



Hill Partnerships Ltd

Hengrove Bookend Plot E2

Remediation Strategy and Verification Plan





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Hengrove Bookend Plot E2

Remediation Strategy and Verification Plan

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TEC is ISO 9001:2015 and ISO 14001:2015 certified by Advanced Certification Limited, a UKAS Accredited Certification Body (number 8872) and ISO 45001:2018 certified by QMS International Ltd for the scope of 'Specialist consultancy services across the UK in contaminated land assessment, ground engineering, waste management and construction phase monitoring'.

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- 1 INTRODUCTION
- 1.1 Terms of Reference
- 1.1.1 TEC has been appointed by Hill Partnerships Ltd to prepare a Remediation Strategy and Verification Plan to support the proposed development at Hengrove Bookend Plot E2. All works were undertaken in accordance with our proposal letter dated 24 October 2022 and referenced CH.2210014.001.
- 1.2 Background
- 1.2.1 The site is understood to currently comprise a parcel of land formerly agricultural, then overgrown derelict land, accessed from The Boulevard, Hengrove, Bristol (Figure 1). The site covers an area of roughly 0.86 hectares, with the centre of the site located at approximate National Grid Reference 359460, 168291. The nearest postcode is BS14 ODB.
- 1.2.2 The proposed development is understood to comprise the erection of a 6-storey building with commercial/retail end use on the ground floor, and residential development of the upper 5-storeys. Between the proposed building and the adjacent existing building will be a covered car park area. (Figure 2).
- 1.2.3 The following reports have previously been produced for the site:
- Hengrove Park, Phase 1 Ground Conditions Desk Study Report. Prepared by AECOM (dated May 2018). This report was undertaken across the wider Hengrove Park site and has not been provided to TEC for review.
 - Hengrove Park, Phase 2 Geotechnical and Geo-environmental Interpretative Report by AECOM (dated November 2018). This report was undertaken across the wider Hengrove Park site and has not been provided to TEC for review.
 - Hengrove E2, Eastern Bookends, Geo-Environmental Assessment Report. Prepared for AECOM by Brownfield Solutions Ltd (ref. LG/M4355/9445 Rev A, dated August 2022). This report was undertaken specifically for the Hengrove E2, Eastern Bookends site and presents a summary of the findings of the earlier reports, which are relevant to the subject site.
 - Plot E2 – HRA Bookend (East), Hengrove, Bristol, Phase 1 Environmental Site Assessment by AECOM (ref. 60608649 dated March 2021).
 - Phase 2 Site Investigation – Block E2 Hengrove, Bristol. Prepared by Clarkebond UK Ltd for The Hill Group (ref: B06053-CLK-XX-XX-RP-GT-0001, Issue P01, dated March 2023). This report was undertaken, following the previous issue and subsequent Local Authority approval of the Rev A version of this Remediation Strategy, primarily to determine the geotechnical conditions and constraints for the proposed development (for foundation design, highway construction and floor slabs) but also includes some additional shallow ground gas monitoring, to further support the reassessment of the Characteristic Situation classification of the site.
- 1.2.4 Reference should be made to the above documents for full details regarding the site conditions and assessment works undertaken. A summary of the salient issues detailed in these reports, in relation to the Remediation Strategy, is provided in Section 2.
- 1.2.5 It should be noted that TEC has used the previous report findings in good faith but takes no liability for the validity or accuracy of this third-party material.
- 1.2.6 The aim of these works is to provide information on the remedial measures required to mitigate against the risks identified during the preliminary Geoenvironmental assessment of the site; and to assist in discharging the relevant pre-commencement planning condition as detailed in the planning permission (Condition 10 of Planning Application 21/02982/FB dated 29th March 2022).
- 1.2.7 This Remediation Strategy and Verification Plan has been undertaken in accordance with current guidance such as LCRM – Land Contamination: risk management (Environment Agency, 2023) and, where appropriate NHBC/LABC Standards.

2 SITE CONDITION SUMMARY

2.1 Introduction

2.1.1 A summary of the salient issues relating to the site and the proposed redevelopment, in relation to ground contamination, is presented below. Reference to the previous reports should be made for detailed information.

2.2 Previous Report Summary

Site History

2.2.1 The site was reportedly originally agricultural land, with construction of Bristol (Whitchurch) airport in 1930, approximately 150m to the north of the site. The airport was used by the Royal Airforce as a flying school during World War 2 and was subsequently decommissioned between 1972 and 1977. Residential development of the surrounding area took place from 1955 onwards. Development of land 100m to the southeast of the site comprising warehouses and factory buildings associated with a bottling plant occurred between 1955 and 1965. Development of the Hengrove Park Leisure Centre and South Bristol Community Hospital and associated parking, which are located adjacent to the site took place between 2006 and 2017.

Environmental Setting

2.2.2 Published geological mapping for the site recorded the underlying ground conditions to comprise Charmouth Mudstone Formation, which is classified as a Secondary Undifferentiated Aquifer. No superficial deposits were reported on site. Information provided within the previous reporting indicates the site is not within an Environment Agency Source Protection Zone (SPZ), and no SPZ's are recorded within 1km of the site. Regional groundwater flow is expected to be towards the west/north west. No surface water features are noted within 200m of the site. No licensed surface water abstractions are present within 1km of the site. The site is not at risk of flooding from rivers, sea, or groundwater.

Unexploded Ordnance

2.2.3 A UXO Threat and Risk Assessment was carried out by UXO specialist 6 Alpha in October 2017, the report concluded a 'Very High' risk rating for the site. The following risk mitigation measures were recommended as a minimum, in order to reduce risk as low as reasonably practicable, during all intrusive works:

- Operational UXO Emergency Response Plan;
- UXO Safety and Awareness Briefings;
- Explosive Ordnance Disposal (EOD) Banksman support; and
- Intrusive magnetometer survey.

Encountered Ground Conditions

2.2.4 During the most recent phase of investigation undertaken in 2023, four windowless sampler boreholes were advanced to a depth of between 3.0m and 3.7mbgl. In 2020, 6No trial pits to a maximum depth of 3.9mbgl, 2No window sample boreholes to a maximum depth of 3.6mbgl and 2No rotary cored boreholes to a maximum depth of 10.0mbgl were advanced, specifically within the site area. Within the AECOM 2021 Phase 1 Environmental Assessment, there is also reference to 2No further window samples which were advanced to depths of 0.4mbgl and 0.85mbgl respectively during 2018.

2.2.5 The site works undertaken in 2023 noted made ground to depths of between 0.3-0.5mbgl to comprise a mixture of reworked natural cohesive soil and building rubble (brick and concrete) associated with the recent localised development of the surrounding area. Prior to this, the composition of made ground across the site was relatively consistent, comprising clayey slightly gravelly sand with varying amounts of brick and concrete as gravel constituents. Made ground across the site was generally identified to a thickness of between 0.15mbgl and 0.4mbgl. Within the trial pits excavated to expose the foundations of the existing retaining wall located within the existing car park, made ground was deeper, with thicknesses varying between 0.6mbgl and 1.2mbgl.

- 2.2.6 Soils described as natural superficial deposits of slightly gravelly clay were not encountered within the most recent phase of investigation (2023) but were noted in previous phases, from depths of between 0.25mbgl to 1.2mbgl to maximum depths of between 3.3mbgl and 4.3mbgl. Low boulder content of limestone was encountered within the superficial strata between 1.1mbgl and 2.9mbgl.
- 2.2.7 Natural solid strata (Charmouth Mudstone Formation) underlying the site was encountered at depths of between 0.4mbgl and 4.6mbgl and was generally described as thinly laminated grey mudstone with interbedded bands of limestone, or grey limestone, which was proven to a maximum depth of 10.0mbgl.
- 2.2.8 Groundwater was not encountered during the investigation works but was recorded at depths of between 1.51mbgl and 3.22mbgl during subsequent rounds of monitoring.

Contamination Summary

- 2.2.9 It was reported that no visual or olfactory evidence of contamination was recorded within made ground or the underlying natural deposits. Soil sampling was undertaken, and a Generic Quantitative Risk Assessment was carried out as part of the previous investigation works. The results of the soil sample analysis were compared to Generic Assessment Criteria (GAC) for a 'Residential without plant uptake' land use scenario. Limited exceedances for PAH were detected by laboratory analysis within made ground in three locations. The exceedances were of Dibenz(a,h)anthracene in TP01 at 0.8mbgl, TP02 at 0.1mbgl and TP03 at 0.8mbgl. The residential without plant update screening value for Benzo(a)pyrene was also exceeded in TP02 at 0.1mbgl.
- 2.2.10 Positive identification of asbestos was reported in a single sample of the 10No samples analysed during the Brownfield Solutions Geoenvironmental Assessment. Quantification of this sample identified <0.001% mass (trace) of amosite fibres in TP04 at 0.1mbgl, located along the eastern boundary of the site.

2.3 TEC Supplementary Assessment

Human Health

- 2.3.1 Review of the proposed site layout drawings, and end use for the site by TEC indicates that the site will be developed with a 6-storey building with retail premises on the ground floor and residential apartments on the upper 5 storeys. Soft landscaping is restricted to limited areas of communal planting surrounding the proposed building and car parking, therefore the GAC for a 'Public Open Space (Residential)' are considered by TEC to be most representative of the end use for the site. Comparison of the recorded concentrations with the alternative GAC indicate no exceedances, which provides confirmation that remediation works will not be required with regards to levels of PAH recorded on the site.
- 2.3.2 Positive identification of asbestos was reported in a single sample analysed during the Brownfield Solutions Geoenvironmental Assessment. While quantification identified <0.001% mass (trace) of amosite fibres in TP04 at 0.1mbgl, a potential risk to site end users and construction workers cannot be discounted at this stage.

Controlled Waters

- 2.3.3 The risk to controlled waters is considered to be very low, due to the limited concentrations and nature of the contamination identified during the investigation (i.e. not significantly mobile within the aqueous environment), the presence of underlying impermeable strata, which will inhibit migration of potentially leachable contaminants and the distance to the nearest surface water feature (245m).

Ground Gas

Radon

- 2.3.4 Initial assessments undertaken as part of the AECOM Phase 1 Environmental Assessment dated March 2021 indicated that no radon protection is required. However, subsequent updates to the radon mapping in December 2022 indicated that the site may be situated within an area where 5-10% of homes are estimated to be at or above the Action Level. Therefore, TEC have obtained an updated site specific Radon Report from the BGS to determine whether radon protective measures are required at the site. The report, presented in Appendix A, confirms that the site lies within an area where less than 1% of homes are

estimated to be at or above the action level (i.e. not within a radon affected area) and that no radon protective measures are required at the site.

Bulk Ground Gas

- 2.3.5 The nearest historical landfill sites identified in proximity to the site are as follows:
- Airport Road, Hengrove, Bristol. Deposited waste not supplied. License holder not supplied, located ~365m west of the site; and
 - Hengrove, Bristol. Deposited waste included household waste. License holder not supplied, located ~830m northwest of the site.
- 2.3.6 Due to distance from the site and the relatively impermeable nature of the underlying strata, the above landfills are not considered to provide a viable off-site source for any gas migration. No further sources of potentially significant ground gas generation have been identified on or in proximity to the site and therefore, the risk from ground gas is considered to be low.
- 2.3.7 In addition, based on the information provided within the previous reports for the site, the encountered made ground materials are not considered to be of a thickness or composition considered to present a potential risk of ground gas generation.
- 2.3.8 Furthermore, the underlying solid geology (Charmouth Mudstone Formation) is generally of low organic content and would not be considered a potential source of ground gas generation on site.
- 2.3.9 Notwithstanding this, combined ground gas and groundwater monitoring standpipes were installed in 2No boreholes (BH01 and BH02) in June 2020 as part of the Brownfield Solutions geoenvironmental assessment of the site. Response zones were installed from 1.0mbgl to the base of each borehole (10.0m bgl in BH01 and 9.9mbgl in BH02) targeting the natural strata of the Charmouth Mudstone Formation. This material generally comprised an upper weathered horizon of high plasticity clay to depths of between ~3.6mbgl to 4.6mbgl, underlain by dark grey carbonate rich mudstone with thin bands of limestone to the base of each borehole.
- 2.3.10 Subsequently 4No rounds of gas monitoring were undertaken. It is noted that gas monitoring was in progress at the time of issue of the geoenvironmental report and it is unclear whether any additional monitoring was completed. Gas monitoring was undertaken at a range of atmospheric pressures of between 990mb and 1013mb, over a range of falling, steady and rising pressure trends.
- 2.3.11 No elevated methane was detected. However, a maximum carbon dioxide concentration of 12.5%v/v was recorded within BH02 on the third round of monitoring, with a maximum flow reading of 1.7 l/hr recorded within BH02 on the first round of monitoring. It is noted this initial flow decreased to a steady flow of 0.1l/hr.
- 2.3.12 Both boreholes were dry during and on completion of the drilling works on site, with no groundwater encountered during the investigation. However, during the first round of monitoring groundwater levels had risen to 1.59mbgl in BH01 and 2.19mbgl in BH02 (a rise of greater than 7.41m over a three week period).
- 2.3.13 With reference to CL:AIRE Research Bulletin RB17 (November 2012) – A Pragmatic Approach to Ground Gas Risk Assessment, several lines of evidence indicate that this initial elevated peak flow and carbon dioxide reading can be considered unrepresentative of actual conditions at the site:
- The initial peak flow reading of 1.7l/hr, reduced to 0.1l/hr during the duration of an individual monitoring round, suggesting that the flow of gas from the monitoring installation was not sustained;
 - A rapid rise in groundwater levels within the boreholes between the installation and first monitoring visit suggests that either ingress of water from surface water infiltration into the borehole occurred, or rising groundwater levels confined within strata of likely low permeability (clay and mudstone) is likely to have created an artificial pressure within the monitoring well;
 - Limited headspace within the monitoring well during the monitoring is likely to have resulted in small volumes of gas giving rise to erroneous high concentrations; and
 - The potential presence of organic material from the surrounding strata or residual drilling flush/installation materials within the groundwater and silt collecting in the base of the well could have degraded and produced small volumes of carbon dioxide, resulting in elevated gas

concentrations within the sealed headspace. This is further evidenced by review of the geotechnical sample data, where samples of mudstone are described by the laboratory as “dark grey carbonate mud” suggesting that the drilling process may have disturbed the rock and could have caused a build up of silty material in the base of the monitoring installation.

2.3.14 In the absence of any other potential source for ground gas emissions either on or off site, Brownfield Solutions discuss the presence of limestone bands within the solid bedrock as being the source of carbon dioxide. Review of the borehole logs by TEC concludes that the limestone bands within the Charmouth Mudstone in BH02 are limited in nature (<10% of the overall strata) and therefore this is unlikely to provide a significant source.

2.3.15 Furthermore, 3No. gas monitoring visits were undertaken by Clarkebond in January to February 2023. Bulk ground gas monitoring was undertaken within 2No. shallow boreholes, with response zones targeting the Charmouth Mudstone Formation. No elevated methane concentrations were recorded (<0.1%) and a maximum carbon dioxide concentration of 2.8% and a maximum flow rate of 0.1l/hr were recorded.

2.3.16 This additional monitoring supports the conclusions of the Lines of Evidence approach presented by TEC, and confirms that the site may be classified as Characteristic Situation 1, with no bulk ground gas protection required.

Ground Gas Conclusions

2.3.17 Based upon this additional information and the additional assessment undertaken by TEC, the risk to the proposed development / structures from bulk ground gas is considered to be low and therefore, no specific bulk ground gas protection measures are considered necessary within the proposed development.

2.3.18 Furthermore, based upon the updated Radon Repot (Appendix A), no radon protection measures are required within the proposed development.

2.4 Refined Conceptual Model

2.4.1 On the basis of the assessment works undertaken by TEC to-date and discussed above, the following relevant contaminant linkages (RCL) have been identified in relation to ground contamination and the proposed development. These are considered by TEC to be as follows:

- RCL1: Risk to site end users via exposure to possible Contaminants of Potential Concern (amosite fibres) within the made ground within proximity to Brownfield Solutions exploratory location TP04 through the inhalation pathway in areas of proposed soft landscaping, where made ground remains;
- RCL2: Cumulative risk to brownfield construction workers and future site maintenance via exposure to Contaminants of Potential Concern (CoPC) within the made ground materials through the inhalation pathway; and
- RCL3: Potential risk of statutory nuisance via disturbance of in situ ground materials during development works resulting in the generation of dust, including fine particulate matter.

3 REMEDIATION OBJECTIVES AND CRITERIA

3.1 Introduction

3.1.1 LCRM defines remediation objectives as site-specific objectives that relate solely to the reduction or control of risks associated with one or more contaminant linkages that are demonstrated, through risk assessment, to present unacceptable risks. LCRM also defines remediation criteria as measures against which compliance with remediation objectives will be assessed.

3.1.2 Remediation objectives and criteria for the identified RCL in relation to the proposed development are presented in Table 3.1.

Table 3.1: Remediation Objectives and Criteria

Relevant Contaminant Linkage (RCL)	Remediation Objective	Remediation Criteria
RCL1: Chronic risk to site end users via exposure to possible Contaminants of Potential Concern (amosite fibres) within the made ground in areas of proposed soft landscaping within proximity to Brownfield Solutions exploratory location TP04.	<ul style="list-style-type: none"> • Long-term effective containment of contaminated ground materials i.e. eliminating exposure to contaminated made ground • Management of contaminant pathway • Ensure the site is suitable for use in relation to the proposed residential development • Satisfy planning requirements in relation land contamination 	Compliance is to be based on the provision and maintenance of an appropriate cover system in proposed areas of soft landscaping, where contaminated ground materials remain following site preparation.
RCL2: Risk to construction workers and future site maintenance workers via exposure to Contaminants of Potential Concern (CoPC) within the made ground through the inhalation pathway.	<ul style="list-style-type: none"> • Long-term effective containment of contaminated made ground • Management of the pathway and receptor 	Adoption of appropriate good brownfield working practices and implementation of appropriate site maintenance procedures and risk assessments. Compliance is to be based on the provision and maintenance of an appropriate cover system following site preparation, where made ground remains
RCL3: Short term disturbance of in-situ ground materials during development works resulting in the potential generation of dust, including fine particulate matter resulting in a potential risk of statutory nuisance.	<ul style="list-style-type: none"> • Effective control of dust and dust generating activities 	Employ best practice methods at all times.

- 4 SCOPE OF REMEDIATION WORKS
- 4.1 Introduction
- 4.1.1 Based on the identified Relevant Contaminant Linkages (RCL), the following Remediation Strategy has been prepared to provide appropriate mitigation against identified risks.
- 4.1.2 The Remediation Strategy has been undertaken in accordance with LCRM – Land Contamination: risk management (Environment Agency 2023) and will require agreement in writing of the Regulatory Authorities prior to commencing any remediation on site.
- 4.2 Remediation Measure
- 4.2.1 Remediation measures to achieve the site-specific remediation objectives set out in Table 3.1 for RCL1 to RCL3 are presented below.
- RCL1
- 4.2.2 RCL1 relates to the chronic risk to site end users via exposure to identified contaminants of potential concern within the made ground materials within proximity to Brownfield Solutions exploratory location TP04, through the inhalation pathway.
- Hard Standing and Building Footprint
- 4.2.3 The proposed development plan (Figure 2) indicates the majority of the of the site area is to be covered by the footprint of the proposed development buildings, or areas of hardstanding. Where present, such hard cover features would remove the identified potential contaminant pathways in relation to site end users.
- Soft Landscaped Areas – eastern site boundary
- 4.2.4 Asbestos (amosite) fibres were identified within a single sample collected from made ground materials along the eastern boundary of the site. Therefore, an engineered cover system, designed to provide complete separation of the receptor from the hazard, would be recommended within proposed areas of soft landscaping within this area where made ground remains.
- 4.2.5 The engineered cover system would need to comprise a visual marker/break layer overlain by a suitable cover thickness, comprising topsoil and subsoil in accordance with the requirements of BS3882:2015 ‘Specification for topsoil’ and BS8601:2013 ‘Specification for Subsoil and Requirements for Use’. Consequently, consolidated minimum thicknesses of 450mm will be required within the general soft landscaped (grassed) areas, 600mm in areas of shrub and 900mm in areas of tree planting. The consolidated depth of topsoil spread should not normally exceed 300mm with the remainder of the rooting depth being made up of suitable subsoil. It should be noted that the thickness of the cover system should be agreed by the regulators as policies and guidance on this issue varies between Local Authorities.
- 4.2.6 Prior to placement of soils and after grading and compacting, an appropriate high visibility geotextile break layer (Terram Hi-Vis or equivalent) should be laid and secured, in accordance with the manufacturer’s instructions, to inhibit mixing with underlying material and minimise mixing and penetration of foreign objects such as glass, metal etc. into the clean cover. Prior to geotextile placement, the graded area should be inspected to ensure no material is protruding from the surface which may cause significant damage to the geotextile.
- General Requirements
- 4.2.7 Careful management of the site works will be required to ensure potential cross-contamination from materials containing CoPC is avoided (Section 6).
- 4.2.8 Imported material will likely be required to provide the proposed depth of cover system within the soft landscaped areas. Therefore, geochemical verification testing should be undertaken on all imported material as well as any excavated material proposed for re-use. The testing regime for such material is detailed below and in Section 6.
- 4.2.9 Topsoil should meet the requirements of BS3882:2015 for multipurpose topsoil whilst subsoils should meet the requirements of BS8601:2013 for multipurpose subsoil. Appropriate certificates of analysis should be provided, in advance of material importation, to demonstrate compliance with these criteria.

4.2.10 Further, in accordance with BS3882:2015 and BS8601:2013, all imported material should be free from propagules of aggressive weeds and bulk vegetative matter, and topsoil and subsoil should have a maximum stone size of 20mm and 50mm, respectively.

Removal of Made Ground / Additional Assessment

4.2.11 Alternatively, given the absence of contamination recorded elsewhere across the site, additional testing in these areas may be undertaken following site preparation – once final site levels are achieved - to potentially refine the remedial requirements. Section 6 of this Remediation Strategy provides the communication process should further assessment be undertaken.

Soft Landscaped Areas – Remaining Site Area

4.2.12 No contaminants of potential concern have been recorded elsewhere on the site and therefore, no remedial measures are considered necessary within the proposed soft landscaped areas elsewhere across the site.

RCL2

4.2.13 RCL2 relates to the risk to construction workers and future site maintenance workers via exposure to potential contaminants (ACM) recorded locally within the made ground materials on site through inhalation.

4.2.14 Short term (acute) exposure to the levels of contamination encountered in this area of the site is considered unlikely to cause significant harm to construction workers providing good brownfield working practices are adopted, including good site welfare and hygiene facilities and the provision of appropriate Personal Protective Equipment (PPE).

4.2.15 Given the recorded presence of localised loose asbestos fibres in encountered made ground, good practice working methods should be adopted as per current guidance (e.g. CL:AIRE (2016), Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance and, CIRIA Report C765 “Asbestos in soil and made ground good practice site guide” (2017)).

4.2.16 Full site maintenance procedures and risk assessments should be documented and implemented to ensure that future maintenance workers are protected from potential residual risk during possible exposure to materials beneath the capping layer (where applicable).

RCL3

4.2.17 RCL3 relates to the potential risk of statutory nuisance via disturbance of in situ ground materials during remediation and development works resulting in the generation of dust, including fine particulate matter.

4.2.18 Development works will provide a long-term betterment with respect to dust generation as all potentially contaminated materials are proposed to be removed and any remaining on site will be effectively capped, e.g. by hardstanding or engineered clean cover. However, given the proposed development works for the site, the short-term potential for the generation of dust and fine particulate matter cannot be discounted. This is due to the requirement for the excavation and handling of potentially dry materials and their transportation on and off-site. In addition, wind blow across bare ground or stockpiles of excavated and treated materials can also represent a potential significant source of dust generation.

4.2.19 Fugitive dust and fine particle generation from remediation and construction activities can be substantially reduced through carefully selected mitigation techniques and effective management. Once particles are airborne, it is very difficult to prevent them from dispersing into the surrounding area. The most effective technique is to control dust at source and prevent it from becoming airborne.

4.2.20 The contractor will be required to take all necessary measures to avoid creating a dust nuisance during both remediation and construction works. Best practicable means should be used to minimise dust.

4.3 General Remedial Measures

Previously Unidentified Contamination

4.3.1 During the site clearance works, should contamination be found at any time when carrying out the development that was not previously identified, it will be reported in writing immediately to the Local

Planning Authority. Following which, further investigation and risk assessment will be undertaken, and where further remediation is considered necessary, a revised remediation scheme will be produced and forwarded to the Local Planning Authority for approval in writing. Section 6 of this Remediation Strategy provides the communication process should further assessment be undertaken.

Services Protection

- 4.3.2 Given the encountered ground conditions, upgraded contaminant resistant below ground service materials may be required by utility providers. The specification for these materials should be agreed in advance of development, with the appropriate statutory undertakers. Due consideration will need to be given to the UK Water Industry Research (UKWIR) guidance for the provision of water supply pipes.

- 5 GENERAL REQUIREMENTS
- 5.1 Environmental Permits / Licences
 - 5.1.1 The Contractor will be required to comply with all relevant legislation, statutory requirements and guidance, Codes of Practice, British Standards and all relevant HSE Guidance and Approved Codes of Practice.
 - 5.1.2 The Contractor will be responsible for obtaining and complying with all necessary permissions, licenses and permits required to undertake the works.
- 5.2 Materials Excavation
 - 5.2.1 Given the presence of elevated contaminant concentrations within the made ground, as a minimum, made ground shall be segregated in accordance with current waste regulations to allow for separate treatment/disposal. Further, segregation may be required should further grossly contaminated materials be encountered. Characterisation of waste materials will be undertaken by suitably experienced person and will be limited to ensure appropriate visual characterisation of materials.
 - 5.2.2 All on site waste material movements on site will be undertaken in a controlled fashion to avoid cross contamination of materials.
- 5.3 Stockpiling
 - 5.3.1 Temporary stockpiles should be on suitable hardstanding or membrane to prevent mixing with underlying materials and such stockpiles will be covered with an impermeable membrane. In addition, to avoid potential cross-contamination, work methodologies should be adopted such that the trafficking over contaminated areas is minimised and, wherever possible, avoided.
- 5.4 Waste Management
 - 5.4.1 Excavated contaminated material will be disposed from site to an appropriately licensed facility. Additional testing may be required in accordance with guidance outlined by the Environment Agency's document 'Waste Sampling and Testing for Disposal to Landfill' (EBPRI 11507B), dated March 2013, to allow determination of an appropriately licensed landfill for disposal. The waste producer must develop a sampling plan using Best Practice with reference to BS EN 14899 (and supporting technical guidance CEN/TR 15310) to ensure samples are representative of the waste being produced.
- 5.5 Materials Transport and Disposal
 - 5.5.1 All waste disposal activities will be undertaken in accordance with the Waste (England and Wales) (Amendment) Regulations 2014 and consequently, the haulier will need to be a licensed waste carrier and evidence of registration will need to be obtained prior to any consignment.
 - 5.5.2 All waste will only be sent to a class of disposal facility permitted to accept the materials identified.
 - 5.5.3 Laboratory results of the excavated material will need to be passed on to the haulier and the material will need to be transported and disposed of accordingly. All excavated contaminated waste materials are to be transported off-site in appropriately sheeted lorries.
- 5.6 De-Watering
 - 5.6.1 While no groundwater was encountered within exploratory holes during the intrusive works, groundwater was recorded during subsequent monitoring from depths of approximately 1.5mbgl and therefore, potentially minor dewatering of excavations maybe required, particularly if excavations are left open.
 - 5.6.2 To minimise the generation of water requiring management, surface run-off and collection should be reduced by ensuring that the scale of open excavation is restricted to that necessary for the immediate works.
- 5.7 Backfilling
 - 5.7.1 Where excavation of contaminated materials occurs, the resultant excavation should be backfilled with general fill or imported clean material. Excavated contaminated materials should not be used for backfilling.

5.8 General Site Safety

- 5.8.1 All aspects of health and safety during site works will be undertaken in accordance with the Construction (Design and Management) Regulations, 2015 (CDM), or superseding documentation. In addition, all remedial works will be undertaken in accordance with the Health and Safety Executive publication (HSG66) "Protection of workers and the general public during the development of contaminated land" (1991), CIRIA Report 132 "A guide for safe working on contaminated sites" (1996) and current best practice guidance, including CIRIA Report C765 "Asbestos in soil and made ground good practice site guide" (2017).
- 5.8.2 Given the recorded presence of localised loose asbestos fibres on site, good practice working methods should be adopted as per current guidance (e.g. CL:AIRE (2016) Control of Asbestos Regulations 2012 – Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Material: Industry Guidance and, CIRIA Report C765 "Asbestos in soil and Made Ground – Good Practice Site Guide" (2017)).

6 VERIFICATION PLAN

6.1 Materials Importation and Verification Testing

Material Importation

6.1.1 Appropriate chemical testing of imported materials will be required if the origin of the imported clean cover capping materials is other than one of the following:

- A “greenfield” site where an appropriate desk study has been undertaken in accordance with BS10175:2011+A2:2017 which shows that no sources of contamination are or have been present; or
- A site where suitable site investigation and testing has been undertaken in accordance with BS10175:2011+A2:2017 which clearly demonstrates the chemical suitability of the imported material.

6.1.2 If the source of the capping materials does not comply with the above or is from a site that is known to be, or suspected of being, contaminated, sufficient testing should be undertaken to confirm the materials are suitable for use. Where separate subsoil and topsoil materials are used in the cover system, it will be necessary to confirm the chemical quality of both of these components.

6.1.3 All imported material, whether used as part of a clean cover system or not, will comply with the limits set out within Table 6.1.

6.1.4 In addition, all imported topsoil and subsoil materials should meet the requirements of BS3882:2015 and BS8601:2013. All imported topsoil and subsoil should be free from foreign objects discernible by the naked eye (e.g. glass, brick, concrete, wire, tarmac, plastic, ceramic, metal, treated wood) or potentially hazardous foreign matter which may represent a risk of traumatic injury or damage to health.

6.1.5 In all cases, a copy of the delivery ticket should be available to confirm the imported materials have been transferred directly from the approved source site.

6.1.6 Where capping materials (including manufactured soils) are sourced from a commercial provider, a copy of the supplier’s routine chemical test certificate(s) and delivery tickets to site should be included within the remediation Verification Report. All test certificates should be current and representative of the material actually being used on site. Should importation be undertaken over an extended period of type separate certification may be required. The amount of testing undertaken by the commercial provider should be linked to the former uses of the source site and the potential for contamination to be present. It is noted that the use of skip waste will not be accepted as capping materials without extensive testing to confirm it is suitability for use.

6.1.7 Quarried aggregate need not be subject to this testing regime where supported by appropriate certification.

6.1.8 Placement of fill materials associated with these remedial works should not be permitted unless this information has been received and approved in advance by the Client’s representative.

6.1.9 All samples will be submitted to an appropriate accredited laboratory (MCERTS/UKAS) for analysis. Given the proposed development includes areas of communal soft landscaping only, limits have been set on the basis of a ‘Public Open Space (Residential)’ site end use.

Table 6.1: Importation & Re-use Criteria

Contaminant	Maximum Import Concentration (mg/kg) ⁽¹⁾
Arsenic	79
Boron	21000
Cadmium	220
Chromium (Total)	1500
Chromium (VI)	21
Copper	12000
Lead	630
Mercury	170

Contaminant	Maximum Import Concentration (mg/kg) ⁽¹⁾
Nickel	230
Selenium	1100
Zinc	81000
Beryllium	2.2
Barium	1300
Vanadium	2000
Cyanide	20
Total Phenol	440
Banded Petroleum Hydrocarbons	
Total Petroleum Hydrocarbons (TPH)	500 ⁽²⁾
Naphthalene	4900
Benzo(a)anthracene	29
Chrysene	57
Benzo(b)fluoranthene	7.1
Benzo(k)fluoranthene	190
Benzo(a)pyrene	5.7
Indeno(1,2,3-cd)pyrene	82
Dibenzo(a,h)anthracene	0.57
Benzo(g,h,i)perylene	640
Benzene	7.2
Ethylbenzene	24000
m & p-xylene	41000
o-xylene	41000
MTBE	73
Asbestos Screen	Absent

Notes:

1. Importation criteria based on human health screening values for 'Public Open Space (Residential)' end use (based on DEFRA C4SL (2014), Environment Agency Soil Guideline Values (2009) and CIEH/LQM GAC (2014), where appropriate, based upon a 'worst-case' Soil Organic Matter (SOM) of 1%).
2. Speciated hydrocarbon contaminants with screening values >500mg/kg are not included as total TPH limit has been set at 500mg/kg.

Verification Testing - Soils

- 6.1.10 Where a cover system is utilised within the proposed soft landscaped areas, verification pits should be excavated to prove the depth, and where necessary, the chemical quality of the clean cover and the presence of an appropriate geotextile.
- 6.1.11 A written description and photographic record of each verification pit shall be obtained, clearly demonstrating the depth of clean cover and the presence of an appropriate geotextile membrane.
- 6.1.12 Where appropriate supporting current certification is not available in relation to the chemical quality of placed imported cover system materials, verification samples of each material type will be taken and chemically analysed. The number of validation samples required may need to be confirmed with the regulatory authorities prior to undertaking the sampling, but would be initially suggested as follows:
- One sample for every 50m³ of fill, if the material is imported from a known 'Greenfield' source; or
 - One sample per 25m³ of fill if the material is derived from site or imported from an unknown source or off-site source without appropriate documentation of non-contaminative history.

6.2 Verification Reporting

6.2.1 In accordance with current guidance, upon completion of the final works a verification report(s) will be prepared that demonstrates the effectiveness of the remediation carried out and identifying any requirements for longer-term monitoring of identified contaminant linkages, maintenance and arrangements for contingency action, if appropriate. It may be that, with prior agreement of the regulatory authorities, partial verification of the site may be obtained should the development be completed in a phased manner.

6.2.2 The verification report(s) will be prepared in accordance with the Environment Agency's Land Contamination: Risk Management guidance (2020).

6.3 Communications Plan

6.3.1 Should, at any time, verification information show that remediation activities have not achieved the remediation criteria derived for the relevant contaminant linkages or additional assessment is undertaken, the following action plan shall be implemented:

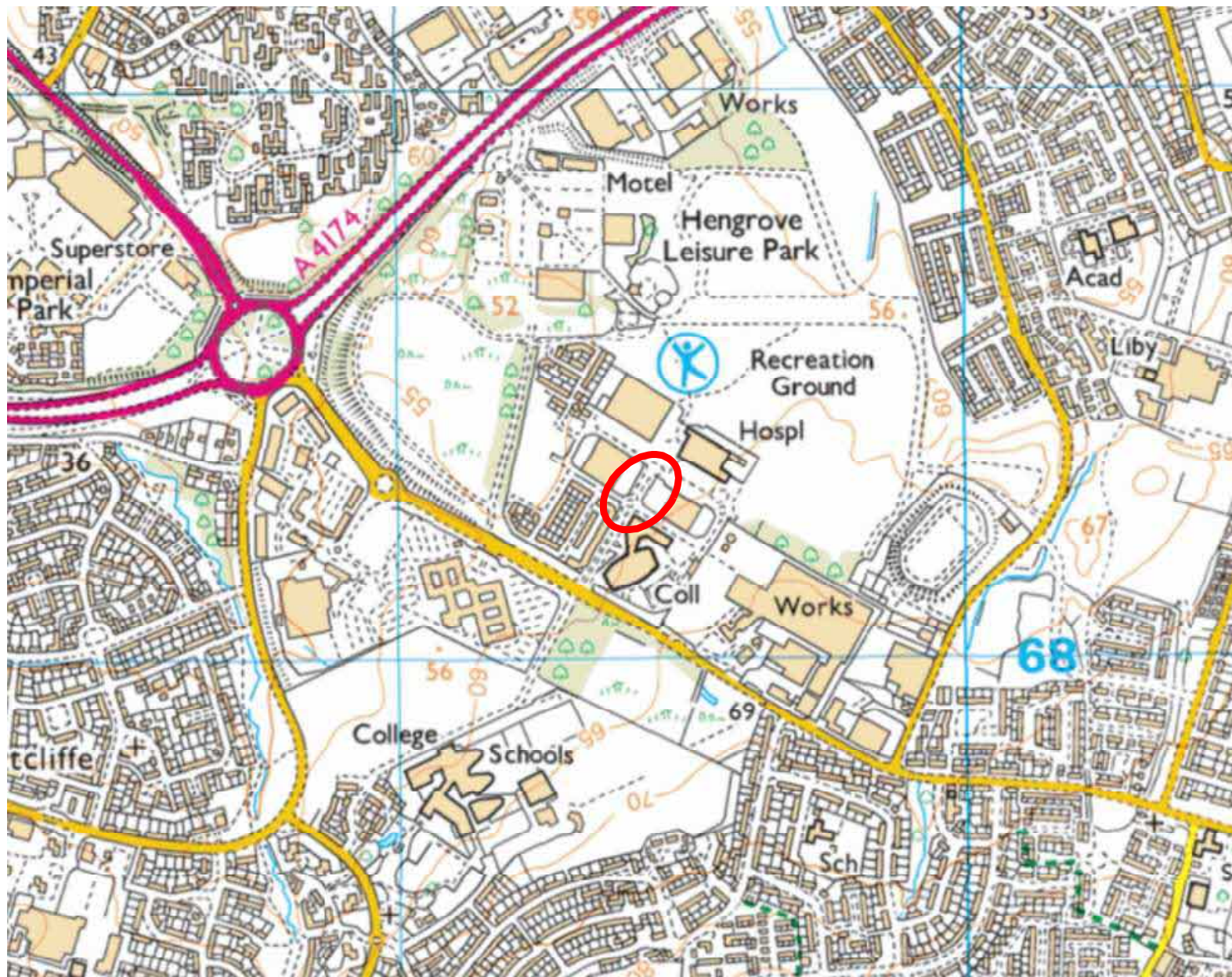
6.3.2 The results shall be notified to the Local Planning Authority immediately and confirmed in writing;

6.3.3 Any agreed remedial action will be undertaken within such reasonable time as required by the Local Planning Authority; and

6.3.4 A report detailing any remedial works undertaken, the monitoring results and the effectiveness of the action plan shall be forwarded to the Local Planning Authority.

TEC

Figures and Drawings



Approximate Site Location:



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Site Name

Hengrove E2, Eastern Bookends

Drawing Name

Site Location Plan

Client Name:

Hill Holdings Ltd

Project No

2210014.001

Figure No:

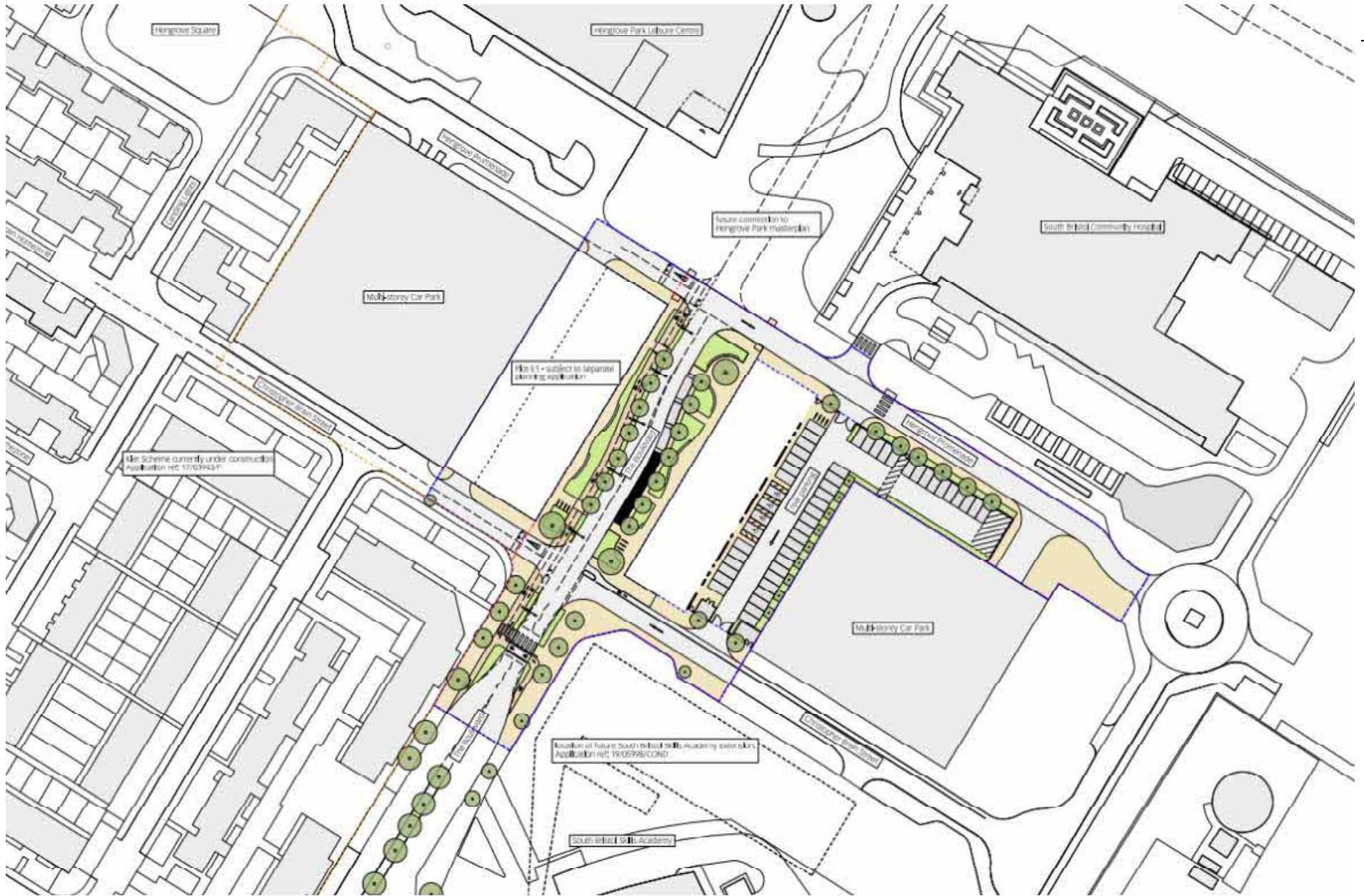
1

Date:

Jan 2023

Scale:

NTS



Extract of Lifschutz Davidson Sandilands Ltd drawing, titled 'Proposed Masterplan', drawing no. P0100, dated 04.21, provided to TEC by Hill Holdings Ltd.



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Site Name
Hengrove E2, Eastern Bookends

Drawing Name
Proposed Development Plan

Client Name:
Hill Holdings Ltd

Project No:
2210014.001

Figure No:
2

Date:
Jan 2023

Scale:
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Appendix A
BGS GeoReport

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Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: *BGS_336025/50372*

Client reference: Hengrove Park Bookend Site

Search location



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Search location indicated in red

Area centred at: 359460, 168291

Radius of site area: 37 metres

Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2023 edition)*, which also provides guidance on what to do if the result indicates that protective measures are required.

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2023 edition) Radon: Guidance on protective measures for new buildings?

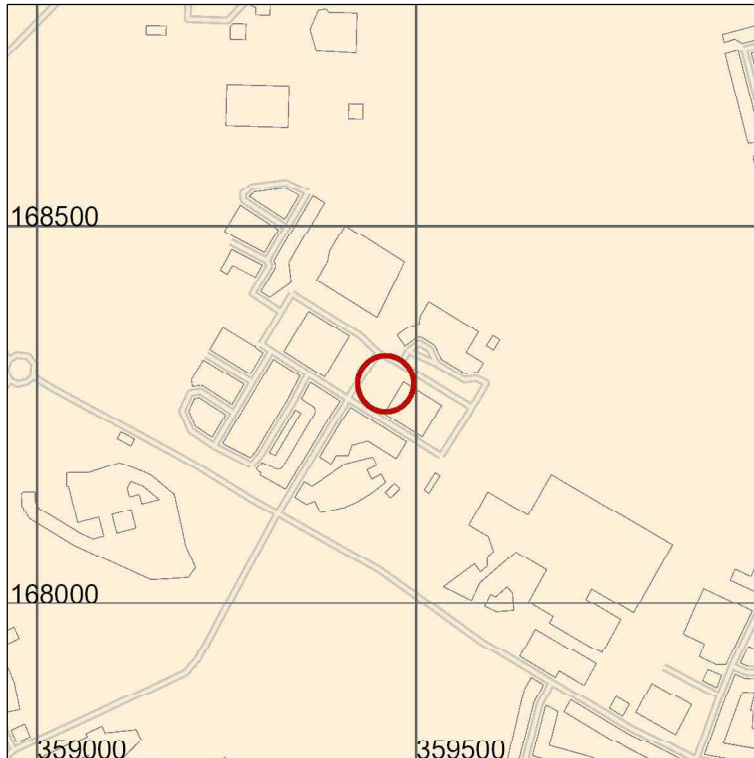
NO RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2023 Edition)*.

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Radon Affected Area



% Homes estimated to be at or above the action level
0-1%
1-3%
3-5%
5-10%
10-30%
30-100%

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 Scale: 1:10 000 (1cm = 100 m)
 Search area indicated in red

Is the property in a radon Affected Area as defined by the UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level? **NO**

Additional Information

THE PROPERTY IS IN AN AREA WHERE LESS THAN 1% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL. THE PROPERTY IS NOT IN A RADON AFFECTED AREA.

The UKHSA recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to be at or above the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a high radon level within the property; the only way to determine the radon level is to carry out a radon measurement.

The UKHSA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m⁻³) should be remediated. Householders with levels between the Target Level (100 Bq m⁻³) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The UKHSA provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a “Radon Affected Area” as identified by the UKHSA. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were at or above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from the UKHSA at www.ukradon.org.

What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level is at or above the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations 2017 require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293): **Radon in the workplace**. BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.uk website: www.brebookshop.com

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