CLEA model incorporates an assessment of land provided by local authorities specifically for people to grow fruit and vegetables for their own consumption. Consumption of such fruit and vegetables present several exposure pathways; plants absorb contaminants mainly via water uptake through roots, the contaminants move to edible portions of plants via translocation and contaminated soil particles become trapped in the skin and between leaves. At present the model fails to account for exposure through the consumption of animals, and their products (e.g., eggs), which have been reared on contaminated land.

Commercial/Industrial: Although there are a wide variety of workplaces and work-related activities, the CLEA assessment of this land-use assumes that work occurs in a permanent, three-storey structure, where employees spend most time indoors, conducting office-based or light physical work. The model assumes employees sit outside during breaks for most of the year. Limitations in applying this land-use to different industries is detailed in EA publication “Updated technical background to the CLEA model” (2011). The generic model assumes that the site would not be covered by hard standing. Risk of exposure to contaminants would be clearly less where commercial land is essentially all buildings and hard standing.

Based on the assumptions of each land use and the associated applicable exposure pathways, a ‘Soil Guideline Value’ (SGV) may be calculated for each contaminant under consideration for a particular land use in order to determine whether certain contaminant soil concentrations pose a significant risk to human health. The primary purpose of the CLEA SGVs are as ‘trigger values’ – indicators to a risk assessor that soil concentrations below this level require no further assessment as it can be assumed that the soil is suitable for the proposed use. Where soil concentrations occur above the SGV then further assessment of the results is required. The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012 provides new clarity on the assessment of risk where soil concentrations exceed the SGV. The guidance introduces a four-stage classification system relating to concentration of contaminants and the assessed risk which indicates appropriate actions. Category 1 and 2 sites are classified as “Contaminated Land” as defined in Part IIA of The Environmental Protection Act (1990). Category 3 and 4 sites are not considered as “Contaminated Land” in accordance with the Act. This can be explained using the figure on the following page.

There are also difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be ‘unacceptable’ and that they would lead

to “significant possibility of significant harm” as defined in Part IIA of The Environmental Protection Act (1990) and determine that the land is “contaminated.” This ultimately requires detailed ‘toxicological’ information of the health effects of individual contaminants and also a scientific judgement on what constitutes an ‘unacceptable’ risk. It is for local authorities or the Environment Agency to determine whether a particular site is contaminated land, and it is for local Planning Authorities to determine whether land affected by contamination can be redeveloped.

Given the SGVs have been derived only for a limited number of contaminants and there was little prospect of further SGVs being published, two professional groupings have produced Generic Assessment Criteria (GACs) in accordance with the CLEA model for a large number of additional contaminants. These GACs were recognised in the new Contaminated Land Statutory Guidance (DEFRA, 2012) and have been produced as follows:

- *LQM/CIEH : 2009 Nathaniel CP, McCaffrey C, Ashmore MH, Cheng NPS GROUP, Gillett A, Ogden R & Scott D : 2009 . The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition). Land Quality Press, Nottingham.*
- *CL:AIRE/EIC/AGS: 2009 : Soil Generic Assessment Criteria (GAC) for Human Health Risk Assessment. Contaminated Land: Applications in Real Environments, Environment Industries Commission & Association of Geotechnical and Environmental Specialists. December 2009.*

Category 4 Screening Levels and LQM/CIEH Suitable 4 Use Levels

For new developments progressing through the planning regime, it is desirable that the soil concentrations are within Category 4 where there is a valid contaminant linkage. The upper boundary between Category 4 and 3 is not defined in the guidance. This boundary can also be better defined by carrying out a Detailed Quantified Risk Assessment (DQRA) and this is discussed later in this appendix.

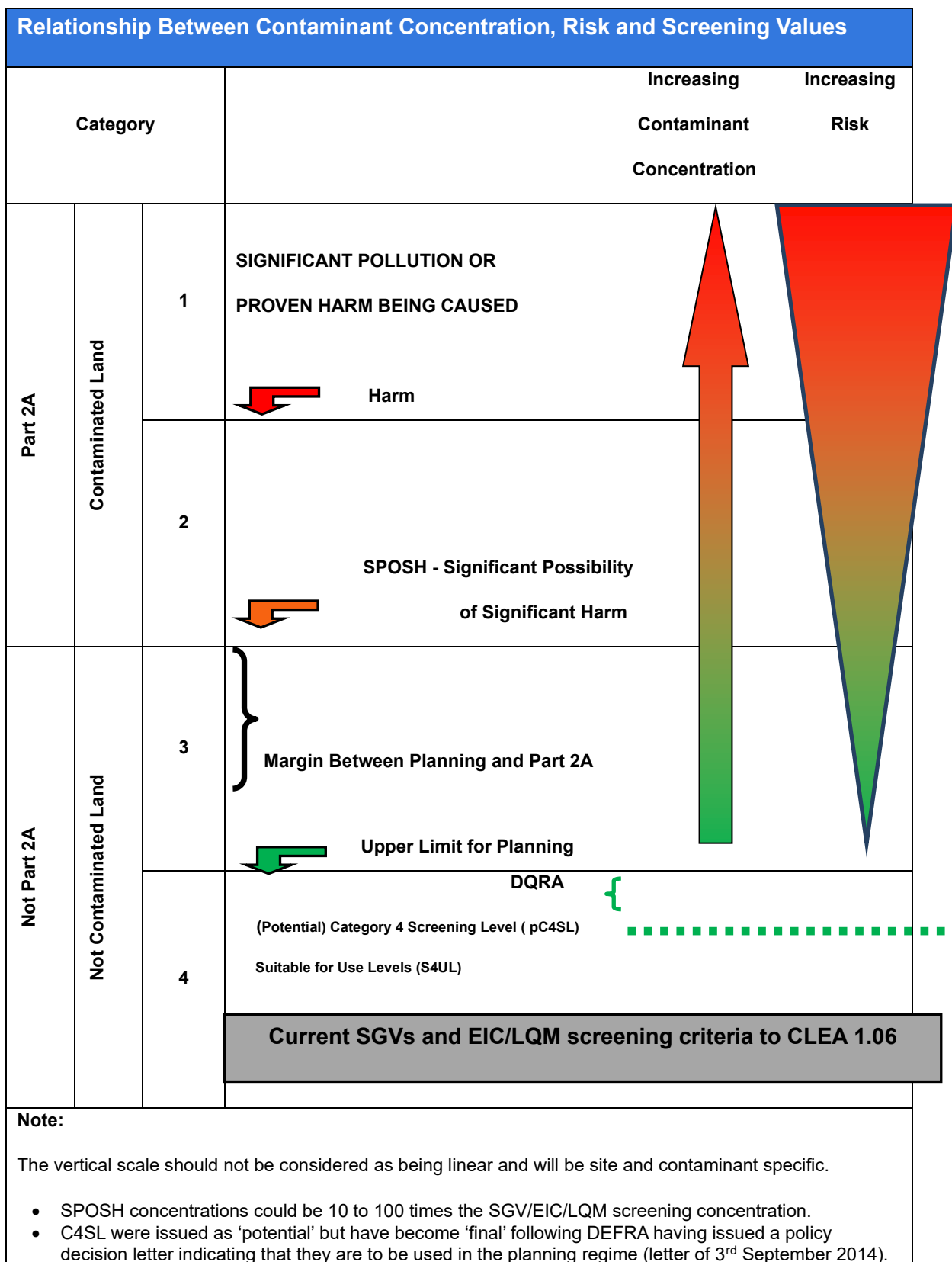
In December 2013 Defra issued the findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. The report was not designed to produce ‘final’ C4SL as the steering group producing the report believes that final C4SL should be set by a ‘relevant authority’ (e.g., Defra), the toxicological framework proposed has not been reviewed by the Committee on Toxicity and the document has yet to be subject to peer review.

In March 2014, appendices to the main Defra report were published detailing the derivation of pC4SL for 6 contaminants and other appendices regarding a review of the CIEH/CL:AIRE statistics guidance and sensitivity analysis. For each contaminant, a range of pC4SL have been produced relating to modifying toxicological parameters only, modifying exposure parameters only or by modifying both. It should be noted that the pC4SL produced for lead (the SGV was withdrawn in 2011) has undertaken a relatively large toxicological review in relation to modelling blood lead concentrations. pC4SL have been produced for:

- Arsenic;
- Benzene;

- Benzo(a)pyrene (as a surrogate marker for PAHs);
- Cadmium;
- Chromium (VI); and
- Lead

As previously discussed the values were initially published as 'potential' C4SL but have become 'final' following DEFRA having issued a policy decision letter indicating that they are to be used in the planning regime (letter of 3rd September 2014). It is considered that the pC4SL provide a simple test for deciding whether land is suitable for use without any remediation. The pC4SL represent a new set of screening levels that are more pragmatic (but strongly precautionary) compared to the existing soil guideline values (SGVs and the other GACs calculate in accordance with the existing CLEA methodology). The pC4SL provide cautious estimates of contaminant concentrations in soil that are still considered to present an acceptable level of risk, within the context of Part 2A, by combining information on toxicology, exposure assessment and normal levels of exposure to these contaminants. pC4SL values should not be seen as 'SPOH values.' Exceeding a pC4SL means that further investigation is required, not that the land is necessarily contaminated. In January 2015, LQM published Suitable 4 Use Levels (S4ULs) for a further 89 contaminants using the Defra C4SL methodology. In a similar manner to the pC4SLs, no authoritative review has been undertaken although the approach and quality of the work undertaken is widely accepted as being of high quality.



Lead:

The SGV for lead was withdrawn in 2011 and is not used in this report. The pC4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling in line with current scientific understanding of lead toxicology.

Nickel

The SGV for nickel was withdrawn in 2015 and is not used in this report. In-house GACs for nickel have been produced using the updated toxicological review by the EFSA and the CLEA 1.071 software.

Public Open Space

The Defra report (December 2013) has also introduced exposure scenarios for two other commonly occurring land uses which require assessment (under the planning and Part 2A regimes) on a relatively frequent basis. These exposure scenarios are:

- Public Open Space – Space Near Residential Housing (POS_{resi}); and,
- Public Open Space – Public Park (POS_{park}).

Potential use of pC4SL relating to Public Open Space (POS) require care due to the significant variability in exposure characteristics. For example, POS may include:

- Children's play areas, public parks where children practise sport several times a week and teenagers only once a week;
- Grassed areas adjacent to residential properties which are rarely used;
- Dedicated sports grounds where exposure is only to players and groundworkers; and,
- Nature reserves or open ground with low level activity (for example, dog walking).

Within the Defra report (December 2013) the following exposure scenarios have been modelled as these are considered the most important for potential exposure for the critical receptor i.e., young children:

- Green open space close to housing, including tracking back of soil (POS_{resi}); and
- Park-type scenario where distance is considered sufficient to discount tracking back of soil (POS_{park}).

Detailed Quantified Risk Assessment (DQRA)

SGVs, GACs, pC4SL and S4ULs are based on a number of basic assumptions. There are two main options for developing Site Specific Assessment Criteria (SSAC) by adjusting the CLEA model so that they have greater relevance to the site:

- **Simple adjustment of the generic SGV / C4SL model.** Such adjustment is restricted to the choice of exposure routes selected for the generic land use, building type, soil type and soil organic matter content within the CLEA software.
- **Detailed adjustment.** It may be relevant to make greater modifications to the model due to the specific use of the land in question. This can include modification to any parameter value, including exposure assumptions, building parameters, and the choice and application of fate and transport models. This is equally relevant to site-specific modifications of existing generic land uses, the development of new land uses, and the inclusion of additional exposure pathways. Much of this can be undertaken using the CLEA software. Depending on the complexity of the detailed adjustments required, it may be necessary to use other tools either alone or in conjunction with the CLEA software. Both options should follow established protocols for DQRA and require sufficient justification and supporting information for the adjustments made. Detailed adjustments are likely to require substantially greater technical justification and supporting documentation, especially if modifications are based on information not contained within the SGV framework documents.

The two choices present the risk assessor with three options/decisions:

1. Use a published SGV/GAC/pC4SL/S4UL if it can be demonstrated that the assumptions inherent in the value are appropriate to the site in question. If they are not, proceed to either option 2 or 3 below.
2. Make simple site-specific adjustments to the generic exposure model used to derive the SSAC. Three examples of when this could be appropriate are:
 - a. High density residential development with no exposed contaminated soil at surface. It is appropriate in this case to consider the relevance of direct contact pathways and consumption of homegrown produce.
 - b. Soil type is significantly different (specifically when soil type is likely to be less protective e.g., made ground) to that assumed in the SGV/GAC/pC4SL/S4UL.
 - c. Soil organic matter content is significantly different to that assumed in the derivation of the SGV/GAC/pC4SL/S4UL.
3. If simple adjustments are not sufficient to reflect site conditions, undertake a DQRA. This may be undertaken using the CLEA software or by using an alternative risk assessment methodology that is relevant, appropriate, authoritative, and scientifically based. Changes to toxicological end points may also be considered, although this should only be undertaken by a toxicology expert. In the context of this guidance, simple adjustments of a generic land use scenario for soil type or SOM content for example are not considered sufficient to be classed as a DQRA.

DQRAs should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

Representative Data

The type, quantity and quality of the available soil data influence the method chosen to obtain a site representative soil concentration that is compared with an SGV/GAC/pC4SL/S4UL in the screening process. The soil data should be representative of the exposure scenario being considered. This can include factors such as:

- Averaging area over which exposure occurs;
- Sample depth; and,
- Heterogeneity of soil.

where the 'averaging area' is defined as:

"That area (together with a consideration of depth) of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions".

Site investigations take discrete samples from a given area (and to a certain depth). It has to be assumed that these samples are to some degree representative of the contaminant concentration throughout that volume of soil. The critical soil volume (taking into account area and depth) which might be usefully compared with an SGV/GAC/pC4SL/S4UL is a site-specific decision, but a starting point is the generic land use scenarios used in the derivation of the SGV/GAC/pC4SL/S4UL. The critical soil volume depends on two factors:

- Contaminant distribution and vertical profile (bands of highly contaminated material or lateral hot spots should not necessarily be averaged out with more extensive cleaner areas of soil without justification)
- Contribution to average exposure underpinning the SGV. Direct contact exposure pathways depend on the adult or child coming into contact with near-surface soils and the area over which that exposure occurs is usually important (i.e., the averaging area). Vapour pathways are less dependent on surface area, for example vapour intrusion may result from a highly concentrated hot spot beneath a building leading to elevated average indoor air concentrations. For the three standard land uses for which SGVs are derived, relevant considerations are:
- For the standard **residential or allotment land use**, the critical soil volume is the area of an individual garden, communal play area or working plot from the surface to a depth of between 0.50m and 1.00m. This is the ground over which children are most likely to come into contact with soil or from which vegetable and fruit produce will be harvested. In the case of volatile contaminants, it may also be appropriate to consider the volume of soil underneath the footprint of the building although vapour intrusion may be driven by a soil volume much smaller than this if the contaminant source is highly concentrated.

- For the standard **commercial land use**, the critical soil volume has to be decided on a case-by-case basis due to the wide range of possible site layouts. However, for non-volatile contaminants, landscaped and recreational areas around the perimeter of office buildings are likely to be most important. For volatile contaminants, the footprint occupied by the building itself should also be considered.
- For **most exposure pathways**, the contamination is assumed to be at or within one metre of the surface.

The use of averaging areas must be justified on the basis of relevance to the exposure scenario. SGVs are relevant only when the exposure assumptions inherent in them are appropriate for the identified exposure averaging area. Further guidance on critical soil volumes and the consideration of averaging exposure areas can be found in:

- *Secondary model procedure for the development of appropriate soil sampling strategies for land contamination (Environment Agency, 2000);*
- *Guidance on comparing soil contamination data with a critical concentration (CIEH/CL:AIRE, 2009); and*
- *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Appendix I (Defra December 2013, March 2014)*

It is the mean soil concentration for the individual contaminant within an individual averaging area, which is compared to the SGV. However, as contaminant concentrations vary across a site, and sampling and analysis will introduce measurement errors, the comparison between measured mean concentration and the SGV must take this uncertainty into account.

There are two principal options available to obtain site representative soil concentrations from a site investigation dataset; statistical and non-statistical methods. Data objectives, quality and quantity are likely to determine which approach is most appropriate. If statistical methods such as those presented in CIEH/CL:AIRE (2011) are to be used, sufficient data need to be available or obtained. No one single statistical approach is applicable to all sites and circumstances. The wider range of robust statistical techniques developed by organisations including the US Environmental Protection Agency (USEPA) are also important tools. Risk assessors should choose an appropriate statistical approach on the basis of the specific site and the decision that is being made. For further guidance on the appropriate use of statistical approaches, refer to USEPA 2006 or good environmental monitoring statistics textbooks.

When statistical approaches are inappropriate (this will depend on the objectives of the site investigation), individual or composite samples should be compared directly to the SGV. Guidance on use of alternative data handling approaches such as the use of composite sampling can be found in documents such as:

- *Verification of remediation of land contamination (Environment Agency, 2010);*
- *Sampling and testing of wastes to meet landfill Waste Acceptance Criteria (Environment Agency, 2005);*

- *Guidance on choosing a sampling design for environmental data collection* (USEPA, 2002); and,
- *Soil Quality – Sampling, ISO 10381 series* (ISO, 2002–2007).

The statistical tests should not be used as arbiters for decisions under Part 2A. They are an additional, useful line of evidence to assist in decision-making. The implications of the basis for the derivation of the site representative soil concentration must be taken into account in any decision-making process and clearly documented.

Where the statistical tests are conducted in accordance with the method described in CL:AIRE 2009:

- For the Planning situation, it has to be demonstrated that the concentration of contaminants is low compared to the pC4SL/S4UL or SSAC. All of the test data should be below the screening criteria and no statistical analysis is required or if there are exceedances of the criteria then a statistical assessment is required. For the statistical assessment this decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the screening criteria.
- For the Part 2A scenario the regulator needs to determine whether the concentration of contaminants is greater than the SGV/GAC/pC4SL/S4UL or SSAC. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the SSAC. However, the regulator may proceed with determination if there is just a 51% probability, “on the balance of probabilities.”

If the screening levels are exceeded then more sophisticated quantitative risk assessment can be undertaken or remedial action may be taken to break the contaminant linkages. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation. Further information about the use of soil guideline values is provided in Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.

Generic Risk Assessment Criteria For Risk To Plants

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus, the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely, and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bioaccumulated and this is highly species dependant. Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought). Some plants (including some rare plants) will only grow in soils where there are relatively high concentrations which would be phytotoxic to other species. Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations.

ByrneLooby has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted by ByrneLooby as indicators of the potential for phytotoxicity: As, Cr, Cu, Ni and Zn (note that Boron has been excluded from this list because the more modern studies do not assess this).

As the CLEA framework is a risk-based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context. Published assessment criteria for the protection of plant life from a number of countries are given in the following Table. The most authoritative source is the British Standard for topsoil, but this only lists three elements. LCRM states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria. This approach has been adopted by ByrneLooby where BS3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table below from, firstly UK, and, secondly, European and then other worldwide criteria. The adopted criteria are highlighted in the table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table B.5: Published Assessment Criteria for Phytotoxic Elements (mg/kg)							
Reference	As	CR (Total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
British Standard for topsoil (BS3882:2007)	-	-	-	-	200 (pH >7)	110 (pH >7)	300 (pH >7)
					135 (pH 6-7)	75 (pH 6-7)	200 (pH 6-7)
					100 (pH 5.5-6.0)	60 (pH 5.5-6.0)	200 (pH 5.5-6.0)
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250	-	400 for sites containing sewage and sludge	-	500 (grass) but may fall to 250 for clover and sensitive species (at pH>6)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
ICRCL 59/83 (1987) now withdrawn for human health assessment	-	-	-	-	130	70	300
ICRCL 70/90 (1990) threshold trigger value	50	-	-	25 *	250	-	1000
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994)	40	230	-	7	190	-	-
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20	-	400	1	100	60	200
New Zealand guidelines for timber treatment sites (1977), estimated based on Cu bioavailability *	-	-	-	-	500 - 1000 clay soils	-	-

New Zealand guidelines for timber treatment sites (1977), soil criteria for protection of plant life (residential/ agricultural setting)	10-20	-	600	25	130	-	-
Note: * Cr (VI) is only likely to be present in as a significant proportion of total Cr where pH >12 so this does not routinely need to be tested for regarding plant health.							

Current Guidance For Controlled Waters Risk Assessment

Summary of Regulatory Context

Government policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990 ^[4] (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995 ^[5], which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- a) Significant harm is being caused or there is a significant possibility of such harm being caused; or,*
- b) Pollution of controlled waters is being, or is likely to be, caused.”*

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

*“the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter”*

Part IIA is supported by a substantial quantity of guidance and other Regulations, especially for England, The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012. The document re-confirms the duties of Enforcing Authorities in dealing with contamination including the role of the Environment Agency which has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist, there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

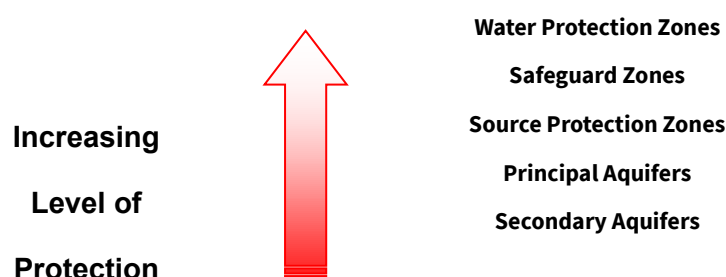
Part IIA places contaminated land responsibility as a part of the planning and redevelopment process rather than Local Authority or Environment Agency taking direct action except in situations of very high pollution risk or where harm is occurring. In the planning process guidance is provided by National Planning Policy Framework (NPPF) of March 2012. This requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be readily agreed with the planners.

Environment Agency Guidance

Legislation and guidance surrounding the protection of controlled waters in the UK is numerous and can be complex. The Environment Agency’s overall position on groundwater is *“To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify”* (The Environment Agency’s Approach to Groundwater Protection, 2017). In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the Environment Agency Policy document *The Environment Agency’s Approach to Groundwater Protection* of March 2017.

The Environment Agency follows a tiered, risk-based approach to drinking water protection, and this should be taken into account when carrying out controlled waters risk assessment:



Tools available for Risk Assessment of Controlled Waters

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. A number of tools are available for this purpose.

Three main stages apply to any risk assessment of controlled waters, these are:

- i. Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting etc)
- ii. Generic Risk Assessment (using the EA Remedial Targets Methodology – Tier 1 - Comparison of groundwater data with relevant standards)
- iii. Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site-specific parameters, using the EA Remedial Targets Methodology - Tiers 2 & 3)

The process is summarised below (Taken from the Environment Agency GP3 consultation document, 2006):

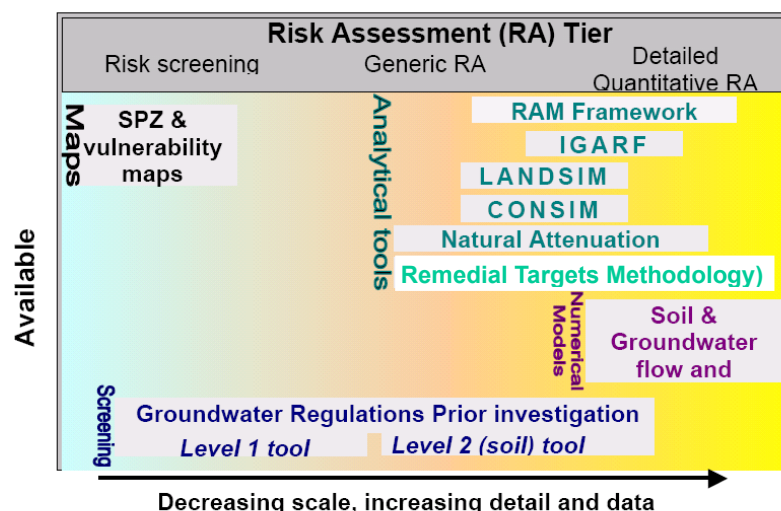


Figure 1-1 Environment Agency groundwater assessment tools, mapped against the different levels of risk assessment.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology “Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination” Environment Agency (2006). The methodology has four tiers of assessment:

- **Tier 1** utilises either a soil concentration (calculation of pore water concentrations based on partitioning calculations), leaching test or pore-water concentration of

perched water as a source concentration input and these are contrasted directly to water quality standards. No dilution or attenuation is considered at Level 1.

- **Tier 2 (groundwater)** considers dilution of the contaminant within the underlying receiving groundwater or surface water body. To determine a dilution, factor the infiltration rate of pore water and the discharge of groundwater beneath the source must be determined. Level 2 Assessment comprises a comparison between measured groundwater concentrations with to water quality standards.
- **Tier 3** considers natural attenuation in the form of dispersion, retardation and degradation of the contaminant. As the levels are progressed, the assessment becomes increasingly more detailed and less conservative as the data requirements are increased with each successive tier. The Environment Agency has released Excel Worksheets to carry out basic calculations using a conservative approach up to Tier 3. However, in this case the conceptual model is a simple one and assumes there is a simple migration of contaminants from the source zone into the aquifer receptor. Using these worksheets requires a sensitivity analysis showing how by varying each parameter, what effect it might have on the outcome of the assessment. Groundwater conceptual models are not always this simple.
- **Tier 4** is for more complex conceptual models where multiple sources, multiple pathways, multiple receptors and complex water balances can be assessed.

The Environment Agency developed a spreadsheet-based code to support the Remedial Target Methodology, and the code is capable of undertaking assessments for Tiers 1 to 3. Tier 4 assessment is not supported by the spreadsheet-based code.

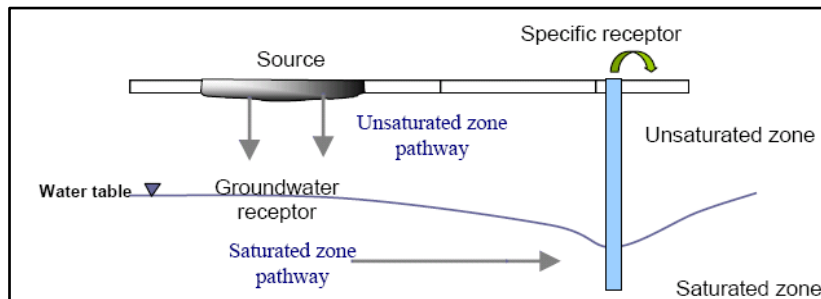
A more advanced code, ConSim 2, developed on behalf of the Environment Agency to support the Remedial Targets Methodology, allows for the introduction of additional geological horizons and is used mainly to determine the concentrations reaching a receptor and the timescales over which this may happen.

The codes assess only the dissolved phase contaminants. There are many further codes commercially available for use in controlled waters risk assessment, particularly for more complex situations, however, these should be used with caution and only once agreement has been obtained from the Environment Agency. All have the overall aim of the estimation of risk from contaminant linkages and the protection of controlled waters.

General notes on each stage of the controlled waters risk assessment process

Risk Screening

The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an early stage. For example, if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic Source-Pathway-Receptor concept is given below (taken from the Environment Agency GP3, 2006):



Generic Risk Assessment

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

There is a hierarchy of screening criteria which is as follows:

- Updated Recommendations on Environmental Technical Standards, River Basin Management (2015-21), April 2012 by the UK Technical Advisory Group on the Water Framework Directive;
- Environmental Quality Standards (EQS) for freshwaters based on The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives);
- Surface Waters (Abstraction for Drinking Water)(Classification) Regulations (1996)
- Surface Waters (Fishlife) (Classification) Regulations (1997)
- UK Drinking Water Standards (DWS) (Water Supply (Water Quality) Regulations 2000);
- Dutch Ministry of Housing, Spatial Planning and Environment (2001) Intervention Values and Target Values – soil quality standards;
- World Health Organisation Guidelines for Drinking Water (2004).

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;

- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be dependent on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

Additional site-specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or *compliance point*. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Definition of Controlled Waters

The term 'controlled waters' is defined in Section 104 of the Water Resources Act 1991 as:

"Territorial Waters...which extend seawards for three miles..., coastal waters..., inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata."

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the Environment Agency recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

Environment Agency's Aquifer Designations

The Environment Agency have classified different types of aquifers from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

The maps are split into two different types of aquifer designation:

- **Superficial (Drift)** – permeable unconsolidated (loose) deposits.
- **Bedrock (Solid)** – solid permeable formations e.g., sandstone, chalk, limestone.

The aquifer designations displayed on the Environment Agency maps are as follows:

- **Principal Aquifers (formerly termed Major Aquifers)** – These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as a major aquifer.
- **Secondary Aquifers (formerly termed Minor Aquifers)** – These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
 - **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
 - **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
 - **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Unproductive Strata (formerly termed Non-Aquifer)** – These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non-Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

Management Of Contaminated Land

When risk assessment of the site has been completed and this indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA online guidance LCRM (2020) “Land Contamination: Risk Management” The stages of managing remediation are as follows:

- (a) Options Appraisal and develop Remediation Strategy;
- (b) Develop Implementation Plan and Verification Plan;
- (c) Remediation, Verification and Monitoring.

The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on-site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

Glossary

TERMS		UNITS	
AST	Above Ground Storage Tank	m	Metres
BGS	British Geological Survey	km	Kilometres
BSI	British Standards Institute	%	Percent
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	%v/v	Percent volume in air
CIEH	Chartered Institute of Environmental Health	mb	Milli Bars
CIRIA	Construction Industry Research Association		(atmospheric pressure)
CLEA	Contaminated Land Exposure Assessment	l/hr	Litres per hour
CSM	Conceptual Site Model	ha	Hectare (10,000m ²)
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	µg/l	Micrograms per Litre
DWS	Drinking Water Standard		(parts per billion)
EA	Environment Agency	ppb	Parts Per Billion
EQS	Environmental Quality Standard	mg/kg	Milligrams per kilogram
GAC	General Assessment Criteria		(parts per million)
GL	Ground Level	ppm	Parts Per Million
GSV	Gas Screening Value	mg/m ³	Milligram per metre cubed
HCV	Health Criteria Value	Mg/m ³	Megagram per metre cubed
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel)	µg/m ³	Microgram per metre cubed
ND	Not Detected	m bgl	Metres Below Ground Level
LMRL	Lower Method Reporting Limit	m bcl	Metre Below Cover Level
NR	Not Recorded	mOD	Metres Above Ordnance Datum (sea level)
OD	Ordnance Datum	kN/m ²	Kilo Newtons per metre squared
PAH	Poly Aromatic Hydrocarbon	kPa	Kilo Pascal – same as kN/m ²
PCB	Poly-Chlorinated Biphenyl	µm	Micro metre
PID	Photo Ionisation Detector		
PCSM	Preliminary Conceptual Site Model		
SGV	Soil Guideline Value		
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)		
SPT	Standard Penetration Test		
SVOC	Semi Volatile Organic Compound		
UST	Underground Storage Tank		
VCCs	Vibro Concrete Columns	VSCs	Vibro Stone Columns
VOC	Volatile Organic Compound		

Appendix C – Exploratory Hole Records

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Trial Pit Log



Personnel: Logged by: M.Simmons Checked by: B.Fagg Approved by: B.Fagg			Equipment & methods: Method: Mechanical excavation with excavator Plant: JCB 3CX Shoring: 20mm filter gravel			Dimensions: Width: 0.55 Length: 2.10 Orientation: Strike A - C = °			Coordinates & level: Easting: 520425.04 m E Northing: 226452.03 m N Level: 95.98 m OD Grid: OSGB			Dates: Start: 23/02/2026 End: 23/02/2026 Logged: 23/02/2026		
Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing									
					Depth		Type & No		Results					
			95.78 0.20	Brown very clayey gravelly fine to coarse SAND with some rootlets. Gravels are angular to sub-rounded, fine to coarse flint. (TOPSOI) Brown slightly clayey gravelly fine to coarse SAND with low cobble content. Gravel and cobbles are angular to sub-rounded, fine to coarse flint. (SAND & GRAVEL)	0.20 - 0.30	ES1								
			(1.50)											
			94.28 1.70											
				Trial pit ends at 1.70 m (Target depth reached.)										

Sheet 1 of 1

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Sheet 1 of 1

Sheet 1 of 1

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Dynamic Sample Log



Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.40	Start date: 27-02-26	End date: 27-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools	Logger: G.Illsley	Logged: 27-02-26	Remarks: Insulated hand tools	mE:	519995.96
WLS	0.40	5.00	27-02-26	27-02-26		Windowless sampling rig	G.Illsley	27-02-26		mN:	226590.01
										mAOD:	90.46
										Grid:	OSGB

Backfill/ Instaln	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
				(0.50)	Dark brown very clayey slightly gravelly fine to coarse SAND with cobbles. Gravels and cobbles are angular to sub-rounded fine to coarse flint. (TOPSOIL)			0.10 - 0.20	ES1	
			89.96	0.50	Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded, fine to coarse flint. (GLACIAL TILL)					
				(0.50)						
			89.46	1.00	Medium dense orangish brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub-rounded fine to coarse flint. (SAND & GRAVEL)	Dry	0.00	1.00 - 1.45	C	N=10 (2,3/3,2,3,2)
				(0.50)						
			88.96	1.50	Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse flint. (GLACIAL TILL)			1.50 - 1.60	ES2	
				(1.00)		Dry	0.00	2.00 - 2.45	C	N=31 (4,5/9,5,8,9)
					2.30 - 2.50 m: Large grey flint cobble / boulder at least 200mm.					
			87.96	2.50	Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to coarse flint. (GLACIAL TILL)					
				(0.60)						
					3.00 - 3.10 m: Large grey flint cobble / boulder at least 100mm.	Dry	0.00	3.00 - 3.45	C	N=19 (8,8/6,4,4,5)
			87.36	3.10	Medium dense orangish brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub-rounded fine to coarse flint. (SAND & GRAVEL)					
				(0.50)						
			86.86	3.60	Medium dense brown mottled black clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub-rounded fine to medium flint. (SAND & GRAVEL)					
				(0.60)		Dry	0.00	4.00 - 4.45	C	N=14 (3,3/3,4,4,3)
			86.26	4.20	Firm brown very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded, fine to coarse flint. (GLACIAL TILL)					
			86.06	4.40	Firm yellowish brown sandy slightly gravelly CLAY. Sand is fine to coarse, gravel is angular to sub-rounded, fine to medium flint. (GLACIAL TILL)					
			85.86	4.60	Orangish brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub-rounded, fine to coarse flint. (SAND & GRAVEL)					
			85.76	4.70	Medium dense dark orangish brown slightly gravelly fine to coarse SAND. Gravel is angular to sub-rounded, fine to medium flint. (SAND & GRAVEL)					
				(0.30)		Dry	0.00	5.00 - 5.45	C	N=18 (6,5/6,4,4,4)
			85.46	5.00						
	SP (50)				Dynamic sample ends at 5.00 m (Target depth reached.)	Water	Casing	Depth	Type & No	Results

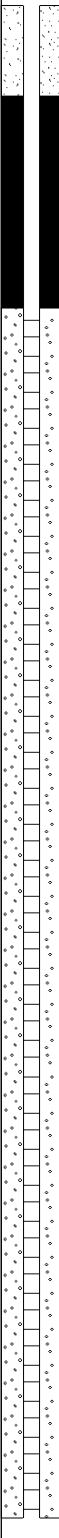
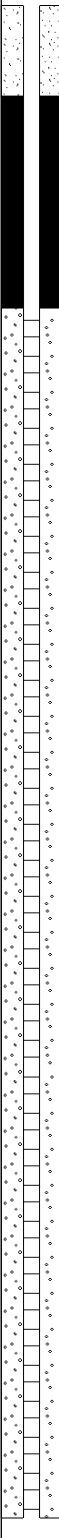
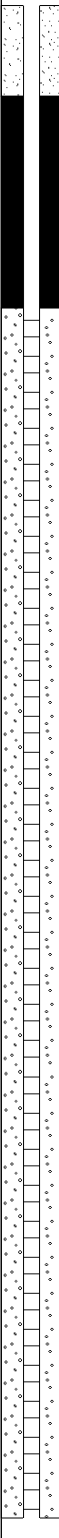
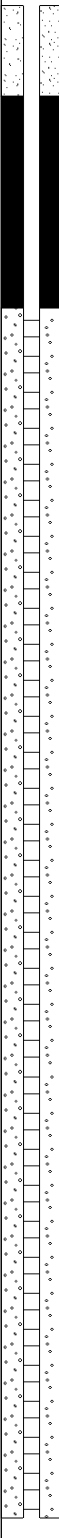
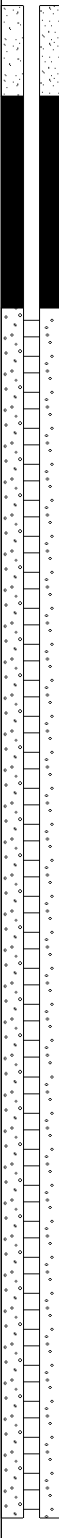
Groundwater entries:				Casing:		Depth related remarks:			Run details:				
Struck:	Rose to:	Casing:	Sealed:	Cased to:	Diameter (mm):	From	to:	Remarks	From:	to:	Ø	Duration:	Recovery:
									0.40	1.00	101	00:07:00	100
									1.00	2.00	87	00:06:00	100
									2.00	3.00	87	00:07:00	100
									3.00	4.00	67	00:07:00	100
									4.00	5.00	67	00:06:00	100

1 AGS Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres.		Project: Sperberry Hill BESS		Exploratory position reference:	
Log issue: DRAFT		Project No: C57/2338		WS01	
Scale: 1:25		Client: Brockwell Energy			
				Sheet 1 of 1	

Dynamic Sample Log



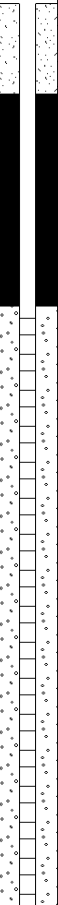
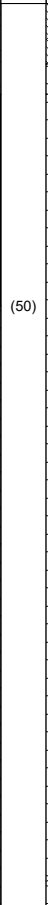
Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.40	Start date: 27-02-26	End date: 27-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools	Logger: G.Illsley	Logged: 27-02-26	Remarks: Insulated hand tools	mE: 520103.99	
WLS	0.40	5.00	27-02-26	27-02-26		Windowless sampling rig	G.Illsley	27-02-26		mN: 226244.99	
										mAOD: 87.11	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing					
						Water	Casing	Depth	Type & No	Results	
				(0.30)	Dark brown very clayey slightly gravelly fine to coarse SAND with cobbles. Gravel and cobbles are angular to sub-rounded, fine to coarse flint. (TOPSOIL)	Dry	0.00	0.10 - 0.20	ES1	N=15 (3,4/3,4,4,4)	
			86.81	0.30	Firm brown very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded, fine to medium flint. (GLACIAL TILL)						
				(0.40)							
			86.41	0.70	Creamish white stained red structureless CHALK comprising a sandy clay matrix and sub-angular to sub-rounded fine to coarse low to medium density intact chalk fragments (Grade Dm). (SEAFORD CHALK FORMATION)				1.00 - 1.45		C
				(1.30)					1.20 - 1.30		ES2
						Dry	0.00	2.00 - 2.45	C	N=8 (3,1/1,2,2,3)	
			85.11	2.00	Creamish white structureless CHALK comprising a gravelly clay matrix and sub-angular to sub-rounded fine to coarse low to medium density intact chalk fragments (Grade Dm). (SEAFORD CHALK FORMATION)				2.20 - 2.30		ES3
				(3.00)							
						Dry	0.00	3.00 - 3.45	C	N=9 (3,2/2,2,3,2)	
						Dry	0.00	4.00 - 4.45	C	N=10 (4,2/2,3,2,3)	
			SP (50)	5.00	Dynamic sample ends at 5.00 m (Target depth reached.)	Dry	0.00	5.00 - 5.45	C	N=10 (3,2/3,2,3,2)	
			Inst (Ø)				Water	Casing	Depth	Type & No	Results

Dynamic Sample Log



Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.40	Start date: 27-02-26	End date: 27-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools	Logger: G.Illsley	Logged: 27-02-26	Remarks: Insulated hand tools	mE: 520161.03	
WLS	0.40	3.00	27-02-26	27-02-26		Windowless sampling rig	G.Illsley	27-02-26		mN: 226701.03	
										mAOD: 96.38	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			96.18	0.20	Soft dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to medium flint. (TOPSOIL)			0.10 - 0.20	ES1	
			96.08	0.30	Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to medium flint. (GLACIAL TILL)					
					Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub-rounded fine to medium flint and chalk. (GLACIAL TILL)					
						Dry	0.00	1.00 - 1.45	C	N=11 (2,2/3,3,2,3)
								1.50	ES2	
				(2.60)						
			93.48	2.90	Greyish white stained red structureless CHALK comprising a clay matrix. (SEAFORD CHALK FORMATION) Dynamic sample ends at 3.00 m (Target depth reached.)					
			93.38	3.00		Dry	0.00	3.00 - 3.45	C	N=27 (4,5/7,7,6,7)

Groundwater entries:			Casing:		Depth related remarks:			Run details:				
Struck: Rose to:	Casing: Sealed:		Cased to:	Diameter (mm):	From	to:	Remarks	From:	to:	Ø	Duration:	Recovery:
								0.40	1.00	101	00:06:00	100
								1.00	2.00	87	00:06:00	100
								2.00	3.00	67	00:06:00	100
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres.			Project: Sperberry Hill BESS Project No: C57/2338 Client: Brockwell Energy					Exploratory position reference: WS03				
Log issue: DRAFT Scale: 1:25												

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Dynamic Sample Log



Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.40	Start date: 26-02-26	End date: 26-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools Windowless sampling rig	Logger: M.Simmons M.Simmons	Logged: 26-02-26 26-02-26	Remarks: Insulated hand tools	mE: 520854.98	mN: 226469.51
WLS	0.40	3.00	26-02-26	26-02-26						mAOD: 95.97	Grid: OSGB

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			95.67	(0.30)	Dark brown very clayey slightly gravelly fine to coarse SAND. Gravels are sub-angular to sub-rounded, flint. (TOPSOIL)	Dry	0.00	0.10 - 0.20	ES1	N=15 (1,2/3,4,3,5)
				(0.90)	Firm orangish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravels are sub-angular to sub-rounded, fine to coarse, flint. (GLACIAL TILL)			0.75 - 0.85	ES2	
				(0.40)	Medium dense reddish brown silty fine to coarse SAND. (SAND & GRAVEL)			1.00 - 1.45	C	
			94.77	1.20	Firm orangish brown sandy gravelly CLAY. Sand is fine to coarse. Gravels are sub-rounded to rounded, fine to coarse, flint, chalk. (GLACIAL TILL)	Dry	0.00	2.00 - 2.45	C	N=18 (4,4/4,4,5,5)
				(0.40)	Firm brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravels are angular to sub-rounded, fine to medium, flint, chalk. (GLACIAL TILL)			3.00 - 3.45	C	
			92.97	3.00	Dynamic sample ends at 3.00 m (Target depth achieved.)	Dry	0.00			

Groundwater entries:				Casing:		Depth related remarks:				Run details:				
Struck: Rose to: Casing: Sealed:				Cased to: Diameter (mm):		From to: Remarks				From: to: Ø Duration: Recovery:				
										0.40 1.00 101 00:06:00 100				
										1.00 2.00 87 00:06:00 100				
										2.00 3.00 77 00:06:00 100				
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres.				Project: Sperberry Hill BESS						Exploratory position reference:				
Log issue: DRAFT				Project No: C57/2338						WS05				
Scale: 1:25				Client: Brockwell Energy										
										Sheet 1 of 1				

Backfill/Instal'n	Water-strike	Legend	Level	Depth (thickness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
	(50)		89.23	0.30	Dark brown very clayey slightly gravelly fine to coarse SAND. Gravels are sub-angular to sub-rounded, flint. (TOPSOIL)	Dry	0.00	0.10 - 0.20	ES1	N=4 (1,1/0,0,2,2)
			93.93	0.30	Firm orangish brown sandy gravelly CLAY. Sand is fine to medium. Gravels are sub-angular to sub-rounded fine to coarse flint. (GLACIAL TILL)					
			92.53	1.70	Medium dense yellowish brown silty fine to coarse SAND. (SAND & GRAVEL)	Dry	0.00	2.00 - 2.45	C	N=13 (3,3/3,3,3,4)
			90.83	3.40	Stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravels are sub-angular to sub-rounded, fine to medium, flint, chalk. (GLACIAL TILL)	Dry	0.00	3.00 - 3.45	C	N=13 (2,4/3,3,4,3)
			89.23	5.00	Dynamic sample ends at 5.00 m (Target depth achieved.)	Dry	0.00	5.00 - 5.45	C	N=27 (4,4/5,6,9,6)
Instal'n						Water	Casing	Depth	Type & No	Results

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres. Log issue: DRAFT Scale: 1:25	Project: Sperberry Hill BESS Project No: C57/2338 Client: Brockwell Energy	Exploratory position reference: WS06 Sheet 1 of 1
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Dynamic Sample Log



Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.40	Start date: 26-02-26	End date: 26-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools	Logger: M.Simmons M.Simmons	Logged: 26-02-26	Remarks: Insulated hand tools	mE: 520982.02	
WLS	0.40	3.00	26-02-26	26-02-26		Windowless sampling rig				mN: 225985.05	
										mAOD: 86.88	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			86.63	0.25	Soft brown very sandy slightly gravelly CLAY. Sand is fine to coarse. Gravels are sub-angular to rounded, fine to coarse, chalk, flint. (TOPSOIL)			0.10 - 0.20	ES1	
			(0.65)		Firm orangish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravels are fine to coarse, sub-angular to sub-rounded flint, chalk. (GLACIAL TILL)			0.50 - 0.60	ES2	
			85.98	0.90	White locally stained brown structureless CHALK comprising a sandy gravelly clay matrix of sub-angular to rounded fine to coarse low to medium density intact chalk fragments (Grade Dm). (SEAFORD CHALK FORMATION)	Dry	0.00	1.00 - 1.45	C	N=10 (3,3/3,2,2,3)
			(2.10)			Dry	0.00	2.00 - 2.45	C	N=12 (2,3/2,3,3,4)
			83.88	3.00	Dynamic sample ends at 3.00 m (Target depth achieved.)	Dry	0.00	3.00 - 3.45	C	N=8 (2,2/2,2,2,2)

Inst (Ø)						Water		Casing		Depth		Type & No		Results	
Groundwater entries:				Casing:		Depth related remarks:						Run details:			
Struck: Rose to: Casing: Sealed:				Cased to: Diameter (mm):		From to: Remarks						From: to: Ø Duration: Recovery:			
												0.40 1.00 101 00:07:00 100			
												1.00 2.00 87 00:06:00 100			
												2.00 3.00 77 00:06:00 100			
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres.				Project: Sperberry Hill BESS								Exploratory position reference:			
Log issue: DRAFT				Project No: C57/2338								WS07			
Scale: 1:25				Client: Brockwell Energy											
														Sheet 1 of 1	

Dynamic Sample Log



Borehole formation details:										Location details:	
Type: IP	From: 0.00	To: 0.30	Start date: 26-02-26	End date: 26-02-26	Crew: Aaron Ward Aaron Ward	Plant: Hand tools	Logger: M.Simmons M.Simmons	Logged: 26-02-26	Remarks: Insulated hand tools	mE: 520826.19	
WLS	0.30	3.00	26-02-26	26-02-26		Windowless sampling rig				mN: 225852.75	
										mAOD: 86.89	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			86.69	0.20	Soft brown silty CLAY with common rootlets. (TOPSOIL)	Dry	0.00	0.40 - 0.50	ES1	N=13 (3,2/3,3,3,4)
					Creamish white structureless CHALK comprising a gravelly sandy clay matrix and angular to sub-rounded fine to medium low density intact chalk fragments with remnant bedding (Grade Dm). (SEAFORD CHALK FORMATION)					
			(1.00)					1.00 - 1.45	S	
			85.69	1.20	White structureless CHALK comprising a sandy clay matrix and fine to coarse low to medium density intact chalk fragments with remnant bedding (Grade Dm). (SEAFORD CHALK FORMATION)	Dry	0.00	1.20 - 1.30	ES2	N=17 (4,7/5,5,4,3)
								2.00 - 2.45	S	
			85.09	1.80	White structureless CHALK comprising a sandy clay matrix and angular to sub-rounded fine to coarse low to medium density intact chalk fragments with remnant bedding (Grade Dm). (SEAFORD CHALK FORMATION)	Dry	0.00	3.00 - 3.45	C	N=15 (3,3/4,3,5,3)
			83.89	3.00	Dynamic sample ends at 3.00 m (Target depth achieved.)					
						Water	Casing	Depth	Type & No	Results

Groundwater entries:			Casing:		Depth related remarks:			Run details:			
Struck: Rose to:	Casing: Sealed:		Cased to:	Diameter (mm):	From	to:	Remarks	From:	to:	Ø	Duration: Recovery:
								0.00	1.00	101	00:07:00 100
								1.00	2.00	87	00:06:00 100
								2.00	3.00	77	00:07:00 100
Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in metres.			Project: Sperberry Hill BESS Project No: C57/2338 Client: Brockwell Energy					Exploratory position reference: WS08			
Log issue: DRAFT Scale: 1:25											

Appendix D – Trial Pit Photographs

Trial Pit Photographs



Project name:
Sperberry Hill Solar and BESS
Client:
Brockwell Energy

Project No:
C57/2338
Staff Member(s)
MS

Photo Date
23/02/2026
Report reference
C57-2338-AYE-ENV-R-002



TP01 - Excavation



TP01- Arisings



TP02 - Excavation



TP02 - Arisings

Trial Pit Photographs

Project name:
Sperberry Hill Solar and BESS
Client:
Brockwell Energy

Project No:
C57/2338
Staff Member(s)
MS

Photo Date
23/02/2026
Report reference
C57-2338-AYE-ENV-R-002



TP03 - Excavation



TP03 - Arisings



TP04 - Excavation



TP04 - Arisings

Trial Pit Photographs



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TP05 - Excavation



TP05 - Arisings



TP06 - Excavation



TP06 - Arisings

Trial Pit Photographs



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MS

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TP07 - Excavation



TP07 - Arisings



TP08 - Excavation



TP08 - Arisings

Trial Pit Photographs



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MS

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TP09 - Excavation



TP09 - Arisings



TP10 - Excavation



TP10 - Arisings