Flood Risk Assessment and Drainage Strategy

New Henry Street, Bristol

Issue P01 – 05 December 2023

Prepared For:

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MEINHARDT

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

NEW HENRY STREET, BRISTOL

Quality Assurance Page

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Executive Summary

Meinhardt have undertaken this Flood Risk Assessment (FRA) and prepared this Drainage Strategy (DS) on behalf of Dominus Bristol Limited to support the planning application for a mixed-use development located at Premier Business Park, Kingsland Road, Bristol, BS2. The private site area comprises an area of 0.75 hectares (ha). The OS Grid Reference for the approximate centre of the Site is National Grid Reference ST 60139 72898.

The development proposal is for the demolition of existing structures and redevelopment of the site for two conjoined buildings comprising a light/flexible industrial use; flexible commercial use; student accommodation; public realm works and landscaping; cycle parking and ancillary plant and servicing. The development proposal allows for a total of 705 Student beds. This FRA investigates flood risk on site and in the area and outlines the mitigation measures proposed to ensure the sustainable and safe development of the Site in line with the requirements of the National Planning Policy Framework (NPPF), Environment Agency's (EA) Climate Change allowances guidance and Standing Advice, and the Flood Risk and Coastal Change Planning Practice Guidance (PPG).

The Site is located in Flood Zone 1 where the probability of river or sea flooding is less than 0.1% (1 in 1000) chance in any given year. Therefore, the probability of tidal or fluvial flooding is assessed as negligible.

Available baseline information indicates that the Site is not within an area of significant surface water flood risk. In addition, a surface water drainage strategy has been designed in line with the most recent EA Climate Change Guidance to consider and manage the impact of a 1:100 year plus climate change rainfall event and is presented within this report. The surface water drainage strategy considers surface water runoff management: the solutions proposed ensure that for the 100 year plus 45% climate change allowance event, surface water will be accommodated within the Site and therefore prevent potential exceedance flows off-site. Additionally site levels will aid in reducing any risk of surface water flooding.

Other potential sources of flooding have been investigated and have been deemed insignificant.

The proposed drainage strategy incorporates sustainable drainage systems (SuDS) features in the form of biodiverse green and brown roofs, permeable paving, bio-retention tree pits, and a below ground geo-cellular attenuation tank system. The Site's surface water will be attenuated and reduced to 5.0l/s before being pumped to the local Wessex Water (WW) public surface water sewer beneath Princess Street.

Foul water from the Site will drain by gravity and discharge to the WW public foul water sewer beneath Sussex Street.

1 Introduction

1.1 Project Brief

Meinhardt have been appointed by Dominus Bristol Limited to undertake this Flood Risk Assessment (FRA) and Drainage Strategy (DS) to accompany the planning application for the construction of a student accommodation led mixed-use development (hereafter referred to as the 'Proposed Development') located at Premier Business Park, Kingsland Road, Bristol, BS2 0QX (hereafter referred to as the 'Site'). This report relates solely to the above Site and should not be used for any other reasons other than for which the report was originally prepared.

1.2 Assessment Methodology

The below methodology has been carried out to investigate flood risk on Site and in the surrounding area and to identify suitable mitigation measures required to ensure the sustainability and safety of the Proposed Development over its lifetime.

The report has been produced in line with the requirements of the NPPF and the Environment Agency (EA) Standing Advice, Wessex Water (WW) and the Bristol City Council (BCC) as the Lead Local Flood Authority (LLFA).

A site visit was undertaken in February 2023 by the Meinhardt project team undertaking this FRA and Drainage Strategy to assess any sources of flood risk that may impact the Site, as well as local topography and receptors that may be impacted by the proposed drainage strategy.

The following documents and policies have been reviewed to inform this report:

- BCC – Strategic Flood Risk Assessment Level 1 and 2 (SFRA) (2020);
- BCC – Bristol Development Framework Core Strategy (Local Plan) (2011);
- BCC – Bristol Development Framework Bristol Central Area Plan (2015);
- BCC – Bristol Development Framework Site Allocations & Development Management Policies (2014);
- BCC – Climate Change and Sustainability Practice Note (July 2020);
- BCC – Climate Change and Sustainability Practice Note Addendum (June 2023);
- West of England LLFAs – West of England Sustainable Drainage Developer Guide Sections 1, 2 and Annex (2015)
- Laser Surveys – CCTV Drainage Survey (**Appendix B**);
- Wessex Water Asset Records (2023) (**Appendix C**);
- Maltby Surveys Ltd – Topographical Survey (2022);
- British Geological Society (BGS) Online Viewer, 1:50,000 Bedrock and Superficial deposits;
- EA - Climate change allowances for peak rainfall in England Online Map;
- DEFRA's online Magic Map; and
- GOV.UK's online Long Term Flood Maps.

The local policies discussed in Section 2 have also been considered to inform this assessment.

Meinhardt does not guarantee that the advice provided by this report will guarantee the availability of flood insurance. The insurance industry carry out their own assessments to properties in terms of determining the insurability for flood risk. Those intending to undertake development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencement.

Although this report was prepared using the degree of skill and care ordinarily exercised by engineers practicing under similar circumstances please note that Meinhardt cannot take responsibility for errors in the information provided by third parties.

2 Planning Policy and Guidance

The below policy and guidance are considered relevant to this FRA and Drainage Strategy and have been used to inform this assessment.

2.1 National and Regional Policy

National Planning Policy Framework

The National Planning Policy Framework (NPPF) was updated and published in September 2023 with the aim of protecting the environment and to promote sustainable growth. There is an overarching objective to strive towards sustainable development and ensuring that this is a key element in every proposal.

The following paragraphs from the NPPF are considered relevant to this assessment:

Paragraph 159: Requires that “Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”;

Paragraph 162: Explains that “the aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source”;

Paragraph 167: Explains that “When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere.[…]; and

Paragraph 169: Recommends that “major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;
b) have appropriate proposed minimum operational standards;
c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
d) where possible, provide multifunctional benefits”.

2.2 Local Policy

Bristol Development Framework Core Strategy (2011)

The Core Strategy sets out the spatial vision and strategic objectives for the Bristol and outlines the development principles to ensure new development addresses the key issues facing the city. The following policies are considered relevant to this assessment:

“Policy BCS16: Development in Bristol will follow a sequential approach to flood risk management, giving priority to the development of sites with the lowest risk of flooding. The development of sites with a sequentially greater risk of flooding will be considered where essential for regeneration or where necessary to meet the development requirements of the city.

Development in areas at risk of flooding will be expected to:

- be resilient to flooding through design and layout, and/or
- incorporate sensitively designed mitigation measures, which may take the form of on-site flood defence works and/or a contribution towards or a commitment to undertake such off-site measures as may be necessary, in order to ensure that the development remains safe from flooding over its lifetime.

All development will also be expected to incorporate water management measures to reduce surface water run-off and ensure that it does not increase flood risks elsewhere. This should include the use of sustainable drainage systems (SUDS)."

BCC - Climate Change and Sustainability Practice Note 2020

This practice note provides advice on the implementation of Bristol Local Plan policies for sustainability, climate change and resilience. Section 5.2 is relevant to this assessment and states:

"For previously developed sites, the total run off and runoff rates should be close to Greenfield runoff rates. Where it is demonstrated that this is not reasonably practicable, a minimum reduction of 30% to existing peak flows will be sought."

2.3 Climate Change Guidance

The EA guidance "Flood risk assessments: climate change allowances" was issued in 2016 (last updated May 2022) and provides the most recent information on expected changes in rainfall, river flows and sea levels as a consequence of climate change.

Sea level allowances by river basin district for each epoch is provided in Table 2 of the guidance document.

The guidance provides peak river flow allowances by management catchments, the sub-catchments of the river basin districts. The peak flows are based on percentiles, a percentile is a measure used to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 50% percentile means that the allowance has 50% chances of not being exceeded).

The most recent update to the guidance, updates the Peak Rainfall Allowances, which takes into account UKCP Local 2.2km projections and supporting research FUTURE-DRAINAGE. These are also now provided by management catchments instead of at a national scale and an online "Peak Rainfall Allowances Map" is now provided. Peak rainfall allowances are provided for 1% annual exceedance probability (AEP) events and for 3.3% AEP events.

The guidance states how to apply peak rainfall allowances has changed, using the central allowance for development with a lifetime up to 2100 and the upper end allowance for development with a lifetime from 2100 to 2125. Residential development to have a minimum lifetime of a 100 years, whilst commercial a minimum of 60 years.

The following approach should be used for drainage design:

- Development with a lifetime beyond 2100 - Design your development so that for the upper end allowance in the 1% annual exceedance probability event:
    - There is no increase in flood risk elsewhere
    - Your development will be safe from surface water flooding
- Development with a lifetime of between 2061 and 2100 - For development with a lifetime between 2061 and 2100 take the same approach but use the central allowance for the 2070s epoch (2061 to 2125).
- Development with a lifetime up to 2060 - For development with a lifetime up to 2060, take the same approach but use the central allowance for the 2050s epoch (2022 to 2060).

Exceptions:

In some locations the allowance for the 2050s epoch is higher than that for the 2070s epoch. If so, and development has a lifetime beyond 2061, use the higher of the two allowances.

3 Existing Site

3.1 Site Location and Description

The Site is located in Bristol and the local planning authority is Bristol City Council. The Site is bound by Sussex Street to the south-east, Kingsland Road (and bridge) to the south-west, the Dings railway path to the north-west and Alfred Street to the north-east. The Site is located at Premier Business Park and is separated from The Dings residential area by Kingsland Road. There are railway lines approximately 160m south of the Site

The Site currently accommodates two buildings in industrial use. The buildings span almost the full width of the curtilage. They are located in the north sector of the site with a large forecourt area in the south that contains vehicle parking for the units. Both buildings comprise a two-storey form alongside a large yardage that would have traditionally facilitated servicing by HGVs. The site is entirely hardstanding.

The site is bounded to the north-east by Alfred Street. Here, The Redeemed Christian Church of God occupies a rudimentary single storey post war building with a small forecourt. Adjacent to this to the north is a disused railway line running northeast to north-west which could potentially form a vital link within Bristol's strategic cycle network in the future.

The private site area is 0.75 hectares (ha). The OS Grid Reference for the approximate centre of the Site is National Grid Reference ST 60139 72898. Refer to Figure 1 for an indicative Site location plan.

Figure 1: Indicative Site Location Plan

3.2 Topography

Based on the topograpical survey that was carried out by Maltby Surveys Ltd in November 2022. The levels generally slope from higher levels the south west of the site down to the north east of the Site. Levels in the south west corner of the site are at approximately 12.90mAOD whilst levels in the north east of the site are at approximately 12.00mAOD. Levels in the south east corner of the site are at approximately 12.50mAOD and levels in the north west at approctemyeyl 12.70mAOD.

It should be noted that towards the north of the site (The Dings Railway Path), this sits at a level of approximatly 10.45m AOD compared to the site itself, this level difference is achieved by an existing retaining wall along the northern part of the site. Refer to **Appendix A** for the Topographical Survey.

3.3 Existing Drainage

A CCTV drainage survey of the private on-site drainage network was carried out by Laser Surveys in April 2023, refer to **Appendix B**. The survey shows that the existing site is served by a network of private foul and surface water drainage which convey foul and surface water to the public foul water sewers surrounding the site. The WW asset records (**Appendix C),** and the CCTV survey (**Appendix B**) have been reviewed and are summarised below:

3.3.1 Public Sewers

- The CCTV survey (**Appendix B**) confirmed there is a 450mm diameter public foul water sewer running west to east beneath Sussex Street
- The WW asset records (**Appendix C**) show a 225mm diameter public foul water sewer running northwards beneath Alfred Street, which connects to the 225mm diameter public foul water sewer running east to west along the northern of the Site. However, this sewer could not be located during the CCTV survey.
- The CCTV survey (**Appendix B**) confirmed there is a 750 x 600mm public foul water sewer running south to north beneath Kingsland Road, along the western site boundary. This sewer then changes to a 950 x 852mm sewer towards the middle of the western site boundary and runs beneath existing buildings.
- The CCTV survey (**Appendix B**) confirmed there is a 225mm diameter public surface water sewer to the northeast of the site, running west to east beneath Princess Street.

3.3.2 Private On Site Drainage

- The CCTV survey (**Appendix B**) showed there is a 150mm diameter private foul water network running north to south down the center of the site, this sewer discharges to the 450mm diameter public foul water sewer beneath Sussex Street.
- The CCTV survey (**Appendix B**) showed there is a 225mm diameter private surface water network running north to south down the eastern portion of the site, this sewer discharges to the 450mm diameter public foul water sewer beneath Sussex Street.

3.4 Existing Watercourses, Waterbodies and Flood Defences

The River Avon flows towards Netham where a proportion of flows enter the Feeder Canal. The Feeder Canal is located approximately 420m south of the Site. The Feeder Canal is classified by the EA as a Main River.

The River Avon, classified by the EA as a Main River, is located approximately 620m to the southwest of the Site.

3.5 Geological and Hydrogeological Setting

In July 2022, a preliminary desk-based risk assessment for contamination at the Site by Argyll Environmental. An intrusive ground investigation was carried out by Jomas Associates Ltd. in August 2022. As part of this assessment Meinhardt have reviewed available British Geological Survey (BGS) Geology Viewer mapping and DEFRA's Magic Map. The findings from the above sources are provided below. Refer to **Appendix D** for Geological Reports.

BGS online mapping shows that the Site is underlain by the Redcliffe Sandstone Member Bedrock. No superficial or artificial deposits are reported in the Site's location.

The results of the ground investigation **(Appendix D)** revealed a ground profile comprising Made Ground to a maximum depth of 2.7mbgl, overlying sand deposits of the Redcliffe Sandstone Member. It should be noted that Made Ground was found to be deepest in the south of the Site.

Groundwater was not reported during the ground investigation; however it should be noted that the investigation was only undertaken to a maximum depth of 2.9m.

Argyll Environmental's preliminary desk-based risk assessment **(Appendix D)** for contamination identified a 'moderate' risk to land contamination from on-site sources.**Table 1** provides a summary of the Intrusive Ground Investigation results.

Geological Unit	Aquifer Designation	Top Of Stata – Base of Strata (m bgl)	Typical Strata Description
Made Ground	N/A	0-1.5	Concrete over black/ brown/ red/ grey clayey sandy gravel with localised medium cobble content. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-rounded flint, concrete and brick. Cobbles consist of angular concrete and brick.
Made Ground	N/A	1.5 - 2.7	Concrete over black/ brown/ red silty sandy slightly gravelly clay. Sand is fine to coarse. Gravel consists of fine to coarse, angular to rounded flint, concrete and sandstone
Redcliffe Sandstone Member (Encountered in WS1, WS4 & WS5).	Secondary A Aquifer	1.5 - 2.9 (base not proven)	Medium dense becoming very dense orange/red SAND. Sand is fine to medium.
Redcliffe Sandstone Member (Encountered in WS2 & WS3)	Secondary A Aquifer	1.5 - 1.9 (base not proven)	Medium dense becoming very dense light brown gravelly SAND. Sand is fine to coarse. Gravel consists of fine to coarse, angular to rounded flint.

Table 1: Geological Distribution

According to the DEFRA's online Magic Map, the Redcliffe Sandstone Member is classified as a Secondary A aquifer. The EA defines this as aquifer as having 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.

BCC's Level 1 SFRA Figure 8 British Geological Society SuDS Infiltration Potential Map indicates that the site is located in a zone where 'very significant constraints are indicated'. This accurately reflect the bedrock classification being a Secondary A Aquifer.

According to the DEFRA's online Magic Map for Groundwater Vulnerability, the site is located in an area of high groundwater vulnerability.

According to the DEFRA's online Magic Map for Source Protection Zones, the Site is not located within a Source Protection Zone.

BCC's Level 1 SFRA states that Bristol does not contain any Critical Drainage Areas as defined by the EA.

According to the Argyll Environmental's preliminary desk-based risk assessment **(Appendix D)**, a review of the Enviro+Geoinsight Report indicates that there are:

- No Source Protection Zones within 500m of the site.
- 2No. groundwater abstractions within 2km of the site; the nearest is located 65m north-west.
- 23No. surface water abstractions within 2km of the site; the nearest is located 366m south-west.
- no potable water abstractions reported within 2km of the site.
- no surface water features or water networks (OS MasterMap) reported within 250m of the site.

4 Proposed Development

4.1 Proposed Development Description

The proposal is for the d*emolition of existing structures and redevelopment of the site for two conjoined buildings comprising light industrial use (Class E(g)(iii)); flexible retail/light industrial use (Class E(a) / Class E(g)(iii)); flexible commercial use (Class E(b-g)); flexible industrial use (Class E(g)(iii) / Class B8 / Sui Generis; student accommodation use with ancillary community space (Sui Generis); public realm works and landscaping; cycle parking; ancillary plant and servicing; and other associated works*.

The development proposal allows for a total of 705 Student beds.

4.2 Vulnerability Classification

According to Annex 3 of the NPPF the Proposed Development will have uses which range between 'less vulnerable' and 'more vulnerable'.

4.3 Sequential and Exception Tests

As stated in the NPPF, a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.

Since the Site is in Flood Zone 1 the development is considered appropriate and automatically meets the requirements of the Sequential test and the Exception test is not required to be completed.

4.4 Impact of Climate change on the Proposed Development

The typical lifespan for a residential development is 100 years. Climate change allowances have been considered based on this lifespan.

As the Site is located within Flood Zone 1 where the probability of fluvial and tidal flooding is lower than 0.1% in any year, fluvial and tidal flooding is not expected to become a significant issue when the impact of climate change is taken into account.

The impact of climate change on surface water runoff at the Site in the surrounding areas could present a higher risk however the Drainage Strategy produced as part of this report has been designed to accommodate surface runoff during all events up to and including the 100 year plus a 45% climate change allowance.

Based on the EA's climate change allowance guidance, the attenuation requirements for the proposed drainage strategy will be determined using the central estimates but will be modelled with a freeboard that can accommodate the upper end estimates to prevent potential exceedance flows off-site.

5 Flood Risk

5.1 Relevant Maps and Data

Online UK Government Flood Maps have been used to identify flood risk from fluvial, tidal, surface water, and artificial sources.

5.2 Tidal and Fluvial Flooding

Based on the online GOV.UK Flood Map for Planning, the Site is located in Flood Zone 1 where the probability of river or sea flooding is less than 0.1% (1 in 1000) chance in any given year.

Based on the information available, the probability of fluvial and tidal flooding can be assessed as **negligible**.

5.3 Surface Water Flooding

The GOV.UK Long Term Flood Risk Maps provide a general indication of areas that may be at risk of surface water flooding. The maps take a broad account of underground drainage and typical storms which are likely to cause flooding. The map identifies that there is a high risk of surface water flooding directly north of the Site in the location of the railway path, refer to **Figure 2.** However, the rest of the site is shown to be at Very Low risk**.** This corresponds to the topography of the Site with the northern portion of the Site being at the lowest level, however as this level is significantly lower than the main site (circa 2m) the risk of flooding is minimal.

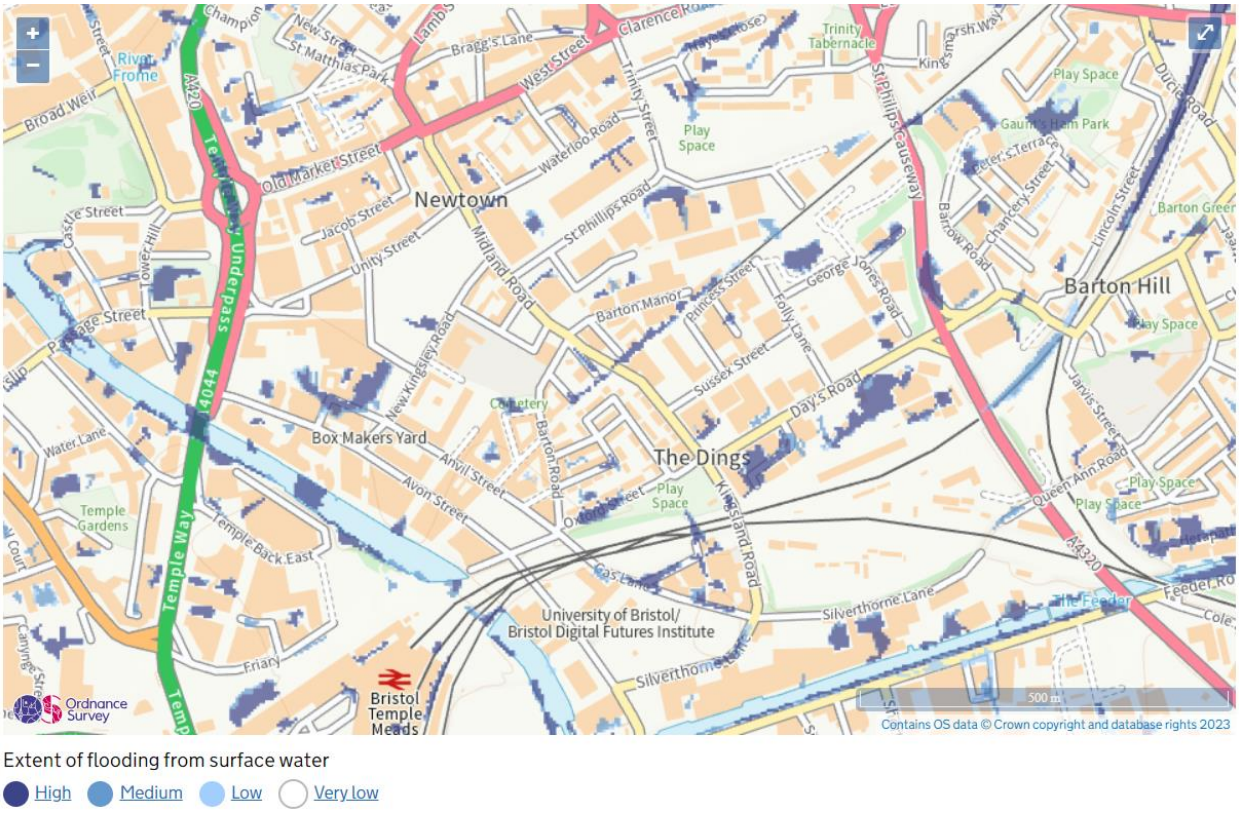


Figure 2: Extract from GOV.UK's Long Term Flood Risk Map for Surface Water Flooding

Therefore, based on the available information and modelling, surface water flooding in this local area of the Site can be considered as **Low.**

5.4 Artificial Sources of Flooding

According to the online GOV.UK's Long Term Flood Risk Map, the Site is shown to be within the maximum extent of flooding from reservoirs when there is also flooding from rivers. Refer to **Figure 3**.

BCC's Level 1 SFRA states that there are reservoir dams either in Bristol or located such that Bristol would suffer flooding if a collapse occurred.

Since spring 2009 all reservoirs, under the 1975 Reservoir Act, require the development of a Flood Plan and associated inundation mapping along with governing their maintenance and management. As such the risk of flooding from a reservoir is low and is being managed on a strategic level under the 1975 Reservoir Act.

BCC's Level 1 SFRA states that whilst the likelihood of failure of the reservoirs is low. The risk to life and damage to property in such an event is very likely to be significant. The raised reservoirs that pose a risk to Bristol consist of the Barrow and Chew Valley Lake reservoir to the south of Bristol.

BCC's Level 1 SFRA states that the Floating Harbour upstream of the Feeder Canal is a significant body of water in one of the areas of greatest flood risk in central Bristol. The Harbour has direct influence and interaction with the tidal River Avon fluvial flows. Therefore for SFRA modelling purposes it was assumed that the flood gates into the Feeder Canal were open, representing a flood defence failure.

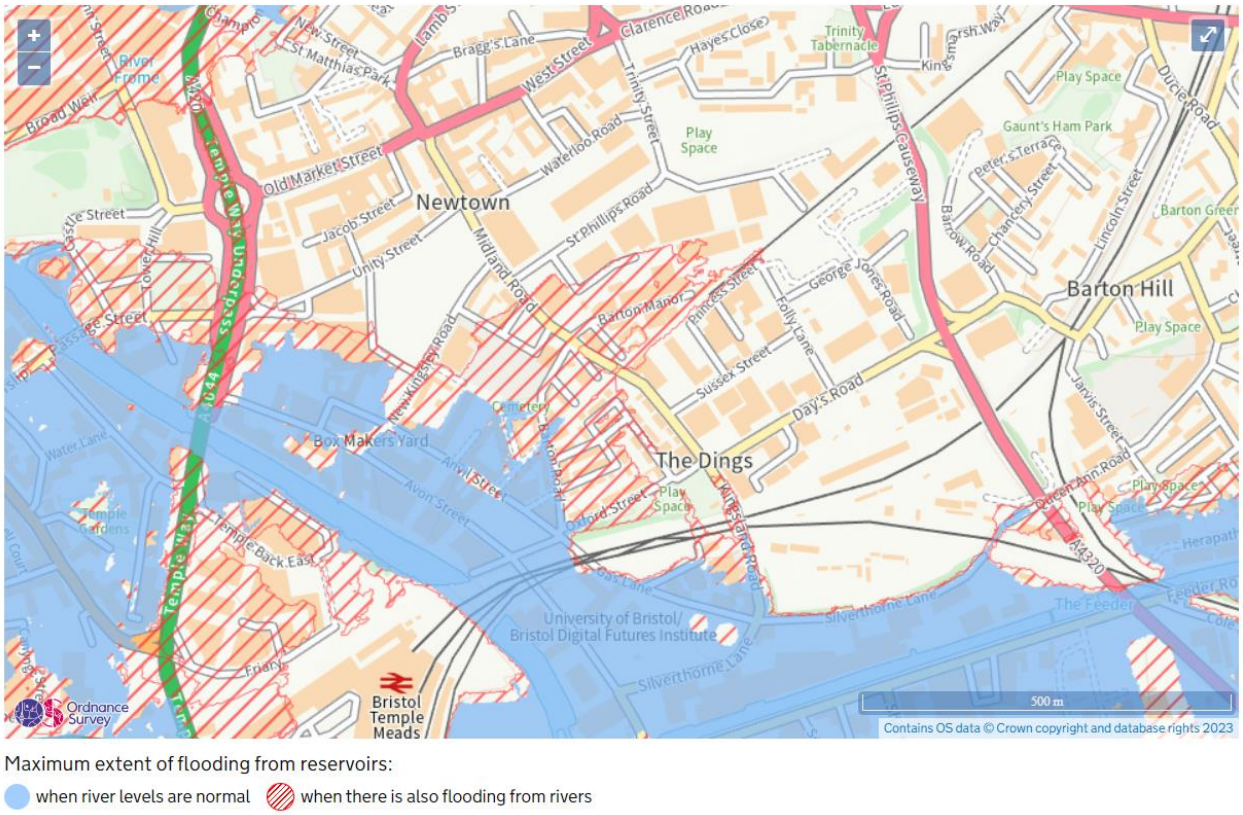


Figure 3: Extract from GOV.UK's Long Term Flood Risk Map for Surface Water Flooding

Based on the available information, the probability of flooding from artificial sources can be assessed as **Low.**

5.5 Groundwater Flooding

Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. In a groundwater flooding event, water levels rise sufficiently to intersect the surface and inundate low lying land.

BCC's Level 1 SFRA states that groundwater flooding has been reported at locations throughout the city but this has tended to be in isolated basements that than groundwater rising above the ground surface to cause flooding on a large scale.

Groundwater was not encountered during ground investigation **(Appendix D)**; however it should be noted that the investigation was only undertaken to a maximum depth of 2.9m.

Based on the information available and the assessment undertaken, the probability of groundwater flooding impacting the Site cannot be excluded and should be assessed as **Low.**

5.6 Sewers Flooding

The risk of flooding to the site from overloaded sewers and surrounding drainage is based on the capacity of the network, operational / maintenance of the network and topography in the vicinity of the Site when sewer flooding occurs sewage can be released back out of the drainage network through the top of manholes, drains or low-lying fittings such as toilets and showers.

Based on the Historic Flood Map included in BCC's Level 1 SFRA, the Site is not located in an area that with a recorded historic flood event. It should be noted however that the SFRA was issued in 2020 and subsequent flooding events may have occurred since this time.

Based on the information available the probability of sewer flooding impacting the Site cannot be excluded and be assessed as **Low.**

7 Flood Risk Mitigation Measures

The below flood mitigation measures are required to manage the risk of flooding identified at the site. The proposed mitigation measures are based on best practice and the EA guidance and advice. Additionally, the scheme aims to comply with DEFRA's guidance on Improving the Flood Performance of New Buildings so that the ground level in particular can quickly recover from flood events.

As discussed in the previous sections the only source of flooding at the site was identified as surface water flooding, however as this surface water flooding is taking place in the existing Dings railway path which will sit approximately 2m below the sites proposed FFL the risk of surface water to the site is Low.

Any potential risk linked to surface water runoff generated is limited through the design of the Drainage Strategy, with attenuation provided to cater for the 1:100 year + 45% climate change event. The management of surface water runoff is discussed in the proposed Drainage Strategy below.

The proposed drainage strategy includes a range of design and management solutions with general design guidance outlined below.

7.1 Finished Floor Levels

In order to mitigate against surface water flooding the Site it is proposed that the external ground levels of the Site comprise of a gentle slope falling away from the buildings, this will allow any external surface water runoff to naturally flow away from the building rather than towards it. It is also recommended that the buildings itself/ themselves will have raised thresholds.

It is recommended that the Site's external levels remain slightly elevated compared to the surrounding roads to reduce risk of these surface water flow paths entering the Site.

8 Drainage Strategy

8.1 Sustainable Surface Water Drainage Strategy

The proposed surface water has been designed in accordance with best practise and guidance to ensure that surface water is managed effectively to limit the risk off-site as well as on site.

The drainage strategy has been based on Building Regulations 2010 Part H which state that surface water runoff from a Site shall discharge to one of the following in order of priority:

- An adequate soakaway or some other adequate infiltration system;
- A watercourse; and
- Sewer.

Due to the local geology, infiltration of surface water into the ground is not deemed feasible. There are no watercourses in the vicinity of the Site, therefore the site will discharge to a local public sewer.

Biodiverse green and brown roofs will be installed on roofs where suitable, refer to the roof level drainage strategy drawings in **Appendix E.** The biodiverse green and brown roofs will add to the amenity of the development by contributing to the visual aesthetics of the development and will increase the biodiversity of the development by creating habitats for wildlife.

It is proposed that a 1277m^3 below ground geo-cellular attenuation tank will be incorporated in the Proposed Development. Surface water from the Site will be routed to this attenuation system, where the water will be retained before being routed to a pump chamber. Surface water from the site will be pumped from this chamber at a rate of 5.0 l/s to a surface water demarcation chamber at the site boundary. From this point the surface water will discharge by gravity to the 225mm diameter WW surface water sewer beneath Princess Street. Refer to drainage strategy drawing in **Appendix E.**

Permeable paving is proposed to be installed between the central soft landscape elements within New Henry Street itself.

Bio-retention tree pits will be provided on site. These areas will contribute to the reduction of flow rates from the site and also provide treatment to the surface water run-off by removing sediments and pollutants from the water. The amenity value of the areas in which they are installed will also be increased by enhancing visual aesthetics of the area.

Details on the type and substrate depth of the biodiverse green and brown roofs have not yet been confirmed so have not been considered during the modelling and calculations at this stage. Any runoff reductions via the biodiverse green and brown roofs will be confirmed at the detailed design stage following planning approval.

Similarly the extent of permeable paving will be confirmed post planning so has not been included in the modelling and calculations at this stage. Any runoff reductions via the permeable paving will be confirmed at the detailed design stage following planning approval.

A pre-planning enquiry was issued to WW in March 2023 based on the scheme submitted for planning in April 2023, (ref: 23/01469/F). WW's response (**Appendix C**) stated that although a pumped surface water solution wouldn't normally be encouraged, due to the Government's steer to avoid having surface water discharged into foul or combined water sewers, the proposed discharge method would likely be deemed acceptable. The latest architectural layouts have led to no significant changes to the previous drainage strategy issued in support of the previous application submitted in April 2023 (ref: 23/01469/F). Therefore it is understood that WW's response is still relevant.

8.1.1 Surface Water Modelling

When undertaking the modelling for the surface water drainage strategy the following assumptions were made:

- Micro-Drainage software has been used for all hydraulic design;
- FEH rainfall data has been used when determining existing runoff rates;
- HR Wallingford Greenfield Runoff Rate Estimation Tool (www.uksuds.com) was used to determine the proposed greenfield runoff rates;
- CV values are set at 1.0 (100%) for hardstanding areas (roads/roofs) within MicroDrainage, for conservative measures at this stage, at the detailed design stage this figure will be reviewed in consultation with the LLFA;
- The private site area is 0.75ha;
- The existing Site has been considered to be 100% impermeable;
- The proposed drainage area of the site is considered to be 0.75ha, and is considered to be fully impermeable for the purposes of modelling; and
- The proposed drainage network has been designed for the 1 in 100 year plus 45% climate change event.

Modelling results are available in **Appendix F**.

8.1.2 Existing Surface Water Network Results

The existing area draining to the surface water network is 0.75ha and assumed to be 100% impermeable. MicroDrainage was used to determine the existing surface water discharge rates, refer to **Appendix F.** Results are summarised in **Table 2** below.

Table 2: Exiting Surface Water Discharge Rates

Return Period (years)	Existing Surface Water Discharge Rates (l/s)
1 in 2	70.16
1 in 30	147.33
1 in 100	201.36
1 in 100 + 45%	N/A

8.1.3 Proposed Surface Water Network Results

The proposed surface water discharge rates will be limited to 5.0 l/s. The proposed surface water discharge rates are shown in **Table 3** below.

Table 3: Proposed Surface Water Discharge Rates

Return Period (years)	Proposed Surface Water Discharge Rates (l/s)	Reduction in Surface Water Discharge Rates (%)
1 in 2	5.0	93
1 in 30	5.0	97
1 in 100	5.0	98
1 in 100 + 45%	5.0	N/A

Although the above strategy identifies the general principles of surface water drainage management at the Site, assumptions and design solutions proposed will need to be re-assessed at the detailed design stage and any necessary approvals sought.

8.2 Offsite Effects

The surface water drainage strategy demonstrates that the drainage network at the Site is designed to accommodate runoff during all events up to and including the 100 year plus 45% climate change allowance and therefore prevents potential exceedance flows off-site.

The development will not cause effects elsewhere in terms of fluvial and tidal flood risk due to its location within Flood Zone 1.

8.3 Residual Flood Risk

The only substantial risk of flooding from the Proposed Development was identified as surface water flooding, all other potential sources of flooding were considered negligible to low. However as discussed in the previous sections, the proposed design solutions detailed in the proposed drainage strategy minimise any residual risk linked to potential extreme rainfall events, additionally the area of existing surface water flooding to the north of the site is circa 2m lower then the proposed development platform so any residual risk is managed.

It has been recommended that the Site's external levels remain slightly elevated compared to the surrounding roads to reduce risk of the surface water flow paths in the surrounding roads entering the site.

The proposed drainage strategy demonstrates that the drainage network at the Site is designed to accommodate runoff during all events up to and including the 100 year plus a climate change allowance preventing potential exceedance flows off-site. Drainage exceedance routes have also been considered and allowed for as part of the development of parameters to ensure that any surface water runoff exceeding the drainage network capacity would naturally flow away. Refer to exceedance routes drawing in **Appendix E.**

8.4 Foul Water Drainage Strategy

The proposed foul water drainage strategy for the site involves the MEP engineer's coordination of the superstructure drainage up until it enters the below-ground drainage network.

Foul water flows from the proposed development will be collected at a high level and conveyed to the boundaries of the building, before connecting to a demarcation manhole via downpipes. The private on plot foul drainage network will be further developed during detailed design stages.

It is proposed that foul water from the Site drains via the demarcation chamber to the 450mm diameter WW foul water sewer running beneath Sussex Street. Refer to Drainage Strategy Drawing in **Appendix E** for an indicative connection location.

To prevent any internal flooding as a result of overloaded public sewers, non-return valves will be utilised to prevent sewer flooding entering the Site.

A pre-planning enquiry was issued to WW in March 2023 based on the scheme submitted for planning in April 2023, which proposed 630 residential units. WW's response (**Appendix C**) stated that WW would carry out any required improvement works to accommodate the proposed foul water flows. A revised pre-planning enquiry has been issued to WW based on the latest architectural updates for which this report has been updated, updating the residential units to 705. At the time of writing, no response has been received from WW. However, as per the previous WW response, WW are obligated to provide capacity and any necessary upgrades works within 24 months of planning being approved (at WW's cost) to ensure the development can drain foul water.

9 Drainage Maintenance and Management strategy

The Drainage Maintenance and Management Strategy (**Table 4**) has been produced based on the information provided within the SUDS Manual; it is expected that the maintenance for the entire scheme will be under the management of Dominus, in which a suitably qualified maintenance specialist will undertake the work.

Table 4: Proposed Drainage Maintenance Strategy

Drainage Feature	Regular Maintenance	Occasional Maintenance	Monitoring
Drainage Channels	Inspections will be frequent and regular, depending on local conditions, but at least annually by Site management. Inspections will include gratings; covers including their locking bolts; sumps and sump buckets; exposed concrete surround and adjacent paving. Channels will be flushed with water or high-pressure jetting (no boiling water or cleaning agent will be used). All silt buckets and sumps will be cleaned out replaced back into the units ensuring they are correctly fitted.	All channel surfaces and joints will be checked and repaired as necessary.	Inspected every 6 months or after large storm.
Geo-Cellular Tanks	Inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary. Remove debris from the catchment surface where it may cause risk to performance (monthly).		Inspect every 6 months or after large storm.
Permeable Paving	Brushing and Vacuuming tree times a year at the end of Winter, Mid – Summer or after Autumn leaf fall or as required on site, or manufacturer' recommendations	Removal of weeds as required	Inspect for evidence of poor operation and/or weed growth, every 3 months and after large storms. Inspect silt accumulation rates and stablish appropriate brushing frequency, annually. Monitor inspection chambers, every 3 months and after large storms.
Biodiverse Roofs	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes, integrity of waterproofing and structural stability. Inspect drain inlets to ensure unrestricted runoff from the drainage layer. Remove debris and litter to prevent clogging of inlet drains and inference with plant growth.	Replace dead plants as required Remove invasive and nuisance vegetation including weeds.	Inspected every 6 months or after large storm.
Manholes / Inspection Chambers	Inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary.		Inspect every 6 months or after large storm.

10 Conclusion

This FRA and DS has been prepared on behalf of Dominus Bristol Limited to support the planning application for the purpose-built student accommodation development located at located at Premier Business Park, Kingsland Road, Bristol, BS2 0QX.

The EA and the online GOV.UK Flood Map for Planning identify that the Site is located in Flood Zone 1 where the probability of river or sea flooding is less than 0.1% (1 in 1000) chance in any given year. Meaning that the probability of tidal or fluvial flooding can therefore be assessed as negligible.

Risk of surface water flooding on site has been mitigated by the design of an outline drainage strategy which demonstrates the ability to accommodate surface water runoff during all events up to and including the 100 year plus an appropriate climate change allowance to prevent potential exceedance flows off-site. Surface water flooding is also reduced as well by the the proposed levels design which ensures levels continue to be higher than then existing Dings Railway Path for which the surface water flooding is present. As such the Proposed Development will reduce the probability of surface water flooding at the Site and in the surroundings.

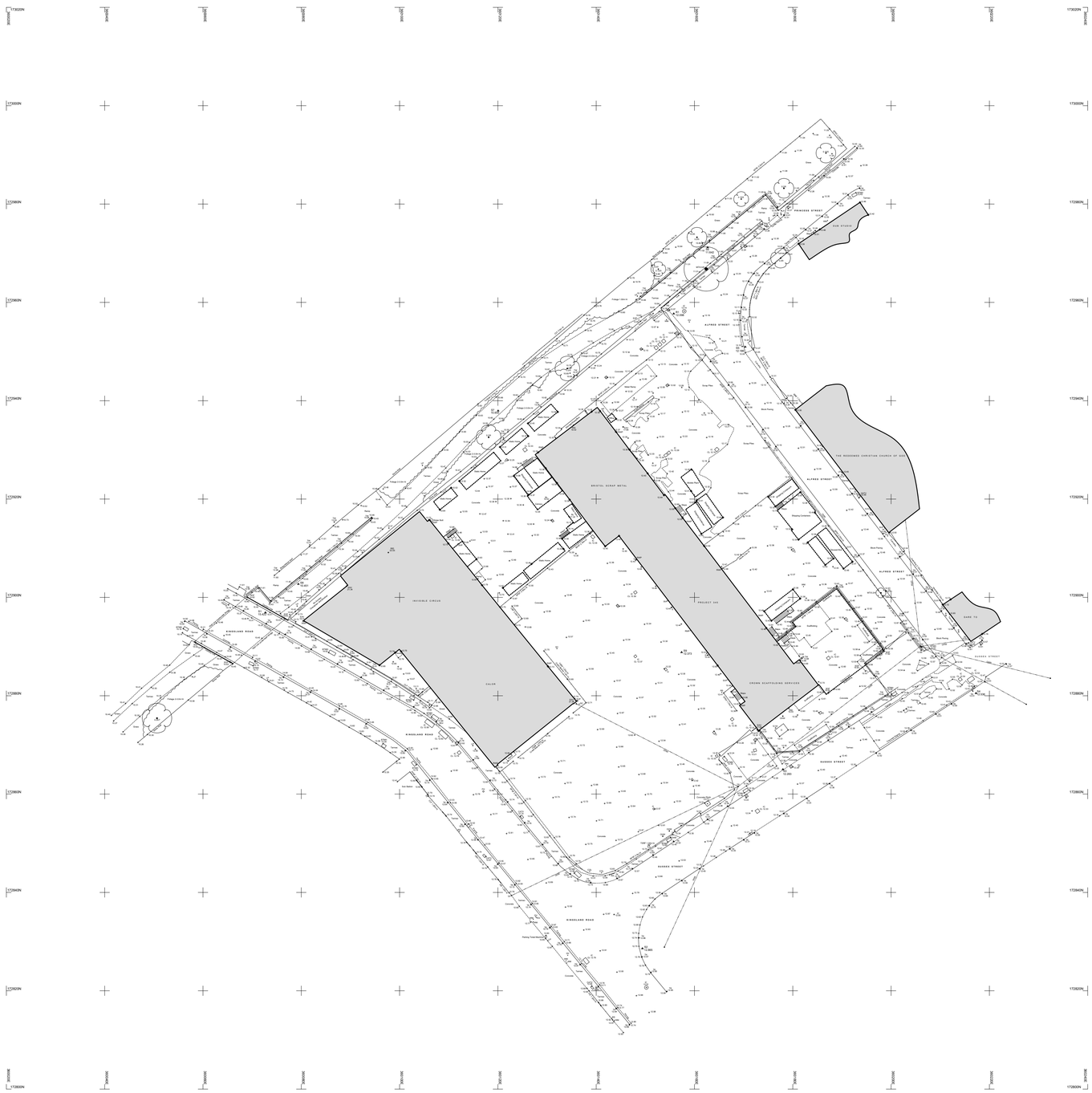
Other potential sources of flooding have been investigated and are deemed negligible to low. Considering the above, it can be concluded that there are no flood risk, surface or foul water drainage grounds on which to refuse this application.

The proposed surface water drainage strategy optimises the use of SuDS in line with best practice, and national and local planning policy. The proposed drainage strategy incorporates sustainable drainage systems (SuDS) features in the form of biodiverse green and brown roofs, permeable paving, bio-retention tree pits, and a below ground geo-cellular attenuation tank system. The Site's surface water will be attenuated and reduced to 5.0l/s before being pumped to the local Wessex Water (WW) public surface water sewer beneath Princess Street.

Foul water from the Site will drain by gravity and discharge to the WW public foul water sewer beneath Sussex Street.

The Pre-Planning enquiry submitted to WW in March 2023 for the drainage strategy issued for planning in April 203 has been updated to reflect the latest architectural changes including the increase of proposed residential units to 705 units. However, as there are no changes to the surface water drainage strategy since the previous WW response, and the obligation for WW to provide capacity for proposed foul water flows we understand that the previous response received from WW is still relevant.

Appendix A – Topographical Survey



SURVEY STATIONS - COORDINATE SCHEDULE

Station	Easting	Northing	Level
R1	360155.782	172957.715	12.098
S1	360072.707	172896.929	15.422
S2	360149.404	172828.609	12.865
S3	360177.996	172865.034	12.283
S4	360217.272	172880.520	12.536
S5	360170.331	172950.958	12.186
S6	360162.679	172971.186	11.642
S7	360120.052	172937.966	10.655
S8	360079.403	172902.719	10.451
S9	360157.379	172888.846	12.373

Survey station S2 has a direct relationship to the Ordnance Survey active network. All other stations have been descaled about this point.
The scale factor for these quoted stations is 1.
This is effectively a local coordinate system with a good connection to the OS to facilitate overlaying of further OS digital data.
Please contact Maltby Surveys if further clarification is required.

LEGEND

BANKING — Top / Bottom

BUSHES & HEDGES

TREES — MT / 3T / 0.2 / 6 (Multiple Trunks / No of Trunks / Dia of Bole / Height of Tree)

NOTE:- SPREADS AND HEIGHTS ARE INDICATIVE ONLY

GATES — Single / Double

WALL — Width drawn to scale 0.23w

BUILDING

OPEN SIDED BUILDING

GLASS ROOFED

CONTOURS 25.50

ABBREVIATIONS (WHERE APPLICABLE)

ARCH HEAD HEIGHT	AHH	MARKER	MKR
ARCH HEAD LEVEL	AHL	MONITORING WELL	MW
ARCH SPRINGER HEIGHT	ASH	NOTICE BOARD	NB
ARCH SPRINGER LEVEL	ASL	NAME PLATE	NP
AIR VALVE	AV	OVERHEAD WIRES	OHW
BED LEVEL	BL	PARKING METER	PM
BELISHA BEACON	BB	RIDGE LEVEL	RID
BOLLARD	B	ROOF LEVEL	RL
BRITISH TELECOM BOX	BTB	ROAD SIGN	RS
BRITISH TELECOM MANHOLE	BTMH	RODDING EYE	RE
BRICKWORK	BKWK	RETAINING WALL	RTW
BUS STOP	BS	RAIN WATER PIPE	RWP
CABLE TV	CATV	SLUICE VALVE	SV
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CONCRETE POST	CP	TREE STUMP	ST
EAVES LEVEL	EAV	SOIL AND VENT PIPE	SVP
ELECTRICAL COVER	ELEC	THRESHOLD LEVEL	THL
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ELECTRICITY POLE	EP	TELEPHONE CALL BOX	TCB
EARTH ROD	ER	TOP OF KERB	TK
FLOWER BED	FB	TURNSTILE	TS
FINISHED FLOOR LEVEL	FFL	TRAFFIC LIGHT	TL
FIRE HYDRANT	FH	TOP OF WALL	TW
FLOOR LEVEL	FL	UNABLE TO LIFT	UTL
FLAG STAFF	FS	UNABLE TO SURVEY	UTS
GAS PIPE	GP	VENT PIPE	VP
GAS VALVE	GV	WATER METER	WM
GULLY	G	WATER LEVEL	WL
GATE STOP	GS	WASH OUT	WO
INSPECTION COVER	IC	WASTE PIPE	WP
INVERT LEVEL	IL	WATER TANK	WT
LAMP POST	LP	WATER VALVE	WV

FENCES

BARBED WIRE FENCE	BWF	LARCH LAP FENCE	LLF
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FENCE POST	FPO	POST AND WIRE FENCE	PWF
INTERWOVEN FENCE	IWF	STEEL PALISADE SECURITY FENCE	SPSF
IRON RAILING FENCE	IRF	TUBULAR STEEL RAIL FENCE	TSRF

REV.	NOTES	DWN	DATE
A	---	---	--/--/----

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Notes:
Grid and levels relate to OS GPS Active Network.
Sheet is North orientated unless stated.

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CHECKED	SJM	
		SCALE
		1/500 (A1 Sheet)

RICS

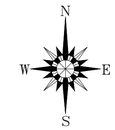
Sussex Street, Bristol, BS2 0RA

TOPOGRAPHICAL SURVEY

Job No	Rev	Drawing Number
22/281		22/281/100/Overview

Date : November 2022

Grid



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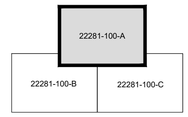

LEGEND

BANKING — Top / Bottom

BUSHES & HEDGES

TREES — MT / 3T / 0.2 / 6 (Multiple Trunks: No of Trunks; Dia of Bole; Height of Tree)

NOTE:- SPREADS AND HEIGHTS ARE INDICATIVE ONLY

GATES — Single / Double

WALL — Width drawn to scale: 0.23m

BUILDING

OPEN SIDED BUILDING

GLASS ROOFED

CONTOURS — 25.50

ABBREVIATIONS (WHERE APPLICABLE)

ARCH HEAD HEIGHT	AHH	MARKER	MKR
ARCH HEAD LEVEL	AHL	MONITORING WELL	MW
ARCH SPRINGER HEIGHT	ASH	NOTICE BOARD	NB
ARCH SPRINGER LEVEL	ASL	NAME PLATE	NP
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BOLLARD	B	ROOF LEVEL	RL
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FLAG STAFF	FS	UNABLE TO SURVEY	UTS
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INTERWOVEN FENCE	IWF	STEEL PALISADE SECURITY FENCE	SPSF
IRON RAILING FENCE	IRF	TUBULAR STEEL RAIL FENCE	TSRF

REV.	NOTES	DWN	DATE
A	---	---	--/----

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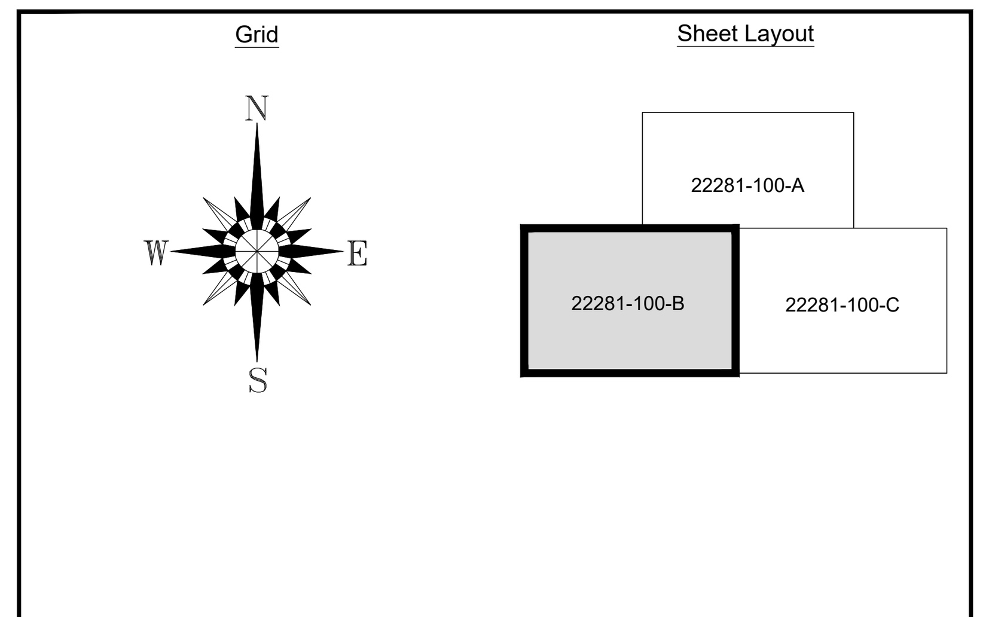
SURVEYED	JS	CLIENT
DRAWN	JS	DOMINVS GROUP
CHECKED	SJM	SCALE
RICS		1/200 (A1 Sheet)

Sussex Street, Bristol, BS2 0RA

TOPOGRAPHICAL SURVEY

Job No	Rev	Drawing Number
22/281		22/281/100/A

Date : November 2022



LEGEND

BANKING	Top / Bottom	WALL	Width drawn to scale 0.23w
BUSHES & HEDGES		BUILDING	
TREES MT / 3T / 0.2 / 6 (Multiple Trunks, No of Trunks, Dia of Bole, Height of Tree)		OPEN SIDED BUILDING	
NOTE:- SPREADS AND HEIGHTS ARE INDICATIVE ONLY		GLASS ROOFED	
GATES	Single, Double	CONTOURS	25.50

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GAS PIPE	GP	VENT PIPE	VP
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IRON RAILING FENCE	IRF	TUBULAR STEEL RAIL FENCE	TSRF

REV.	NOTES	DWN	DATE
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CHECKED	SJM	
RICS		SCALE
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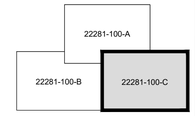
TOPOGRAPHICAL SURVEY

Job No	Rev	Drawing Number
22/281		22/281/100/B

Date : November 2022

Grid

Sheet Layout



LEGEND

BANKING — Top / Bottom

BUSHES & HEDGES

TREES — MT / 3T / 0.2 / 6 (Multiple No of Trunks, No of Trunks, Dia of Bole, Height of Tree)

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BUILDING

OPEN SIDED BUILDING

GLASS ROOFED

CONTOURS — 25.50

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REV.	NOTES	DWN	DATE
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SURVEYED	JS	CLIENT
DRAWN	JS	DOMINVS GROUP
CHECKED	SJM	
RICS		SCALE
		1/200 (A1 Sheet)

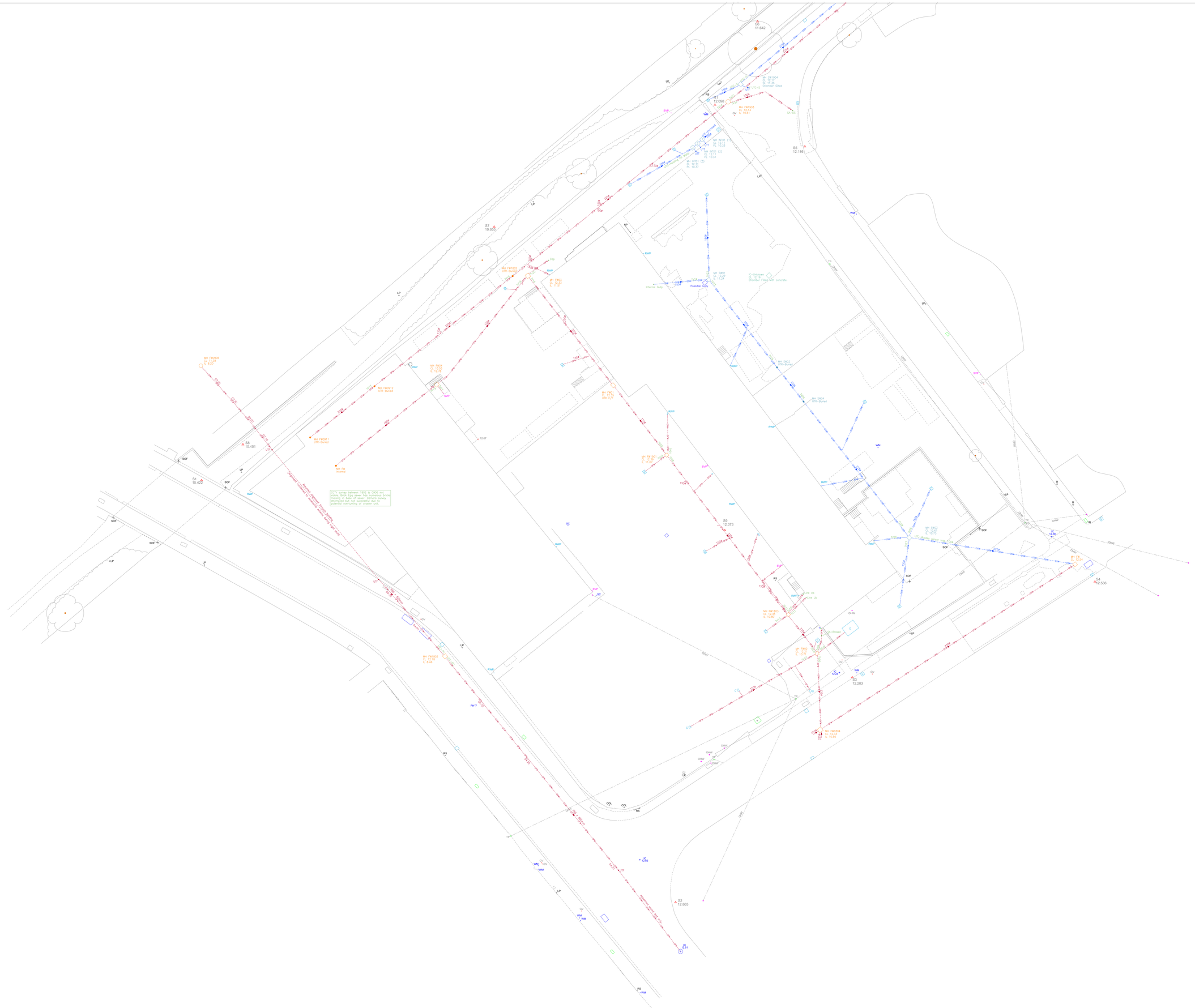
Sussex Street, Bristol, BS2 0RA

TOPOGRAPHICAL SURVEY

Job No	Rev	Drawing Number
22/281		22/281/100/C

Date : November 2022

Appendix B – CCTV Drainage Survey



LASER SURVEYS

LAND AND BUILDING SURVEYS, UNDERGROUND SERVICES LOCATION, CCTV DRAINAGE SURVEYS.
Established 1975. Member of The Survey Association.
OPEN SPACE, LEIGH SINTON ROAD, UPPER INTERFIELDS, MALVERN, WR14 1UT
TEL: 01886 833173 email: worcester@lasersurveys.com
THE OLD DAIRY, STUBBERS FARM, MOUNTNESSING ROAD, BLACKMORE, ESSEX, CM4 0NX
TEL: 01277 821555 email: london@lasersurveys.com

DATUM NOTES

DRAWING IS BASED ON SITE DIGITAL DATA PROVIDED BY MENHARDT (UK) LIMITED.

LEVELS ARE RELATED TO -- SUPPLIED DIGITAL DATA.

SURVEY CONTROL STATIONS SHOWN

ABBREVIATIONS (where applicable)

(A)	Assumed/Approximate	OH	Overhead
A	Arch Ht	PAV	Paving
AC	Air-Con Unit	PB	Post Box
AG	Above Ground	PD	Pit Depth
AV	Air Valve	PE	Pipe
B	Beam Ht	PL	Pit Level
BBL	Blockdrop Invert Level	PM	Parking Meter
BK	Brick	P/R	Post and Rail
BL	Bollard	PSC	Size Change
BS	Bus Stop	PT	Post
BSU	Beam Slopes Up	P/W	Post and Wire
BT	British Telecom	RE	Rodding Eye
C	Ceiling Ht	RET	Retaining
C/B	Close Boarded	RS	Road Sign
C/T	Covertad	RSJ	Rolled Steel Joist
CL	Cover Level	S	Step
CLK	Clock Face	SA=	Survey Abandoned-
CN	Connection	=BE	-Buck at Bend
CO	Column	=CM	-Intruding Connection
Conc	Concrete	=DA	-Debris Attached
CP	Catch Pit	=DS	-Debris Settled
CPS	Concrete Paving Slabs	=JD	-Joint Displaced
CSU	Ceiling Slopes Up	=LT	-Loss of Traction
CTV	Cable Television	=OB	-Obstruction
CW	Combined Water	=OL	-Operating Limit
DC	Drainage Channel	=RT	-Roots
D	Depth	=PC	-Poor Condition
D	Door Ht	=ST	-Camera Stuck
DP	Drain Pipe	=UW	-Under Water
EP	Electricity Pole	S/C	Surcharged
ER	Earthing Rod	SD	Silt Depth
FC	False Ceiling Ht	SK	Soakaway
FB	Flower Bed	SL	Silt Level
FE	Fence	SP	Spring Ht
FH	Fire Hydrant	SPT	Septic Tank
FL	Floor Level	ST	Silt Trap
FP	Flag Pole	SV	Stop Valve
FW	Foul Water	SVC	Security Video Camera
GP	Gate Post	SW	Storm Water
GV	Gas Valve	TCB	Telephone Call Box
GY/G	Gully	THL	Threshold Level
H	Head Ht	TL	Traffic Light
HL	High Level Invert	TR	Tree
HT	Hedge	TP	Telegraph Pole
IC	Inspection Cover	TNo	Item Number in CCTV Report
IL	Invert Level	UG	Underground
INJNT	Interceptor	UTC=	Unable to Camera-
I/R	Iron Railings	=A	-No Access
JB	Junction Box	=D	-Debris
JN	Junction	=DRP	-Drop Pipe
KO	Kerb Outlet	=F	-Flow/Water Level
LB	Litter Bin	=PC	-Poor Condition
LP	Lamp Post	=R	-Roots
MC	Material Change	=S/C	-Surcharged
MG	Multi Girth Tree	UTF	Unable to Trace Further
MH	Manhole Cover	UTL	Unable to Locate
MK	Marker	UTR	Unable to Raise
NDP	No Depths Possible	UTT	Unable to Trace
NPV	No Pipes Visible	VP	Vent Pipe
NOPV	No Other Pipes Visible	WL	Water Level
NW	No Valve Visible	WM	Water Meter
		WO	Wash Out

NOTES

- Drainage pipe sizes (where shown) have been gauged from the surface for safety reasons and should be regarded as approximate only.
- Tree species (where shown) should be treated with caution and expert identification is advised.
- Although this is a digital survey the accuracy and amount of detail shown is only commensurate with the graphical scale of mapping as specified. Care should be exercised when working to larger scales.
- Visible features in the vicinity of the boundaries as shown above, may not represent the extent of legally conveyed ownership.
- Whilst every effort has been made to achieve accuracy on this plan, CRUCIAL clearance dimensions, levels and invert levels should be checked prior to design and construction.
- Kerb levels have been taken in the bottom of the channel.
- All pipes are 100Ø unless specified otherwise.

SHEET LAYOUT
(NOT TO SCALE)

SUSSEX STREET
BRISTOL
BS2 0RA

CCTV DRAINAGE SURVEY

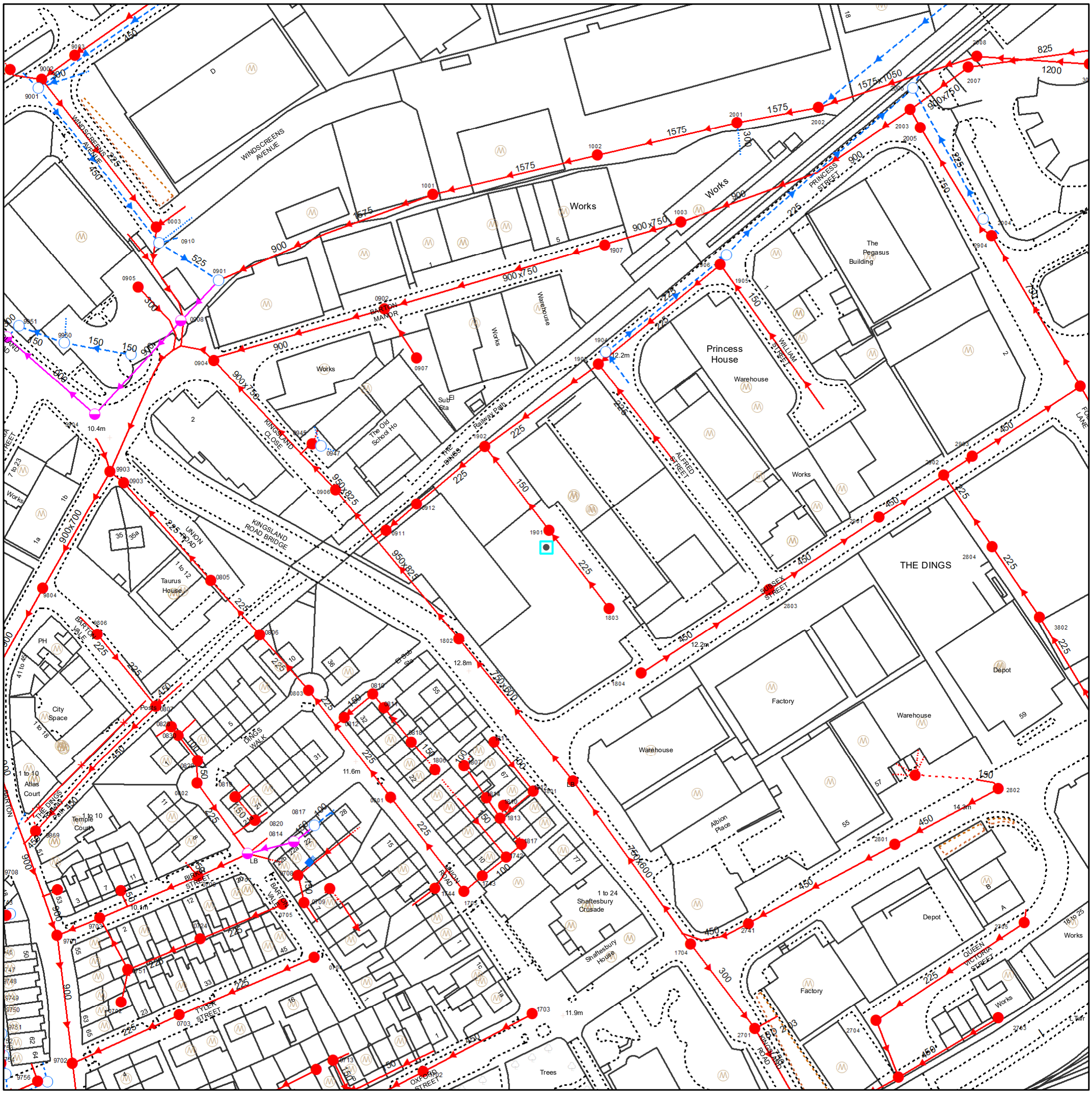
SURVEYED FOR:	MENHARDT (UK) LIMITED 10 ALDERSGATE STREET LONDON EC1A 4HJ
SURVEYOR:	A RHODES
DATE:	APRIL 2023

NO	DATE	REVISION NOTES
1	11/04/23	Additional drainage survey added.

SHEET NUMBER	N 1771/1	REVISION 1
DRAWING TITLE	DRAINAGE	
SCALE	1 : 200 (A0)	
SEE ALSO DWG NOS		
SHEET	1 of 1	
JOB NUMBER	N 1771-R1	

Appendix C – Wessex Water Asset Records and Consultation

Wessex Water Web Map



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WATER MAINS

- Distribution Main
- Washout Main
- Raw Water Main
- Abandoned Main
- Private Main

SITES

- Source
- Reservoir
- Pump
- Treatment Works

FITTINGS

- Valve - Open
- Valve - Closed
- Fire Hydrant
- Pressure Reducing Valve
- Meter

SEWERS

	PUBLIC	PRIVATE	SECTION 104
Foul			
Surface			
Combined			
Abandoned			

OTHER WESSEX PIPES

- Rising Mains
- Standby Rising Mains
- Effluent Disposal (EDM)
- Overflow
- Syphon (S)

NON-WESSEX / UNKNOWN

- Private Rising Mains
- Culverted Watercourse (CW)
- Highway Drain (H)
- Use Unknown (?)
- Status Unknown (SU)

Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow) styles of line are shown on the key in sample/typical colours.

STRUCTURES

- Manhole - Foul
- Manhole - Surface
- Manhole - Combined
- Outfall
- Inlet
- Lamphole (LH)
- Bifurcation - Foul
- Bifurcation - Surface
- Bifurcation - Combined
- Combined Sewage Overflow (CSO)
- Pumping Station - Surface
- Pumping Stn - Foul/Combined
- Gully
- Vent Column (VC)
- Rodding Eye (RE)
- Catchpit (CP)
- Flushing Chamber (FC)
- Soakaway (SK)
- Non Return Valve
- Washout
- Air Valve
- Hatch Box (HB)

OTHER STRUCTURES

- Attenuation Tank
- Storage Tank
- Chamber
- Tunnel
- Interceptor

Wessex Water
YTL GROUP

Date: 16/02/2023, 09:51:09

Scale: 1:1,250

Centre: 360,141, 172,898

N W E S

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 28 March 2023 12:09
To: Jasmine Houze
Cc: Gurdeep Bansal
Subject: WWRESP: ST67SW/ 420 - New Henry Street [Filed 26 Jun 2023 13:57]
Attachments: SITE_LOCATION_PLAN.pdf

Categories: Filed by Mail Manager

Good afternoon, Jasmine,

Re: ST67SW/ 420 - New Henry Street - Premier Business Park Sussex Street Bristol BS2 0RA. Demolition of existing structures and redevelopment of the site to comprise flexible commercial use (*Class E*), flexible commercial and community use (*Class E/F1/F2*), and student accommodation use (*Sui Generis*).

Many thanks for your email and for meeting with me. Please note the requested preliminary confirmation below,

Surface drainage

In line with the NPPF, relevant flood risk guidance and Wessex Water's policy, A surface water point of connection must be reviewed to an adequate point within the 225 mm dia surface water sewers within Princess Street. Although a pumped method of conveying surface water is not encouraged, the Government steer is for surface water drainage to no longer be combined with foul water due to the nationwide focus on reducing discharges from storm overflows from combined sewers as well as reducing the unnecessary high carbon footprint arising from pumping and treating surface water which could be returned to the environment without needing to pass through sewage treatment works.

There are three surface water manholes within Princess Street that Wessex Water is prepared to consider connecting into, the onus is on the developer to determine the best method of doing so. There are no recorded levels for manholes 1906 and 2006; cover levels for 1904 are provided below and must be verified with a survey prior to details being implemented.

MH Reference	ST6072 1904
Cover Level	12.202
Lowest Invert	11.362
Depth	0.840

Capacity improvements to be managed by Wessex Water will include the predicted foul flows from any approved commercial /industrial uses being of domestic type only. The applicant must contact Wessex Water with information should a discharge of a non-domestic nature be approved. It may be possible to either build over or divert the public sewers crossing the site subject to a full application and a detailed engineering appraisal to determine feasibility and any loss of capacity/gradients upon implementing any derived schemes. It is also likely that the approved layout through planning will direct the final drainage layout and method of conveyance; Further information on how to apply can be found via the links below.

- *Building near or over a minor public sewer*

I hope the above high-level comments are enough to proceed with the design and Investigatory works. Please let me know if anything else is required in the interim.

Kind regards,

Teddy Amuah
Wessex Water
Claverton Down Bath BA2 7WW

wessexwater.co.uk

From: Teddy Takyi-Amuah
Sent: 14 March 2023 11:15
To: Jasmine Houze <Jasmine.Houze@meinhardt.co.uk>
Cc: Gurdeep Bansal <Gurdeep.Bansal@meinhardt.co.uk>
Subject: RE: ST67SW/ 420 - New Henry Street - Pre Development Enquiry.

Many thanks for your email on the above Jasmine,

Re: ST67SW/ 420 - Premier Business Park Sussex Street Bristol BS2 0RA

Can you please confirm some times next week to go over the proposal? It was reviewed earlier today during our Team meeting; based on Wessex Water & Bristol policy; it is highly unlikely that surface water will be permitted into the foul regardless of the restrictions on site and the requirement to pump. We may resort to agreeing to a connection further downstream. This particular drainage catchment is restricted in terms of capacity due to consented sewer overflows immediately downstream.

Can you please confirm some days and times next week to discuss this further?

Kind regards,

Teddy Amuah

From: Jasmine Houze <Jasmine.Houze@meinhardt.co.uk>
Sent: 13 March 2023 15:28
To: Planning Liaison <planning.liaison@wessexwater.co.uk>; Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>

Cc: Gurdeep Bansal <Gurdeep.Bansal@meinhardt.co.uk>
Subject: New Henry Street - Pre Development Enquiry.

Hi Teddy,

My colleague Craig Marchant has passed on your details, hope that is ok.

Please find attached a pre-development enquiry for a new site located in Bristol.

As some background, the site is an existing industrial estate so is a brownfield site. The LLFA's Climate Change and Sustainability Practice Note Addendum (2023) states "For previously developed sites, the total run off and runoff rates should be close to Greenfield runoff rates. Where it is demonstrated that this is not reasonably practicable, a minimum reduction of 30% to existing peak flows will be sought."

As stated in the form we are unable to discharge at greenfield runoff rates (3.1 l/s) without pumping surface water from the site. It is proposed that surface water will discharge rate from the site (0.75ha impermeable) will discharge via gravity at 5.0l/s for all storm events up to and including the 1 in 100 year event plus 45% climate change allowance.

We are unable to drain the surface water from the site to a surface water sewer as the nearest sewer is very shallow, and again would require a pumped outfall. The drainage survey (attached) for the site shows the surface water and foul water from the site both drain unrestricted to the existing Wessex Water foul water sewer beneath Sussex Street. It is therefore proposed that surface water and foul water from the site both continue to drain to this sewer.

Please can you advise if this approach is acceptable.

Thanks,
Kind regards,

Jasmine Houze
Senior Civil Engineer

MEINHARDT

Meinhardt (UK) Ltd, 10 Aldersgate Street, London, EC1A 4HJ
MOB: 07932 420944

Appendix D – Geotechnical Information

JOMAS ENGINEERING ENVIRONMENTAL

WE LISTEN, WE PLAN, WE DELIVER

Geotechnical Engineering and Environmental Services across the UK.

GEO-ENVIRONMENTAL ASSESSMENT (GROUND INVESTIGATION) REPORT

UNITS 1-15 PREMIER ESTATES,
SUSSEX STREET,
BRISTOL,
BS2 0RA

JOMAS ASSOCIATES LTD
Unit 24 Sarum Complex, Salisbury Road, Uxbridge UB8 2RZ
www.jomasassociates.com 0333-305-9054 info@jomasassociates.com

Report Title: **Geo-environmental Assessment Ground Investigation Report for Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA**

Report Status: **Final v1.0**

Job No: **P4639J2633/JLW**

Date: **11/10/2022**

QUALITY CONTROL – REVISIONS

Version	Date	Issued By

Prepared by: JOMAS ASSOCIATES LTD **For:** DOMINVS PROJECT COMPANY 23 LIMITED

Prepared by	Reviewed by	Approved by
Josephine Whitehead MSci (Hons), FGS	Tom Elbourne BSc (Hons), CGeol CSci FGS, RoGEP - Professional	James Field BSc (Hons), CGeol, FGS, RoGEP - Professional
Geotechnical Engineer	Senior Geo-environmental Engineer	Associate Director
.....	.....	.....

Should you have any queries relating to this report, please contact

JOMAS ASSOCIATES LTD

www.jomasassociates.com

0843 289 2187

info@jomasassociates.com

CONTENTS

Page

APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS

APPENDIX 4 – SOIL GAS MONITORING TEST RESULTS

EXECUTIVE SUMMARY

Dominvs Project Company 23 Limited commissioned Jomas Associates Ltd to undertake a Geo-environmental ground investigation at the site referred to as Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA.

The principal objectives of the study were as follows:

- To determine the nature and where possible, the extent of contaminants potentially present at the site;
- To establish the presence of significant pollutant linkages, in accordance with the procedures set out within the Environment Agency (EA) report R&D CLR11 and relevant guidance within the National Planning Policy Framework (NPPF);
- To assess whether the site is safe and suitable for the purpose for which it is intended, or can be made so by remedial action.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Site History and Ground Investigation	
Desk Study Overview	A Desk Study report has been produced for the site and issued separately. A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information. A review of earliest available (1884) historical maps indicates that the site was comprised of four rows of terraced housing with private gardens. Henry Street runs down through the middle of site, and Princess Street runs along the north-west of site. By the map dated 1950, 2No ruins were identified on-site. Few changes occur to the site until the map dated 1964 when the housing to the east of Henry Street has all been demolished, except for 1No in the north of site. A depot has been constructed in this area. Some buildings have been demolished west of Henry Street, with 17No terraced residential houses with private gardens remaining. By 1972, all residential buildings on site have been demolished. Henry Street is no longer present. 1No warehouse type building has been constructed in the west of site, and 3No smaller buildings have been constructed in the south-west of site. The smaller buildings in the south-west of site appear to have been demolished by 1985. Few changes then occur to the site until the present day. Current site uses include commercial/industrial; business operate out of the units on site including "The Invisible Circus" circus training (Unit 15), "Bristol Scrap Metal" (Units 6-11), "Calor Gas" (Units 12 & 13), "Crown Scaffolding" (Unit 1) and "Sovereign Motors" (Units 4-5). In the late 19th century, the land use in the vicinity of site was largely mixed industrial and residential with major railway lines and stations present. During the 1950s and 1960s, much of the surrounding land underwent heavy industrial redevelopments, with the construction of depots and factories and demolition of residential buildings. In the 1970s, many of the surrounding railway lines became disused and business parks were built in these areas. Currently, the site is part of Premier Business Park.

Site History and Ground Investigation	
	Information provided by the British Geological Survey indicates that the site is directly underlain by solid deposits of the Redcliffe Sandstone Member. No superficial or artificial deposits are reported on site. Borehole records from approximately 144m north-east of the site indicated Made Ground to a depth of 3.2mbgl, overlying possible tidal flat deposits to 8.4mbgl, beneath which were deposits of sand, gravel and sandstone to the base of the borehole The solid deposits underlying the site are identified as a Secondary A Aquifer. A review of the Enviro+Geoinsight Report indicates that there are 2No groundwater abstractions within 2km of the site; the nearest of which is located 65m north-west. There are no potable water abstractions reported within 2km of the site and there are no source protection zones within 500m of the site. There are 23No surface water abstractions within 2km of the site; the nearest of which is located 366m south-west. There are no surface water features or water networks (OS MasterMap) reported within 250m of the site. There are no Environment Agency Zone 2 or 3 floodplains reported within 50m of the site. In order to clarify the potential risks associated with the historic coal mining in the area, it was recommended that Consultant's Coal Mining Report is obtained for the site. An intrusive investigation was also recommended to confirm the preliminary geo-environmental risks identified. The investigation should assess the thickness of Made Ground and allow samples of made ground and natural soils to be taken for laboratory analysis. Soil gas monitoring should be undertaken due to the presence of a historical landfill site 144m to the east of the site (former Barton Hill Gas Holder Site). This should be undertaken in accordance with CIRIA C665.
Intrusive Investigation	The ground investigation was undertaken on 30 August 2022, and consisted of the following: • 5 No windowless sampling boreholes, drilled to a maximum depth of 2.9m below ground level (bgl), with associated in-situ testing and sampling; • Laboratory analysis for chemical purposes; • 4No return visits to monitor ground gas concentrations and groundwater levels.
Ground Conditions	The results of the ground investigation revealed a ground profile comprising Made Ground to a maximum depth of 2.7mbgl, overlying sand deposits of the Redcliffe Sandstone Member. Groundwater was not reported during the course of the investigation.

Site History and Ground Investigation	
Environmental Considerations	Following generic risk assessments, elevated concentrations of arsenic and lead were detected in soils in excess of generic assessment criteria for the protection of human health within a "residential without plant uptake" end-use scenario. No asbestos containing materials or fibres were detected in the Made Ground samples analysed in the laboratory. Where the site is to be covered by the building footprint and hard surfacing, no formal remedial measures are considered necessary in terms of human health, as the building and hard surfacing are expected to provide a barrier to potential receptors. In areas of soft landscaping, Made Ground should be encapsulated with a minimum 450mm of imported clean topsoil, placed on a geotextile membrane. Further investigation is recommended to increase the sample density across the site and beneath building footprints. Recommended remedial measures may be revised based on the findings of such works. The current soils may not satisfy the requirements of BS:3882 due to elevated concentrations of phytotoxic contaminants. The risk to controlled waters from soils is considered low on the basis that the extensive hard cover of the site will severely restrict the potential mobilisation of contaminants within the Made Ground. Based on the calculated GSVs, and in consideration of the conceptual site model, the site is classified as Characteristic Situation 1 (CS1) and no formal gas protection measures are considered to be necessary. Upgraded potable water supply pipe materials are unlikely to be required. The water supply pipe requirements for this site should be discussed at an early stage with the relevant utility provider. A remedial strategy will be required for the proposed development. This should include reference to information from the currently pending petroleum licensing information request. Further investigation is recommended within the vicinity of tanks that may be reported by the petroleum licensing authority (if any – response pending) and within the footprints of the existing building. If tanks are identified on site these will require removal along with associated hydrocarbon impacted soils under the supervision of a suitably qualified environmental consultant with appropriate verification works undertaken. As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out. Should any contamination be encountered, a suitably qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.

1 INTRODUCTION

1.1 Terms of Reference

1.1.1 Dominvs Project Company 23 Limited ("The Client") has commissioned Jomas Associates Ltd, to assess the risk of contamination posed by the ground conditions at a site referred to as Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA, prior to the redevelopment of the site.

1.1.2 To this end a Desk Study has been produced for the site and issued separately (Jomas, August 2022), followed by an intrusive investigation (detailed in this report).

1.1.3 The previous reports undertaken for the site by Jomas are detailed in Table 1.1:

Table 1.1: Previous Reports - Jomas

Title	Author	Reference	Date
Desk Study/Preliminary Risk Assessment Report for Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Jomas Associates Ltd	P4639J2633/JLW	17 August 2022

1.1.4 The intrusive investigation was undertaken in accordance with Jomas proposal dated 04 August 2022

1.2 Proposed Development

1.2.1 It is understood that proposed development comprises demolition of the existing buildings on site and construction of a new building comprising commercial/retail units at ground level and residential units above. No private gardens or extensive areas of soft landscaping are anticipated.

1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'Residential without plant uptake'.

1.3 Objectives

1.3.1 The objectives of Jomas' investigation were as follows:

- To conduct an intrusive investigation, to determine the nature and extent of contaminants potentially present at the site;
- To establish the presence of significant pollutant linkages, in accordance with the procedures set out within Part IIA of the Environmental Protection Act 1990, associated statutory guidance and current best practice including the EA report R&D CLR 11.

1.4 Scope of Works

1.4.1 The following tasks were undertaken to achieve the objectives listed above:

- Intrusive ground investigation to determine shallow ground conditions, and potential for contamination at the site;
- Undertaking of laboratory chemical testing upon samples obtained;
- The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Supplied Documentation

1.5.1 A report previously prepared by a third-party was supplied to Jomas Associates at the commencement of this investigation. Table 1.2 details the document supplied:

Table 1.2: Supplied Reports

Title	Author	Reference	Date
Environmental Report for Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Argyll Environmental	298881269	25 July 2022

1.6 Limitations

1.6.1 Jomas Associates Ltd has prepared this report for the sole use of Dominvs Project Company 23 Limited, in accordance with the 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 by any other party without the explicit written agreement of Jomas Associates Limited. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.

1.6.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless Jomas Associates Limited has actual knowledge to the contrary, information obtained from public sources or provided to Jomas Associates Limited by site personnel and other information sources, have been assumed to be correct. Jomas Associates Limited does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.

1.6.3 Whilst every effort has been made to ensure the accuracy of the data supplied, and any analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.

1.6.4 Any reports provided to Jomas Associates Limited have been reviewed in good faith. Jomas Associates Limited cannot be held liable for any errors or omissions in these reports, or for any incorrect interpretation contained within them.

1.6.5 This investigation and report has been carried out in accordance with the relevant standards and guidance in place at the time of the works. Future changes to these may require a re-assessment of the recommendations made within this report.

1.6.6 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING

2.1 Site Information

2.1.1 The site location plan is appended to this report in Appendix 1.

Table 2.1: Site Information

Name of Site	-
Address of Site	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Approx. National Grid Ref.	360144 172903
Site Area (Approx)	0.74ha
Site Occupation	Light industrial use
Local Authority	Bristol City Council
Proposed Site Use	Demolition of existing buildings, and construction of a mixed-use building

2.2 Desk Study Overview

2.2.1 A Desk Study report has been produced for the site and issued separately. A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information.

2.2.2 A review of earliest available (1884) historical maps indicates that the site was comprised of four rows of terraced housing with private gardens. Henry Street runs down through the middle of site, and Princess Street runs along the north-west of site. By the map dated 1950, 2No ruins were identified on-site. Few changes occur to the site until the map dated 1964 when the housing to the east of Henry Street has all been demolished, except for 1No in the north of site. A depot has been constructed in this area. Some buildings have been demolished west of Henry Street, with 17No terraced residential houses with private gardens remaining. By 1972, all residential buildings on site have been demolished. Henry Street is no longer present. 1No warehouse type building has been constructed in the west of site, and 3No smaller buildings have been constructed in the south-west of site. The smaller buildings in the south-west of site appear to have been demolished by 1985. Few changes then occur to the site until the present day. Current site uses include commercial/industrial; business operate out of the units on site including “The Invisible Circus” circus training (Unit 15), “Bristol Scrap Metal” (Units 6-11), “Calor Gas” (Units 12 & 13), “Crown Scaffolding” (Unit 1) and “Sovereign Motors” (Units 4-5).

2.2.3 In the late 19th century, the land use in the vicinity of site was largely mixed industrial and residential with major railway lines and stations present. During the 1950s and 1960s, much of the surrounding land underwent heavy industrial redevelopments, with the construction of depots and factories and demolition of

residential buildings. In the 1970s, many of the surrounding railway lines became disused and business parks were built in these areas. Currently, the site is part of Premier Business Park.

2.2.4 Information provided by the British Geological Survey indicates that the site is directly underlain by solid deposits of the Redcliffe Sandstone Member.

2.2.5 No superficial or artificial deposits are reported on site.

2.2.6 Borehole records from approximately 144m north-east of the site indicated Made Ground to a depth of 3.2mbgl, overlying possible tidal flat deposits to 8.4mbgl, beneath which were deposits of sand, gravel and sandstone to the base of the borehole

2.2.7 The solid deposits underlying the site are identified as a Secondary A Aquifer.

2.2.8 A review of the Enviro+Geoinsight Report indicates that there are 2No groundwater abstractions within 2km of the site; the nearest of which is located 65m north-west. There are no potable water abstractions reported within 2km of the site and there are no source protection zones within 500m of the site.

2.2.9 There are 23No surface water abstractions within 2km of the site; the nearest of which is located 366m south-west.

2.2.10 There are no surface water features or water networks (OS MasterMap) reported within 250m of the site.

2.2.11 There are no Environment Agency Zone 2 or 3 floodplains reported within 50m of the site.

2.2.12 In order to clarify the potential risks associated with the historic coal mining in the area, it was recommended that Consultant's Coal Mining Report is obtained for the site.

2.2.13 An intrusive investigation was also recommended to confirm the preliminary geo-environmental risks identified. The investigation should assess the thickness of Made Ground and allow samples of made ground and natural soils to be taken for laboratory analysis. Soil gas monitoring should be undertaken due to the presence of a historical landfill site 144m to the east of the site (former Barton Hill Gas Holder Site). This should be undertaken in accordance with CIRIA C665.

2.2.14 The conceptual site model is reproduced in Table 2.2 overleaf.

Table 2.2: Preliminary Risk Assessment for the Site

Sources	Pathways (P)	Receptors	Consequence of Impact	Probability of Impact	Risk Estimation	Hazard Assessment
• Potential for contaminated ground associated with previous and current site use – on site (S1) - Depot (1986) - Fuel distribution and suppliers (current) - Scrap metal merchants (current) - Special purpose machinery and equipment (current) - Electronic equipment (current) • Potential for Made Ground associated with previous development operations – on site (S2) • Potential buried/above-ground tanks associated with former and current site use, and potential tanks observed during the walkover – on site (S3) • Current and previous industrial use – off site (S4) - Railways sidings (immediately N of the site) - Unspecified warehouse 7m SE (1986) - Plastic works and engineering works 60m NE (1972) - Railway land 61m N (1913) - Unspecified works 63m N (1986) - Garage 70m S (1972) - Nursery 71m SE (1921) • Historical landfill – off site (S5) - Former Barton Hill Gas Holder Site 144m E (1984-1992)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	Medium	Likely	Moderate	GI – Ground Investigation
			Severe for Asbestos	Low likelihood	Moderate for Asbestos	
	• Accumulation and migration of soil gases (P5)		Severe	Low likelihood	Moderate	
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff (P3) • Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled Waters (R6) - Secondary A aquifer - 2No groundwater abstractions within 2km	Medium	Low likelihood	Moderate	

3 GROUND INVESTIGATION

3.1 Scope of Works

3.1.1 The ground investigation was undertaken on 30 August 2022.

3.1.2 A summary of the fieldwork carried out at the site, with justifications for exploratory hole positions, is presented in Table 3.1 below.

Table 3.1: Scope of Intrusive Investigation

Investigation Type	Number of Exploratory Holes Achieved	Exploratory Hole Designation	Depth Achieved (m BGL)	Justification
Windowless Sampler Boreholes	5	WS1 –WS5	Max. depth 2.9mbgl	Obtain shallow samples for contamination testing. WS1 – located adjacent to known buried tanks on site WS2 – non-targeted to provide site coverage WS3 – non-targeted to provide site coverage WS4 – located in the east of site, closest to the Former Barton Hill Gas Holder Site WS5 – non-targeted to provide site coverage
Monitoring Wells	3	WS1, WS3 and WS4	Max. depth 2mbgl	Combined soil gas and groundwater monitoring wells. All response zones in Made Ground and Redcliffe Sandstone Member

3.1.3 The ground investigation was undertaken in accordance with British Standard BS5930:2015+A1:2020 “Code of practice for ground investigations”, British Standard BS10175:2011+A2:2017 “Investigation of potentially contaminated sites - code of practice” and AGS Guidelines for Good Practice in Site Investigations.

3.1.4 Exploratory hole positions are shown on the exploratory hole location plan presented in Figure 2, Appendix 1. The exploratory hole records are included in Appendix 2.

3.1.5 Where monitoring well installations were not installed, the exploratory holes were backfilled with the arisings (in the reverse order in which they were drilled) and the ground surface was reinstated so that no depression was left.

3.2 Laboratory Analysis

3.2.1 A programme of chemical laboratory testing, scheduled by Jomas Associates Limited, was carried out on selected samples of Made Ground and natural strata.

3.2.2 Chemical testing of soils was undertaken by i2 Analytical Limited, which holds UKAS and MCERTS accreditations for a wide range of determinands.

3.2.3 The samples were analysed for a wide range of contaminants as shown in Table 3.2 below:

Table 3.2: Chemical Tests Scheduled

	No. of tests
Test Suite	**Made Ground**
Basic Suite 3	3
Basic Suite 5	5
Hydrocarbon Suite	5
Total Organic Carbon	4
Asbestos Screen & ID	8
Polychlorinated Biphenyls	2
Leachable Basic Suite 5	3
Leachable Hydrocarbon Suite	3

3.2.4 The determinands contained in the Basic Suite 3 are as detailed in Table 3.3 overleaf. Basic Suite 5 contains the same determinands but without the hydrocarbon compounds to avoid overlapping with the extended hydrocarbon testing.

3.2.5 The Hydrocarbon Suite includes TPHCWG, PAH, phenols and VOCs including BTEX & MTBE.

Table 3.3: Basic Suite of Determinands

DETERMINAND	LIMIT OF DETECTION (mg/kg)	UKAS ACCREDITATION	TECHNIQUE
Arsenic	1	Y (MCERTS)	ICPMS
Cadmium	0.2	Y (MCERTS)	ICPMS
Chromium	1	Y (MCERTS)	ICPMS
Chromium (Hexavalent)	4	Y (MCERTS)	Colorimetry
Lead	1	Y (MCERTS)	ICPMS
Mercury	0.3	Y (MCERTS)	ICPMS
Nickel	1	Y (MCERTS)	ICPMS
Selenium	1	Y (MCERTS)	ICPMS
Copper	1	Y (MCERTS)	ICPMS
Zinc	1	Y (MCERTS)	ICPMS
Boron (Water Soluble)	0.2	Y (MCERTS)	ICPMS
pH Value	0.1 units	Y (MCERTS)	Electrometric
Sulphate (Water Soluble)	0.0125g/l	Y (MCERTS)	Ion Chromatography
Total Cyanide	1	Y (MCERTS)	Colorimetry
Speciated/Total PAH	0.05/0.80	Y (MCERTS)	GCFID
Phenols	1	Y (MCERTS)	HPLC
Total Petroleum Hydrocarbons (banded)	-	N Y (MCERTS)	Gas Chromatography

3.2.6 To support the selection of appropriate tier 1 screening values, 4No samples were analysed for total organic carbon.

3.2.7 The laboratory test results are included in Appendix 3.

4 GROUND CONDITIONS ENCOUNTERED

4.1 General

4.1.1 A factual record of the conditions encountered during the physical investigation of the site is presented in the following section.

4.2 Ground Conditions

4.2.1 The ground conditions encountered are summarised in Table 4.1 below.

Table 4.1: Ground Conditions Encountered

Stratum and Description	Encountered from (mbgl)	Base of strata (mbgl)	Thickness range (m)
Concrete over black/brown/red/grey clayey sandy gravel with localised medium cobble content. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-rounded flint, concrete and brick. Cobbles consist of angular concrete and brick. (MADE GROUND) *Encountered in WS1, WS2, WS3 & WS5.*	GL	0.5 – 1.5	0.5 – 1.5
(Concrete over) Black/brown/red silty sandy slightly gravelly clay. Sand is fine to coarse. Gravel consists of fine to coarse, angular to rounded flint, concrete and sandstone. (MADE GROUND)	GL – 1.5	1.1 – 2.7	0.4 – 1.5
Medium dense becoming very dense orange/red SAND. Sand is fine to medium. (REDCLIFFE SANDSTONE MEMBER) *Encountered in WS1, WS4 & WS5.*	1.2 – 2.7	>2.0 – >2.9 [base not proven]	>0.2 – >0.8 [thickness not proven]
Medium dense becoming very dense light brown gravelly SAND. Sand is fine to coarse. Gravel consists of fine to coarse, angular to rounded flint. (REDCLIFFE SANDSTONE MEMBER) *Encountered in WS2 & WS3.*	1.1 – 1.5	>1.7 – >1.9 [base not proven]	>0.4 – >0.6 [thickness not proven]

***Consistency estimated using semi-empirical correlations with SPT N-values, Plasticity Indices and published literature*

4.2.2 Made Ground was found to be deepest in the south of the site.

4.3 Groundwater

4.3.1 Groundwater was not reported during the course of the investigation.

4.3.2 It should be noted that changes in groundwater levels can occur for a number of reasons including seasonal effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a standpipe or piezometer installed within appropriate response zones. Changes in groundwater level can have a direct effect on excavation stability and dewatering requirements, and cohesive soils can soften under rising or high groundwater levels.

4.4 Physical and Olfactory Evidence of Contamination

4.4.1 With the exception of a black colouration of some of the Made Ground soils, no other visual or olfactory evidence of potential contamination was identified within the investigation positions.

4.5 Limitations

4.5.1 The boreholes were proposed to be drilled to 5mbgl, however, the drilling equipment refused on the very dense granular deposits of the Redcliffe Sandstone Member and, therefore, the boreholes were terminated at depths ranging from 1.7mbgl to 2.9mbgl.

4.5.2 The possible presence of unidentified natural and/or manmade obstructions elsewhere on site cannot be discounted.

5 RISK ASSESSMENT – ANALYTICAL FRAMEWORK

5.1 Context and Objectives

5.1.1 This section seeks to evaluate the level of chronic risk pertaining to human health and the environment which may result from both the existing use and proposed future use of the site. It makes use of the ground investigation findings, as described in the previous sections, to evaluate further the potential pollutant linkages identified in the desk study. A combination of qualitative and quantitative techniques is used, as described below.

5.1.2 The purpose of generic quantitative risk assessment is to compare concentrations of contaminants found on site against generic assessment criteria (GAC) to establish whether there are actual or potential unacceptable risks. It also determines whether further detailed assessment is required. The approaches detailed all broadly fit within a tiered assessment structure in line with the framework set out in the Department of Environment, Food and Rural Affairs (DEFRA), EA and Institute for Environment and Health Publication, Guidelines for Environmental Risk Assessment and Management.

5.2 Analytical Framework – Soils

5.2.1 There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.

5.2.2 The soil analytical test results have been compared to Suitable 4 Use Levels (S4UL) published by the Chartered Institute of Environmental Health in order to assess the potential long-term risks to human health posed by contaminants in the soils. S4UL'S have been derived for a range of land uses and Soil Organic Matter contents. They represent the minimal or tolerable risk, above which further assessment of the risks or remedial action may be required.

5.2.3 In the absence of a S4UL recommended concentration, other available general assessment criteria (GAC), including the Category 4 Screening Levels (C4SL) published by DEFRA have been used. Site-specific assessments are undertaken wherever possible and/or applicable. All assessments are carried out in accordance with the CLEA protocol.

5.2.4 The assessment criteria used for the screening of determinands within soils are identified within Table 5.1.

Table 5.1: Selected Assessment Criteria - Contaminants in Soils

Substance Group	Determinand(s)	Assessment Criteria Selected
Organic Substances		
Non-halogenated Hydrocarbons	Total Petroleum Hydrocarbons (TPHCWG banded)	S4UL
	Total Phenols	S4UL
Polycyclic Aromatic Hydrocarbons (PAH-16)	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene	S4UL
Volatile Organic Compounds (VOCs/sVOCs)	Toluene, Ethylbenzene, Benzene, Xylenes	S4UL
Inorganic Substances		
Heavy Metals and Metalloids	Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc	S4UL
	Copper, Zinc, Nickel	BS: 3882 (2015)
Cyanides	Free Cyanide	CLEA v1.06

5.2.5 It is understood that the site is to be converted to provide residential and commercial units, without private gardens. As a result, the site has been assessed with regards to a "residential without plant uptake" end use scenario.

5.2.6 GAC have been selected with consideration to the Soil Organic Matter (SOM) content of the soil. From the soils analytical results, the average value for Total Organic Carbon for the Made Ground is 1.13%, which gives an equivalent SOM of 1.94%. Therefore, published GAC have been selected as those derived assuming a SOM of 1%.

5.3 Analytical Framework –Leachate

5.3.1 The requirement to protect groundwater from pollution is outlined in Groundwater Protection: Principles and Practice (GP3, EA, August 2013, v1.1).

5.3.2 Where undertaken, the leachate quality analysis comprises a Level 1 assessment in accordance with the EA Remedial Targets Methodology Document (EA, 2006).

The criteria used by Jomas' in the Level 1 assessment of leachate quality are shown in Table 5.2

5.3.3 **Table**.

Table 5.2: Selected Assessment Criteria - Contaminants in Water

Substance Group	Determinand(s)	Assessment Criteria Selected
Metals	Arsenic, Boron, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Nickel,	EQS/DWS
	Zinc	EQS
	Selenium	DWS
PAHs	Sum of Four – benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	DWS
PAH	Anthracene, Naphthalene	EQS
PAHs	Benzo(a)pyrene	EQS/ DWS
PAHs	Remainder	LEC
Total Petroleum Hydrocarbons	Aliphatic C5-C6, Aliphatic >C6-C8, Aliphatic >C8-C10. Aliphatic >C10-C12, Aliphatic >C12-C16, Aliphatic >C16-C21, Aromatic C5-C7, Aromatic >C7-C8, Aromatic >C8-C10, Aromatic >C10-C12, Aromatic >C12-C16, Aromatic >C16-C21, Aromatic> C21-C35	/WHO
Benzene	Benzene	EQS/ DWS
Toluene	Toluene	EQS/ WHO
Ethylbenzene	Ethylbenzene	WHO
Xylene	Xylene	EQS/WHO

Environmental Quality Standards EQS

Environmental Quality Standards (EQS) have been released by the EA for dangerous substances, as identified by the EC Dangerous Substances Directive. EQS can vary for each substance, for the hardness of the water and can be different for fresh, estuarine or coastal waters.

WHO Health

These screening criteria have been taken from the World Health Organisation Guidelines for Drinking Water Quality (2017). The health value is a guideline value representing the concentration of a contaminant that does not result in any significant risk to the receptor over a lifetime of exposure.

Further criteria have been obtained from 'Petroleum Products in Drinking-water' - Background document for development of WHO Guidelines for Drinking-water Quality (2005).

UK Drinking Water Standards (DWS)

These comprise screening criteria provided by the Drinking Water Inspectorate (DWI) in the Water Supply (Water Quality) Regulations 2018.

6 GENERIC QUANTITATIVE RISK ASSESSMENT

6.1 Screening of Soil Chemical Analysis Results – Human Health Risk Assessment

6.1.1 Laboratory analysis for soils is summarised in Tables 6.1 to 6.4. Raw laboratory data is included in Appendix 3.

6.1.2 Results have been screened against generic assessment criteria for a "residential without plant uptake" end-use scenario, assuming 1% soil organic matter.

Table 6.1: Soil Laboratory Test Results - Metals, Metalloids, Phenol, Cyanide

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No. Exceeding
Arsenic	mg/kg	8	S4UL	40	4.8	59	2No exceedances: WS1 – 0.75mbgl WS3 – 0.5mbgl
Cadmium	mg/kg	8	S4UL	85	<0.2	2.1	0
Chromium	mg/kg	8	S4UL	910	4.8	44	0
Lead	mg/kg	8	C4SL	310	15	400	2No exceedances: WS3 – 0.5mbgl WS5 – 1.0mbgl
Mercury	mg/kg	8	S4UL	56	<0.3	0.3	0
Nickel	mg/kg	8	S4UL	180	2.4	41	0
Copper	mg/kg	8	S4UL	7100	2.9	240	0
Zinc	mg/kg	8	S4UL	40000	39	590	0
Total Cyanide [A]	mg/kg	8	CLEA v 1.06	33	<1.0	<1.0	0
Selenium	mg/kg	8	S4UL	430	<1.0	<1.0	0
Boron Water Soluble	mg/kg	8	S4UL	11000	0.2	2.2	0
Phenols	mg/kg	8	S4UL	440	<1.0	<1.0	0

Notes: [A] Generic assessment criteria derived for free inorganic cyanide.

Table 6.2: Soil Laboratory Test Results - Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
Naphthalene	mg/kg	8	S4UL	2.3	<0.05	0.73	0
Acenaphthylene	mg/kg	8	S4UL	2900	<0.05	<0.05	0
Acenaphthene	mg/kg	8	S4UL	3000	<0.05	0.28	0
Fluorene	mg/kg	8	S4UL	2800	<0.05	<0.05	0
Phenanthrene	mg/kg	8	S4UL	1300	<0.05	2	0

Determinand	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
Anthracene	mg/kg	8	S4UL	31000	<0.05	0.33	0
Fluoranthene	mg/kg	8	S4UL	1500	<0.05	3.2	0
Pyrene	mg/kg	8	S4UL	3700	<0.05	2.9	0
Benzo(a)anthracene	mg/kg	8	S4UL	11	<0.05	2.1	0
Chrysene	mg/kg	8	S4UL	30	<0.05	1.7	0
Benzo(b)fluoranthene	mg/kg	8	S4UL	3.9	<0.05	2.5	0
Benzo(k)fluoranthene	mg/kg	8	S4UL	110	<0.05	0.97	0
Benzo(a)pyrene	mg/kg	8	S4UL	3.2	<0.05	1.8	0
Indeno(123-cd)pyrene	mg/kg	8	S4UL	45	<0.05	1.2	0
Dibenzo(ah)anthracene	mg/kg	8	S4UL	0.31	<0.05	0.31	0
Benzo(ghi)perylene	mg/kg	8	S4UL	360	<0.05	1.5	0
Total PAH	mg/kg	8	-	-	<0.80	21.5	-

Table 6.3: Soil Laboratory Test Results - Total Petroleum Hydrocarbons (TPH)

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
C_8-C_{10}	mg/kg	3	S4UL	27	<0.1	<0.1	0
>C_{10}-C_{12}	mg/kg	3	S4UL	130	<2.0	<2.0	0
>C_{12}-C_{16}	mg/kg	3	S4UL	1100	<4.0	<4.0	0
>C_{16}-C_{21}	mg/kg	3	S4UL	1900	<1.0	9.9	0
>C_{21}-C_{35}	mg/kg	3	S4UL	1900	<10	65	0
Total TPH	mg/kg	3	-	-	<17.1	74.9	-

Note: *The lower value of guidelines for Aromatic/Aliphatics has been selected

Table 6.4: Soil Laboratory Analysis Results - Total Petroleum Hydrocarbons (TPHCWG)

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C_5-C_6 Aliphatic	mg/kg	5	S4UL	42	<0.001	<0.001	0
>C_6-C_8 Aliphatic	mg/kg	5	S4UL	100	<0.001	<0.001	0
>C_8-C_{10} Aliphatic	mg/kg	5	S4UL	27	<0.001	<0.001	0
>C_{10}-C_{12} Aliphatic	mg/kg	5	S4UL	130	<1.0	<1.0	0
>C_{12}-C_{16} Aliphatic	mg/kg	5	S4UL	1100	<2.0	<2.0	0
>C_{16}-C_{35} Aliphatic	mg/kg	5	S4UL	65000	<16.0	<16.0	0
>C_5-C_7 Aromatic	mg/kg	5	S4UL	370	<0.001	<0.001	0

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C_7-C_8 Aromatic	mg/kg	5	S4UL	860	<0.001	<0.001	0
>C_8-C_{10} Aromatic	mg/kg	5	S4UL	47	<0.001	<0.001	0
>C_{10}-C_{12} Aromatic	mg/kg	5	S4UL	250	<1.0	1.4	0
>C_{12}-C_{16} Aromatic	mg/kg	5	S4UL	1800	<2.0	2.1	0
>C_{16}-C_{21} Aromatic	mg/kg	5	S4UL	1900	<10	<10	0
>C_{21}-C_{35} Aromatic	mg/kg	5	S4UL	1900	<10	13	0
Total TPH (Ali/Aro)	mg/kg	5	-	-	<10	23	-

6.2 Asbestos in Soil

6.2.1 8No samples of the Made Ground were screened in the laboratory for the presence of asbestos.

6.2.2 No asbestos containing materials (ACM) or fibres were reported in samples analysed in the laboratory.

6.3 Volatile Organic Compounds

6.3.1 In addition to the suites outlined previously, 5No samples were tested for the presence of volatile organic compounds (VOCs) including BTEX compounds (benzene, toluene, ethylbenzene, xylene).

6.3.2 No VOCs were reported above the laboratory detection limit within any of the samples tested.

6.4 Polychlorinated Biphenyl (PCB) Concentrations

6.4.1 In addition to the suites outlined previously, 2No samples from the vicinity of the off-site electrical substation were analysed for the presence of PCBs.

6.4.2 No PCBs were reported above the laboratory method detection limit.

6.5 Summary of Human Health Generic Quantitative Risk Assessment

6.5.1 In summary, concentrations of arsenic and lead in excess of the GAC have been recorded in samples of Made Ground.

6.6 Screening of Soil Chemical Analysis Results – Potential Risks to Plant Growth

6.6.1 Zinc, copper and nickel are phytotoxins and could therefore inhibit plant growth in soft landscaped areas. Concentrations measured in soil for these determinands have been compared with the pH dependent values given in BS:3882 (2015). This does not constitute a full BS:3882 topsoil test.

6.6.2 Table 6.5 shows the soil analytical results compared with the relevant screening values, adopting a pH value of greater than 7, as indicated by the results of the laboratory analysis.

Table 6.5: Soil Laboratory Analysis Results - Phytotoxic Determinands

Determinand	Threshold level (mg/kg)	Min (mg/kg)	Max (mg/kg)	No. Exceeding
Nickel	110	2.4	41	0
Copper	200	2.9	240	1No exceedance: WS3 – 0.5mbgl
Zinc	300	39	590	2No exceedances: WS3 – 0.5mbgl WS5 – 1.0mbgl

6.6.3 A number of samples have recorded determinands in excess of threshold levels. The current soils may not satisfy the requirements of BS:3882.

6.7 Screening for Water Pipes Materials

6.7.1 The results of the analysis have been assessed for potential impact upon water supply pipes. Table 6.6 below summarises the findings of the assessment:

Table 6.6: Screening Guide for Water Pipes

Determinand	No. of tests	Threshold for Polyethylene Pipes* (mg/kg)	Value for site data (mg/kg)		No of Exceedances
			Min	Max	
Total VOCs	5	0.5	<0.056	<0.056	0
BTEX	5	0.1	<0.005	<0.005	0
MTBE	5	0.1	<0.001	<0.001	0
EC5-EC10	8	1	<0.006	<0.1	0
EC10-EC16	8	10	<6.0	≥3.5 <6.5	0
EC16-EC40	8	500	<11.0	74.9	0
Naphthalene	8	5	<0.05	0.73	0
Phenols	8	2	<1.0	<1.0	0

** UK Water Industry Research (2010) Source Guidance for Selection of Water Supply Pipes to be Used in Brownfield Sites. Report No. 10/WM/03/21.*

6.7.2 The above suggests that upgraded pipe work is unlikely to be required.

6.7.3 The water supply pipe requirements for this site should be discussed at an early stage with the relevant utility provider.

6.8 Assessment of Soil Analytical Data with Respect to Controlled Waters

6.8.1 At the Preliminary Risk Assessment (Desk Study) stage, risks to controlled waters were moderate.

6.8.2 The following controlled waters receptors were identified:

- Secondary A Aquifer within the Redcliffe Sandstone Member
- 2No groundwater abstractions, the nearest 65m north-west of the site

6.8.3 Pathways for migration of leachable/mobile contamination were considered to be potentially present within the underlying Redcliffe Sandstone Member.

6.8.4 The ground conditions encountered are considered to confirm the expected geological succession and confirmed that potential pathways for migration of leachable / mobile contamination are present. Further assessment of these risks is provided in Section 7, with the evaluation of leachate analytical data.

6.8.5 Elevated levels of polyaromatic hydrocarbons (PAHs) have been found in the Made Ground. The only PAHs with stated “moderate” or “high” mobility rankings in groundwater (as per CL:AIRE, 2017) are naphthalene, acenaphthylene, and acenaphthene. Of these compounds, only naphthalene has a statutory water quality standard. Naphthalene was detected at a maximum concentration of 0.73mg/kg within a single sample out of the 8No analysed. Considering that no visual or olfactory evidence of potentially mobile contamination has been encountered, the low concentrations of PAHs detected in soils are not considered to pose a risk to controlled waters.

6.8.6 The presence of localised impacted soils beneath building footprints or in the vicinity of below ground fuel tanks that may be reported on site (information request to the petroleum licensing authority is pending) cannot be ruled out. Such soils may pose a risk to controlled water if present, and further investigation is recommended once access beneath current building footprints is possible.

6.9 Waste Characterisation

6.9.1 The classification of materials for waste disposal purposes was outside the scope of this report. Should quantities of material require off-site disposal, waste classification will be required to determine whether soils may be treated as hazardous or non-hazardous.

6.9.2 Note that Waste Acceptance Criteria (WAC) analysis may then be required by the landfill operator to determine whether materials can be disposed of at either an inert, stable non-reactive hazardous or hazardous landfill.

7 GENERIC QUANTITATIVE RISK ASSESSMENT – LEACHATE DATA

7.1 Assessment of Leachate Analytical Data with Respect to Controlled Waters

7.1.1 No groundwater was reported within the monitoring wells during the 4No return monitoring visits, so groundwater samples could not be collected from site. 3No soil samples were scheduled for leachate analysis in their place.

7.1.2 The results of the laboratory testing are summarised in Tables 7.1 to 7.3 below and compared to GAC for controlled waters receptors. Analytical laboratory certificates are presented in Appendix 3.

Table 7.1: Leachate Laboratory Analysis Results – Metals, Metalloids, Phenol, Cyanide

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No of Exceedances
Arsenic	µg/l	3	10	DWS	<1.0	6.7	0
	µg/l		50	EQS	<1.0	6.7	0
Cadmium	µg/l	3	5	DWS	<0.08	<0.08	0
	µg/l		<0.08-0.25	EQS	<0.08	<0.08	0
Chromium	µg/l	3	50	DWS	<0.4	5.6	0
	µg/l		4.7	EQS	<0.4	5.6	1No exceedance: WS5 – 1.0mbgl
Lead	µg/l	3	10	DWS	<1.0	62	1No exceedance: WS5 – 1.0mbgl
	µg/l		1.2*	EQS	<1.0	62	1No exceedance: WS5 – 1.0mbgl
Nickel	µg/l	3	20	DWS	<0.3	2.4	0
	µg/l		4*	EQS	<0.3	2.4	0
Copper	µg/l	3	1.0	EQS	2.2	14	1No exceedance: WS5 – 1.0mbgl
			2000	DWS	2.2	14	0
Zinc	µg/l	3	10.9*	EQS	2	41	2No exceedances: WS3 – 0.5mbgl WS5 – 1.0mbgl
Mercury	µg/l	3	1.0	DWS	<0.5	<0.5	0
	µg/l	3	0.07	EQS	<0.5	<0.5	0
Selenium	µg/l	3	10	DWS	<4.0	<4.0	0
Boron	µg/l	3	1000	DWS	10	85	0
	µg/l		2000	EQS	10	85	0
Cyanide (Total)	µg/l	3	50	DWS	<10	<10	0
	µg/l		1	EQS	<10	<10	0

Determinand	Unit	No. samples tested	Screening Criteria		Min	Max	No of Exceedances
Phenols (Total)	µg/l	3	7.7	EQS	<10	<10	0

** bioavailable concentration*
***bioavailable concentration + ambient background concentration dissolved for Thames Groundwater (2 µg/L)*

Table 7.2: Leachate Laboratory Analysis Results – Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
Naphthalene	µg/l	3	2.0	EQS	<0.001	<0.001	0
Acenaphthylene	µg/l	3	-	-	<0.001	<0.001	-
Acenaphthene	µg/l	3	-	-	<0.001	<0.001	-
Fluorene	µg/l	3	-	-	<0.001	<0.001	-
Phenanthrene	µg/l	3	-	-	<0.001	<0.001	-
Anthracene	µg/l	3	0.1	EQS	<0.001	<0.001	0
Fluoranthene	µg/l	3	0.0063	EQS	<0.001	<0.001	0
Pyrene	µg/l	3	-	-	<0.001	<0.001	-
Benzo(a)anthracene	µg/l	3	-	-	<0.001	<0.001	-
Chrysene	µg/l	3	-	-	<0.001	<0.001	-
Benzo(b)fluoranthene	µg/l	3	0.017	EQS	<0.001	<0.001	0
Benzo(k)fluoranthene	µg/l	3	0.017	EQS	<0.001	<0.001	0
Benzo(a)pyrene	µg/l	3	0.01	DWS	<0.001	<0.001	0
	µg/l	3	0.00017	EQS	<0.001	<0.001	0
Indeno(a,h)anthracene	µg/l	3	-	-	<0.001	<0.001	-
Dibenzo(ah)anthracene	µg/l	3	-	-	<0.001	<0.001	-
Benzo(g,h,i)perylene	µg/l	3	0.0082	EQS	<0.001	<0.001	0
Sum of four Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(ghi)perylene Indeno(123-cd)pyrene	µg/l	3	0.1	DWS	<0.004	<0.004	0

Table 7.3: Leachate Laboratory Analysis Results – TPHCWG & BTEX

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
Benzene	µg/l	3	1.0	DWS	<1.0	<1.0	0
	µg/l	3	10	EQS	<1.0	<1.0	0
Toluene	µg/l	3	74	EQS	<1.0	<1.0	0
Ethylbenzene	µg/l	3	300	WHO	<1.0	<1.0	0
Xylenes (total)	µg/l	3	500	WHO	<2.0	<2.0	0

Determinand	Unit	No. Samples tested	Screening Criteria		Min.	Max.	No. of Exceedances
	µg/l	3	30	EQS	<2.0	<2.0	0
MTBE	µg/l	3	15	WHO	<10	<10	0
>C5-C6 Aliphatic	µg/l	3	15000	WHO	<1.0	<1.0	0
>C6-C8 Aliphatic	µg/l	3	15000	WHO	<1.0	<1.0	0
>C8-C10 Aliphatic	µg/l	3	300	WHO	<1.0	<1.0	0
>C10-C12 Aliphatic	µg/l	3	300	WHO	<10	<10	0
>C12-C16 Aliphatic	µg/l	3	300	WHO	<10	<10	0
>C16-C21 Aliphatic	µg/l	3	-	-	<10	<10	-
>C21-C35 Aliphatic	µg/l	3	-	-	<10	<10	-
>C5-C7 Aromatic	µg/l	3	10	WHO	<1.0	<1.0	0
>C7-C8 Aromatic	µg/l	3	700	WHO	<1.0	<1.0	0
>C8-C10 Aromatic	µg/l	3	300	WHO	<1.0	<1.0	0
>C10-C12 Aromatic	µg/l	3	90	WHO	<10	<10	0
>C12-C16 Aromatic	µg/l	3	90	WHO	<10	<10	0
>C16-C21 Aromatic	µg/l	3	90	WHO	<10	<10	0
>C21-C35 Aromatic	µg/l	3	90	WHO	<10	<10	0

7.1.3 In addition to the suite outlined above, the 3No leachate samples were also analysed for a suite of volatile organic compounds (VOCs). None of the compounds analysed for were reported above the laboratory method detection limit.

7.1.4 A concentration of leachable lead was found to exceed environmental water quality standards and drinking water standards, and concentrations of chromium, lead, copper and zinc were found to exceed drinking water standards.

7.1.5 On the basis that the proposed development will comprise extensive hard cover and only limited soft landscaping, the potential for surface water infiltration and migration of contaminants is considered to be significantly reduced. In addition, no point source of lead has been identified and therefore specific remedial measures to address leachable lead concentrations are unlikely to be effective or economically viable.

8 SOIL GAS RISK ASSESSMENT

8.1 Soil Gas Results

8.1.1 4No return monitoring visits have been undertaken between 12 and 30 September 2022, to monitor wells installed within boreholes at the site for soil gas concentrations and groundwater levels.

8.1.2 The results of the monitoring undertaken are summarised in Table 8.1 below, with the monitoring records presented in Appendix 4.

Table 8.1: Summary of Gas Monitoring Data

Hole No.	No. of monitoring events	CH_4 (%)	CO_2 (%)	O_2 (%)	VOCs (ppm)	Steady Flow Rate (l/hr)	Peak Flow Rate (l/hr)	Depth to water (mbgl)	Well Response Zone as installed (top/bottom) (mbgl)	Strata targeted by response zone
WS1	4	0.0 – 0.2	0.1 – 2.0	20.3 – 21.0	0.0 – 1.0	0.0 – +0.2	0.0 – +0.2	Dry	1.0 – 2.0	Made Ground and Redcliffe Sandstone Member
WS3	4	0.0 – 0.2	0.4 – 2.1	17.7 – 23.2	0.0 – 1.1	0.0 – +0.1	0.0 – +0.1	Dry	1.0 – 1.9	
WS4	4	0.0 – 0.2	0.9 – 4.6	14.2 – 22.7	0.0 – 1.3	0.0	0.0	Dry	1.0 – 2.0	

8.2 Screening of Results

8.2.1 As shown in Table 8.1, methane was detected at a maximum concentration of 0.2%. The concentrations of carbon dioxide ranged from 0.1% to 4.6% v/v. The maximum concentration of Volatile Organic Compounds measured was 1.3ppm. The maximum gas flow rate recorded was 0.2l/hr.

8.2.2 In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, BS8485 (2015) + A1 (2019) identifies four types of development, termed Type A to Type D.

8.2.3 Type B buildings are defined as

> *"private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels."*

8.2.4 Type B has been adopted as the relevant category for the proposed development.

8.2.5 The soil gas assessment method is based on that proposed by Wilson & Card (1999), which was a development of a method proposed in CIRIA publication R149 (CIRIA, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation based on the limiting borehole gas volume flow for methane and carbon dioxide. In both these methods, the limiting borehole gas volume flow is renamed as the Gas Screening Value (GSV).

8.2.6 The Gas Screening Value (litres of gas per hour) is calculated by using the following equation

GSV = (Concentration/100) X Flow rate

Where concentration is measured in percent (%)
and flow rate is measured in litres per hour (l/hr)

8.2.7 In accordance with CIRIA C665, worst case conditions are used in the calculation of GSVs for the site. These have been summarised below in Table 8.2.

8.2.8 The Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

Table 8.2: Summary of Gas Monitoring Data and Gas Screening Value

Gas	Concentration (v/v %)	Peak Flow Rate (l/hr)	GSV (l/hr)	Characteristic Situation (after CIRIA C665)
CO_2	4.6	0.2	0.0092	**1**
CH_4	0.2	0.2	0.0004	**1**

8.2.9 Based on the calculated GSVs, and in consideration of the conceptual site model, the site is classified as Characteristic Situation 1 (CS1) and no formal gas protection measures are considered to be necessary.

8.2.10 BS 8576:2013 has been used to derived threshold levels for carbon monoxide and volatile organic compounds.

8.2.11 Given the recorded levels it is not considered that additional protection measures need to be incorporated to protect end users from the recorded carbon monoxide concentrations.

8.2.12 PID screening of the monitoring well headspace has revealed maximum concentrations of VOCs of 1.3ppm. No visual or olfactory evidence of potentially mobile contamination was observed during the investigation. It is considered that based on the information obtained to date, the risks to human health receptors via vapour inhalation pathways are generally low.

8.2.13 Notwithstanding the above, it is understood that tanks are present on site which could be a potential source of VOCs. A request has been made to the petroleum licensing authority for more information. It is recommended that any tanks identified on site are removed along with surrounding impacted soils under the

supervision by a suitably qualified geo-environmental engineer, with chemical analysis conducted on the soils surrounding the tanks as is considered suitable.

9 SUMMARY OF RESULTS

9.1 Land Quality Impact Summary

- It is understood that the proposed development comprises demolition of the existing buildings on site and construction of a new building comprising commercial/retail units at ground level and residential units above. No private gardens or extensive areas of soft landscaping are anticipated.

- Following generic risk assessments, elevated concentrations of arsenic and lead were detected in soils in excess of generic assessment criteria for the protection of human health within a "residential without plant uptake" end-use scenario.

- No asbestos containing materials or fibres were detected in the Made Ground samples analysed in the laboratory.

- Where the site is to be covered by the building footprint and hard surfacing, no formal remedial measures are considered necessary in terms of human health, as the building and hard surfacing are expected to provide a barrier to potential receptors. In areas of soft landscaping, Made Ground should be encapsulated with a minimum 450mm of imported clean topsoil, placed on a geotextile membrane. Further investigation is recommended to increase the sample density across the site and beneath building footprints. Recommended remedial measures may be revised based on the findings of such works.

- The current soils may not satisfy the requirements of BS:3882 due to elevated concentrations of phytotoxic contaminants.

- The risk to controlled waters from soils is considered low on the basis that the extensive hard cover of the site will severely restrict the potential mobilisation of contaminants within the Made Ground.

- Based on the calculated GSVs, and in consideration of the conceptual site model, the site is classified as Characteristic Situation 1 (CS1) and no formal gas protection measures are considered to be necessary.

- Upgraded potable water supply pipe materials are unlikely to be required. The water supply pipe requirements for this site should be discussed at an early stage with the relevant utility provider.

- A remedial strategy will be required for the proposed development. This should include reference to information from the currently pending petroleum licensing information request. Further investigation is recommended within the vicinity of tanks that may be reported by the petroleum licensing authority (if any – response pending) and within the footprints of the existing building.

- If tanks are identified on site these will require removal along with associated hydrocarbon impacted soils under the supervision of a suitably qualified environmental consultant with appropriate verification works undertaken.

- As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out. Should any contamination be encountered, a suitably qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.

9.1.1 The above conclusions are made subject to approval by the statutory regulatory bodies.

9.2 Review of Pollutant Linkages Following Site Investigation

9.2.1 The site CSM has been revised and updated from that suggested in the desk study in view of the ground investigation data, including soil laboratory analysis results. Table 9.1 highlights whether pollutant linkages identified in the original CSM are still relevant following the risk assessment, or whether pollutant linkages, not previously identified, exist.

Table 9.1: Plausible Pollutants Linkages Summary (Pre Remediation)

Potential Source (from desk study)	Pathway	Receptor	Relevant Pollutant Linkage?	Comment
• Potential for contaminated ground associated with previous and current site use – on site (S1) - Depot (1986) - Fuel distribution and suppliers (current) - Scrap metal merchants (current) - Special purpose machinery and equipment (current) - Electronic equipment (current) • Potential for Made Ground associated with previous development operations – on site (S2) • Potential buried/above-ground tanks associated with former and current site use, and potential tanks observed during the walkover – on site (S3) • Current and previous industrial use – off site (S4) - Railways sidings (immediately N of the site) - Unspecified warehouse 7m SE (1986) - Plastic works and engineering works 60m NE (1972) - Railway land 61m N (1913) - Unspecified works 63m N (1986) - Garage 70m S (1972) - Nursery 71m SE (1921) • Historical landfill – off site (S5) - Former Barton Hill Gas Holder Site 144m E (1984-1992)	• Ingestion and dermal contact with contaminated soil (P1) • Inhalation or contact with potentially contaminated dust and vapours (P2) • Permeation of water pipes and attack on concrete foundations by aggressive soil conditions (P6)	• Construction workers (R1) • Maintenance workers (R2) • Neighbouring site users (R3) • Future site users (R4) • Building foundations and on site buried services (water mains, electricity and sewer) (R5)	**Y**	See Section 8.1 above for remedial measures. The findings of this report should be included in the construction health and safety file, with adequate measures put in place for the protection of construction and maintenance workers. Contact should be made with relevant utility providers to confirm if upgraded materials are required.
	• Accumulation and migration of soil gases (P5)		**N**	Site has been characterised as CS1 and no gas protection measures are deemed necessary.
	• Leaching through permeable soils, migration within the vadose zone (i.e., unsaturated soil above the water table) and/or lateral migration within surface water, as a result of cracked hardstanding or via service pipe/corridors and surface water runoff (P3) Horizontal and vertical migration of contaminants within groundwater (P4)	• Neighbouring site users (R3) • Building foundations and on site buried services (water mains, electricity and sewer) (R5) • Controlled Waters (R6) - Secondary A aquifer - 2No groundwater abstractions within 2km	**?**	A significant risk of impact to controlled waters has not currently been identified; however, further investigation required in building footprints and in vicinity of fuel tanks that may be reported by the licensing authority.

10 REFERENCES

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BRE Special Digest 1: Concrete in Aggressive Ground, 2005

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Environment Agency (2004) *Model procedures for the management of land contamination*. CLR11. Bristol: Environment Agency

Environment Agency, NHBC & CIEH (2008) *Guidance for the safe development of housing on land affected by contamination*. R & D Publication 66. London: Environment Agency

Environment Agency (2006) *Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination* Environment Agency

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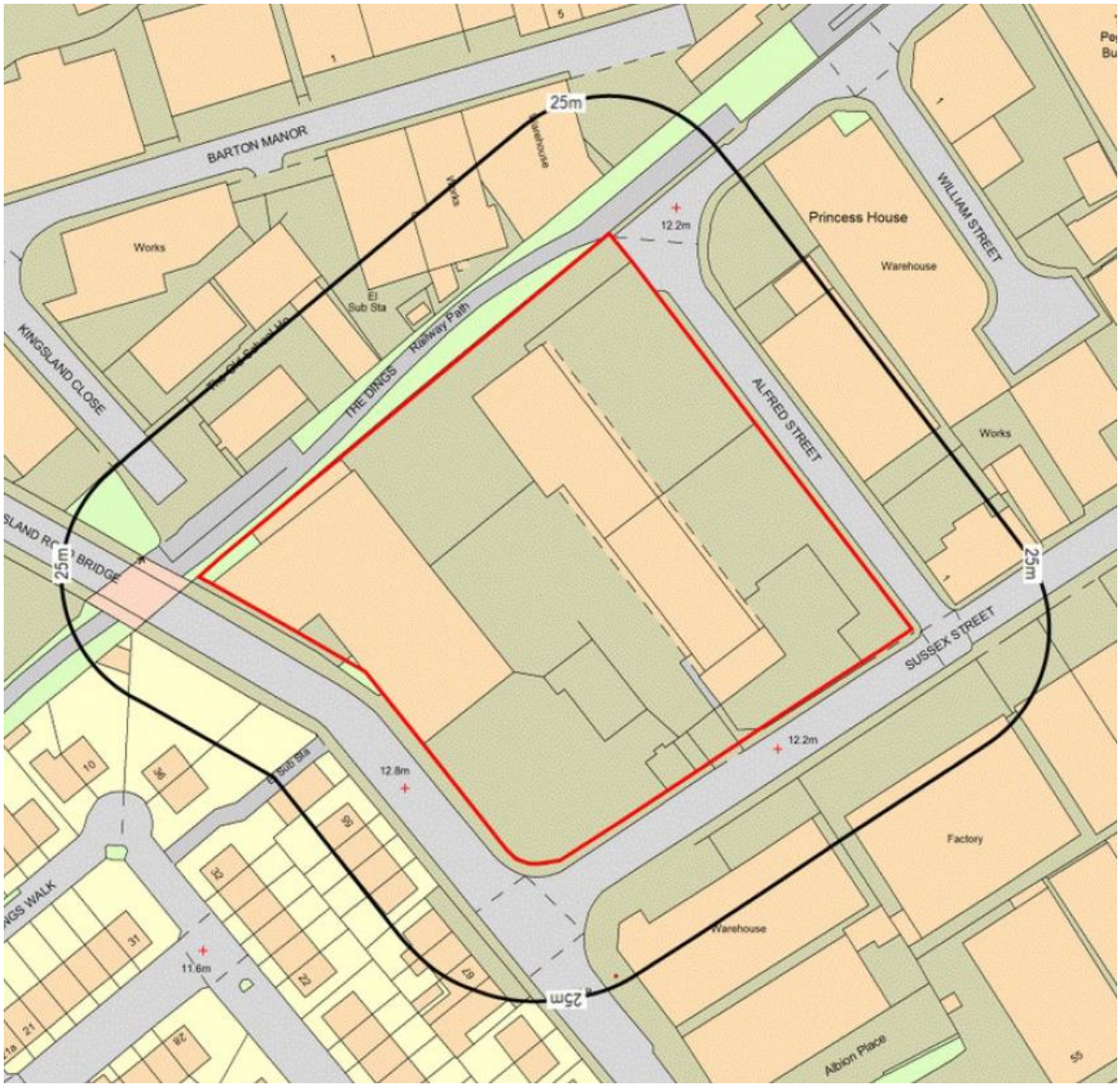
Ministry of Housing, Communities & Local Government: *National Planning Policy Framework*. February 2019.

APPENDICES

APPENDIX 1 – FIGURES

PROJECT NAME	Units 1-15 Premier Estates, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Location Plan	**PROJECT NO.**	P4639J2633
DATE	August 2022	**FIGURE**	1



PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Completed Exploratory Hole Plan	**PROJECT NO.**	P4639J2633
DATE	August 2022	**FIGURE NO.**	2

N

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 1: Access to Units 2-5. Photo taken viewing north-west.

Photo 2: External yard for Units 2-5, which contains storage containers utilised as offices. Photo taken viewing north.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 3: External yard for Units 2-5, which contains storage containers utilised as offices. Photo taken viewing south-west.

Photo 4: External yard for Units 2-5, with Units in the rear of the photo. Photo taken viewing west.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

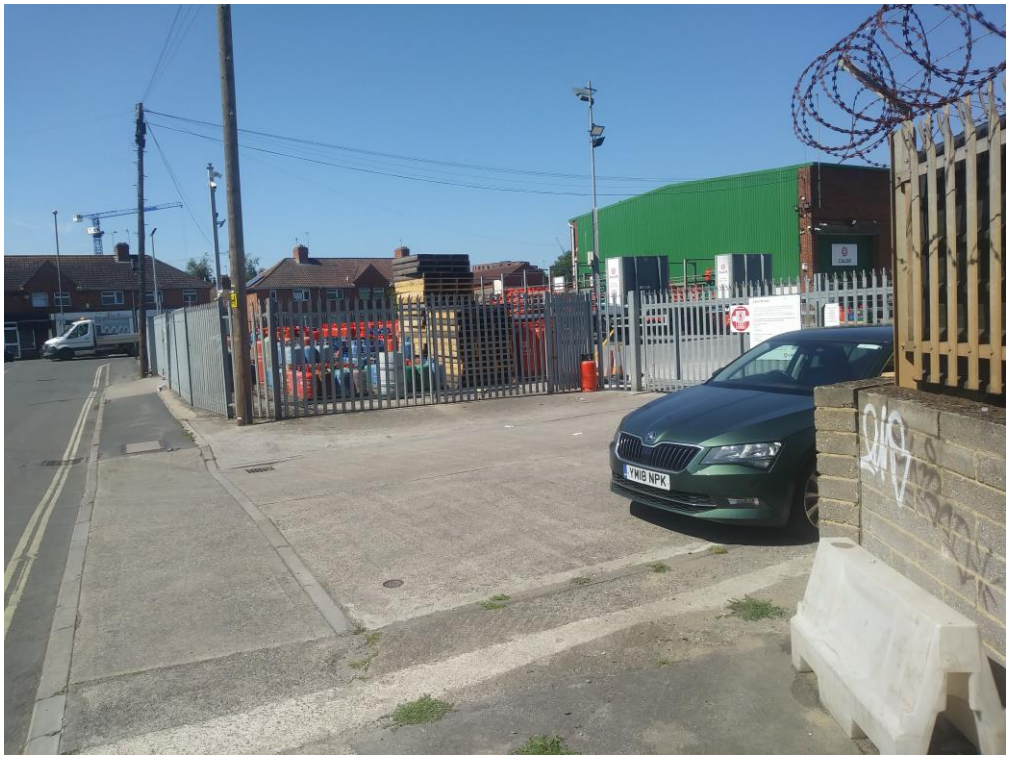
Photo 5: Access gate to Unit 1 (Crown Scaffolding). Photo taken viewing west.

Photo 6: External yard and buildings for Crown Scaffolding. Photo taken viewing west.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 7: External yard for Crown Scaffolding. Photo taken viewing north-west.

Photo 8: Access to Units 12 & 13 (Calor Gas). Photo taken viewing west.



PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 9: External yard for Calor Gas. Photo taken viewing south.

Photo 10: External yard and building for Calor Gas. Photo taken viewing south-west.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 11: External yard for Calor Gas, containing many gas cansiters. Photo taken viewing south-west.

Photo 12: External yard for Calor Gas, containing many gas cansiters. Photo taken viewing north.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 13: 2No plastic pipes coming out of the concrete in the north of the Calor Gas yard, which could be vent pipes.

Photo 14: Access to Units 14 & 15 (telecommunications company and The Invisible Circus. Photo taken viewing south-west.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 15: 3No manhole covers identified in the north of the site.

Photo 16: External yard for Units 14 & 15. Photo taken viewing north.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 17: External yard and building for Units 14 & 15. Photo taken viewing north-west.

Photo 18: Roller door to Unit 14. Photo taken viewing south-west.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 19: Access to Units 6-11 (Bristol Scrap Metal). Photo taken viewing west.

Photo 20: External yard and buildings for Bristol Scrap Metal. Photo taken viewing south.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 21: Inside 1No unit occupied by Bristol Scrap Metal. Photo taken viewing west.

Photo 22: External yard for Bristol Scrap Metal. Photo taken viewing north-east.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 23: 2No manhole covers located within the Bristol Scrap Metal yard.

Photo 24: External yard for Bristol Scrap Metal. Photo taken viewing north.

PROJECT NAME	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**CLIENT**	Dominvs Project Company 23 Limited
TITLE	Site Photo Plan	**FIGURE**	3

Photo 25: Western boundary of the site viewed from off-site. Land to the north noted to slope upwards to the north. Photo taken viewing north.

Photo 26: View of the northern boundary of site from off-site, showing the retaining wall located along this boundary. Photo taken viewing east.

APPENDIX 2 – EXPLORATORY HOLE RECORDS

WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS1		
Site Address:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Project No:	P4639J2633
Client:	Dominvs Project Company 23 Limited	Ground Level:	12.065
Logged By:	JRO	Date Commenced:	30/08/2022
Checked By:	JLW	Date Completed:	30/08/2022
Type and diameter of equipment:	Windowless Sampler Rig	Sheet No:	1 Of 1

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No groundwater strike recorded.
2: Borehole terminated at 2mbgl due to equipment refusal.
3:
4:

Sample or Tests										Strata				
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N						
									0.00					
											0.20		Concrete. (MADE GROUND)	
ES	0.25												Brown grey sandy gravel. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-angular flint and concrete. (MADE GROUND)	
											0.50			
									0.50				Brown silty slightly gravelly clay. Gravel consists of fine to coarse, angular to rounded flint, concrete and sandstone. (MADE GROUND)	
ES	0.75													
SPT	1.00	2	3	3	2	3	3	11	1.00					
											1.20			
													Medium dense becoming very dense orange red SAND. Sand is fine to medium. (REDCLIFFE SANDSTONE MEMBER)	
ES	1.50								1.50					
SPT	2.00	9	13	16	34			50	2.00		2.00			
	50 blows for 130mm total penetration.													
									2.50					
									3.00					
									3.50					
									4.00					
									4.50					
									5.00					

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

		Exploratory Hole No:	WS2
Site Address:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Project No:	P4639J2633
Client:	Dominvs Project Company 23 Limited	Ground Level:	12.241
Logged By:	JRO	Date Commenced:	30/08/2022
Checked By:	JLW	Date Completed:	30/08/2022
Type and diameter of equipment:	Windowless Sampler Rig	Sheet No:	1 Of 1

Water levels recorded during boring, m						
Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No groundwater strike recorded.
2: Borehole terminated at 1.7mbgl due to equipment refusal.
3:
4:

Sample or Tests									Strata				
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N					
										0.20		Concrete. (MADE GROUND)	
ES	0.25									0.50		Brown grey slightly clayey sandy gravel. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-angular flint and concrete. (MADE GROUND)	
										1.10		Brown black silty slightly gravelly clay. Gravel consists of coarse, angular flint and sandstone. (MADE GROUND)	
ES	1.00												
SPT		2	4	3	4	4	3	14					
ES	1.50									1.70		Medium dense becoming very dense light brown gravelly SAND. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-rounded flint. (REDCLIFFE SANDSTONE MEMBER)	
SPT	1.70	12	17	31	19			50					
	50 blows for 90mm total penetration.												

0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS3		
Site Address:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Project No:	P4639J2633
Client:	Dominvs Project Company 23 Limited	Ground Level:	12.610
Logged By:	JRO	Date Commenced:	30/08/2022
Checked By:	JLW	Date Completed:	30/08/2022
Type and diameter of equipment:	Windowless Sampler Rig	Sheet No:	1 Of 1

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No groundwater strike recorded.

2: Borehole terminated at 1.9mbgl due to equipment refusal.

3:

4:

Sample or Tests									Strata				
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N					
										0.10		Concrete. (MADE GROUND)	
ES	0.25									0.30		Light brown mottled dark brown clayey sandy gravel. Sand is fine to coarse. Gravel consists of fine to coarse, angular concrete. (MADE GROUND)	
ES	0.50											Brown black mottled red clayey sandy gravel with medium cobble content. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-angular brick and concrete. Cobbles consist of angular concrete and brick. (MADE GROUND)	
SPT	1.00	2	3	3	3	4	4	14		1.10			
ES	1.25									1.50		Black brown slightly gravelly clay. Gravel consists of medium to coarse, angular concrete and sandstone. (MADE GROUND)	
ES	1.75									1.90		Very dense light brown gravelly SAND. Sand is fine to coarse. Gravel consists of fine to coarse, sub-angular to rounded flint. (REDCLIFFE SANDSTONE MEMBER)	
SPT	2.00	10	12	27	23			50					
	50 blows for 140mm total penetration.												

0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

Exploratory Hole No:	WS4		
Site Address:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Project No:	P4639J2633
Client:	Dominvs Project Company 23 Limited	Ground Level:	12.316
Logged By:	JRO	Date Commenced:	30/08/2022
Checked By:	JLW	Date Completed:	30/08/2022
Type and diameter of equipment:	Windowless Sampler Rig	Sheet No:	1 Of 1

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No groundwater strike recorded.

2: Borehole terminated at 2mbgl due to equipment refusal.

3:

4:

Sample or Tests									Strata				
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N					
										0.00			
										0.20		Concrete. (MADE GROUND)	
ES	0.25											Red brown mottled black silty slightly gravelly clay. Gravel consists of fine to coarse, angular sandstone and flint. (MADE GROUND)	
										0.50			
ES	1.00									1.00			
SPT		2	3	3	5	4	5	17					
										1.50			
												Very dense orange red SAND. Sand is fine to medium. (REDCLIFFE SANDSTONE MEMBER)	
ES	1.75												
SPT	2.00	8	14	22	28			50		2.00			
	50 blows for 110mm total penetration.												
										2.50			
										3.00			
										3.50			
										4.00			
										4.50			
										5.00			

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

WINDOW/WINDOWLESS SAMPLING BOREHOLE RECORD

		Exploratory Hole No:	WS5
Site Address:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	Project No:	P4639J2633
Client:	Dominvs Project Company 23 Limited	Ground Level:	12.731
Logged By:	JRO	Date Commenced:	30/08/2022
Checked By:	JLW	Date Completed:	30/08/2022
Type and diameter of equipment:	Windowless Sampler Rig	Sheet No:	1 Of 1

Water levels recorded during boring, m

Date:						
Hole depth:						
Casing depth:						
Level water on strike:						
Water Level after 20mins:						

Remarks

1: No groundwater strike recorded.

2: Borehole terminated at 2.9mbgl due to equipment refusal.

3:

4:

Sample or Tests									Strata				
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)	Strata Description	Installation
		75	75	75	75	75	75	N					
										0.10		Concrete. (MADE GROUND)	
ES	0.50									0.60		Grey mottled brown sandy gravel. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-rounded concrete and flint. (MADE GROUND)	
ES	1.00											Black mottled red clayey sandy gravel. Sand is fine to coarse. Gravel consists of fine to coarse, angular to sub-angular concrete, brick and flint. (MADE GROUND)	
SPT		1	2	2	3	2	3	10		1.50			
ES	1.75											Brown sandy slightly gravelly clay. Sand is fine to coarse. Gravel consists of medium to coarse, angular to sub-angular sandstone and flint. (MADE GROUND)	
SPT	2.00	3	4	5	6	6	5	22					
										2.70			
D	2.80											Very dense orange red SAND. Sand is fine to medium. (REDCLIFFE SANDSTONE MEMBER)	
SPT		6	7	13	37			50		2.90			
	50 blows for 100mm total penetration.												

0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00

Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample

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APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS

JLW
Jomas Associates Ltd
Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD

e: Jomas Associates -

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 22-82240

Project / Site name:	Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA	**Samples received on:**	02/09/2022
Your job number:	JJ2633	**Samples instructed on/ Analysis started on:**	02/09/2022
Your order number:	P4639JJ2633.6	**Analysis completed by:**	12/09/2022
Report Issue Number:	1	**Report issued on:**	12/09/2022
Samples Analysed:	8 soil samples		

Izabela Wójcik

Signed:

Izabela Wójcik
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414150	2414151	2414152	2414153	2414154
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.75	0.25	1.00	0.50
Date Sampled				30/08/2022	30/08/2022	30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	49	< 0.1	25	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	2.3	16	4.9	9.9	12
Total mass of sample received	kg	0.001	NONE	1.2	1.2	1.2	1.2	1.2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	ASE	ASE	ASE	ASE	ASE
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	10.9	8.3	9.2	8.2	9.4
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	540	540	1200	350	4300
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.038	0.023	0.048	0.012	0.99
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	76	46	97	24	2000
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	38	22.9	48.4	12.2	992
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	1.3	-	-	1.6
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.54	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.53	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.52	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.43	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.44	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.18	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.48	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.24	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.27	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	3.63	< 0.80	< 0.80	< 0.80	< 0.80

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414150	2414151	2414152	2414153	2414154
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.75	0.25	1.00	0.50
Date Sampled				30/08/2022	30/08/2022	30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.9	46	7.4	39	59
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	1.5	0.2	0.7	1.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.6	< 0.2	0.5	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	8.3	44	5.7	33	16
Copper (aqua regia extractable)	mg/kg	1	MCERTS	8.6	38	12	19	240
Lead (aqua regia extractable)	mg/kg	1	MCERTS	24	140	39	78	400
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	4.6	41	4.5	30	21
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	46	160	68	94	590
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Petroleum Hydrocarbons								
Petroleum Range Organics (C6 - C10) $_{HS\_1D\_TOTAL}$	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0	< 2.0	-	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	-	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	-	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	MCERTS	< 10	< 10	-	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	-	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	1.4	< 1.0	-	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	2.1	< 2.0	-	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	-	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	13	< 10	-	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	MCERTS	23	< 10	-	< 10	< 10
TPH (C10 - C12) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	2	MCERTS	-	-	< 2.0	-	-
TPH (C12 - C16) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	4	MCERTS	-	-	< 4.0	-	-
TPH (C16 - C21) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	1	MCERTS	-	-	< 1.0	-	-
TPH (C21 - C40) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	10	MCERTS	-	-	< 10	-	-
VOCs								
Chloromethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Chloroethane	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
Bromomethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Vinyl Chloride	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414150	2414151	2414152	2414153	2414154
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.75	0.25	1.00	0.50
Date Sampled				30/08/2022	30/08/2022	30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Trichloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Trichloroethene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Dibromomethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Tetrachloroethene	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Styrene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Tribromomethane	µg/kg	1	NONE	< 1.0	< 1.0	-	< 1.0	< 1.0
o-Xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Bromobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Butylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0	< 1.0	-	< 1.0	< 1.0

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414150	2414151	2414152	2414153	2414154
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.75	0.25	1.00	0.50
Date Sampled				30/08/2022	30/08/2022	30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
PCBs by GC-MS								
PCB Congener 28	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 52	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 101	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 118	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 138	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 153	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
PCB Congener 180	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
Total PCBs by GC-MS								
Total PCBs	mg/kg	0.007	MCERTS	-	-	-	-	< 0.007

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414155	2414156	2414157
Sample Reference				WS4	WS5	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00
Date Sampled				30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	38	< 0.1
Moisture Content	%	0.01	NONE	14	1.1	10
Total mass of sample received	kg	0.001	NONE	1.2	1.2	1.2
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	ASE	ASE	ASE
General Inorganics						
pH - Automated	pH Units	N/A	MCERTS	8.4	9.1	11.1
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	240	320	5200
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.021	0.012	1.1
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	42	24	2300
Water Soluble SO4 (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	21	11.8	1140
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	0.2	-	1.4
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.73
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.28
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.33
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	3.2
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.9
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.1
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.7
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.5
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.97
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.8
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.2
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.31
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.5
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	21.5

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414155	2414156	2414157
Sample Reference				WS4	WS5	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00
Date Sampled				30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	19	4.8	27
Boron (water soluble)	mg/kg	0.2	MCERTS	2.2	0.3	0.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.6	2.1
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	3
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	29	4.8	26
Copper (aqua regia extractable)	mg/kg	1	MCERTS	11	2.9	62
Lead (aqua regia extractable)	mg/kg	1	MCERTS	25	15	370
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	2.4	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	62	39	470
Monoaromatics & Oxygenates						
Benzene	µg/kg	1	MCERTS	-	< 1.0	-
Toluene	µg/kg	1	MCERTS	-	< 1.0	-
Ethylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
p & m-xylene	µg/kg	1	MCERTS	-	< 1.0	-
o-xylene	µg/kg	1	MCERTS	-	< 1.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	< 1.0	-
Petroleum Hydrocarbons						
Petroleum Range Organics (C6 - C10) $_{HS\_1D\_TOTAL}$	mg/kg	0.1	MCERTS	< 0.1	-	< 0.1
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	-	< 1.0	-
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	-	< 2.0	-
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	-	< 8.0	-
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	-	< 8.0	-
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	MCERTS	-	< 10	-
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	-	< 0.001	-
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	-	< 1.0	-
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	-	< 2.0	-
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	-	< 10	-
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	-	< 10	-
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	MCERTS	-	< 10	-
TPH (C10 - C12) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	2	MCERTS	< 2.0	-	< 2.0
TPH (C12 - C16) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	4	MCERTS	< 4.0	-	< 4.0
TPH (C16 - C21) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	1	MCERTS	< 1.0	-	9.9
TPH (C21 - C40) $_{EH\_CU\_1D\_TOTAL}$	mg/kg	10	MCERTS	< 10	-	65
VOCs						
Chloromethane	µg/kg	1	ISO 17025	-	< 1.0	-
Chloroethane	µg/kg	1	NONE	-	< 1.0	-
Bromomethane	µg/kg	1	ISO 17025	-	< 1.0	-
Vinyl Chloride	µg/kg	1	NONE	-	< 1.0	-
Trichlorofluoromethane	µg/kg	1	NONE	-	< 1.0	-

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414155	2414156	2414157
Sample Reference				WS4	WS5	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00
Date Sampled				30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
1,1-Dichloroethene	µg/kg	1	NONE	-	< 1.0	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	< 1.0	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	< 1.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	< 1.0	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-
Trichloromethane	µg/kg	1	MCERTS	-	< 1.0	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-
1,2-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	< 1.0	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	< 1.0	-
Benzene	µg/kg	1	MCERTS	-	< 1.0	-
Tetrachloromethane	µg/kg	1	MCERTS	-	< 1.0	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-
Trichloroethene	µg/kg	1	MCERTS	-	< 1.0	-
Dibromomethane	µg/kg	1	MCERTS	-	< 1.0	-
Bromodichloromethane	µg/kg	1	MCERTS	-	< 1.0	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-
Toluene	µg/kg	1	MCERTS	-	< 1.0	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	< 1.0	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	< 1.0	-
Tetrachloroethene	µg/kg	1	NONE	-	< 1.0	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	< 1.0	-
Chlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-
Ethylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
p & m-Xylene	µg/kg	1	MCERTS	-	< 1.0	-
Styrene	µg/kg	1	MCERTS	-	< 1.0	-
Tribromomethane	µg/kg	1	NONE	-	< 1.0	-
o-Xylene	µg/kg	1	MCERTS	-	< 1.0	-
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-
Isopropylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
Bromobenzene	µg/kg	1	MCERTS	-	< 1.0	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	< 1.0	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-
Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	< 1.0	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	< 1.0	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-

Analytical Report Number: 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA
Your Order No: P4639JJ2633.6

Lab Sample Number				2414155	2414156	2414157
Sample Reference				WS4	WS5	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.50	1.00
Date Sampled				30/08/2022	30/08/2022	30/08/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
PCBs by GC-MS						
PCB Congener 28	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 52	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 101	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 118	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 138	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 153	mg/kg	0.001	MCERTS	-	< 0.001	-
PCB Congener 180	mg/kg	0.001	MCERTS	-	< 0.001	-
Total PCBs by GC-MS						
Total PCBs	mg/kg	0.007	MCERTS	-	< 0.007	-

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2414150	WS1	None Supplied	0.25	Brown sand with concrete and stones.
2414151	WS1	None Supplied	0.75	Brown clay and sand.
2414152	WS2	None Supplied	0.25	Brown gravelly loam with chalk and stones.
2414153	WS2	None Supplied	1	Brown clay and sand with concrete.
2414154	WS3	None Supplied	0.5	Brown loam and clay with gravel and brick.
2414155	WS4	None Supplied	1	Brown sandy clay.
2414156	WS5	None Supplied	0.5	Light brown sand with concrete and stones.
2414157	WS5	None Supplied	1	Brown loam and sand with concrete and brick.

Analytical Report Number : 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

Analytical Report Number : 22-82240
Project / Site name: Units 1-15 Premier Estates, Sussex Street, Bristol, BS2 0RA

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

UKAS TESTING
4041

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Analytical Report Number : 22-83851

Project / Site name:	Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA	**Samples received on:**	02/09/2022
Your job number:	JJ2633	**Samples instructed on/ Analysis started on:**	12/09/2022
Your order number:	P4639JJ2633 7	**Analysis completed by:**	19/09/2022
Report Issue Number:	1	**Report issued on:**	19/09/2022
Samples Analysed:	3 leachate samples		

Signed:

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

UKAS TESTING
4041

Analytical i2 Environmental Science

Analytical Report Number: 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Your Order No: P4639JJ2633 7

Lab Sample Number				2423233	2423234	2423235
Sample Reference				WS1	WS3	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
General Inorganics						
pH (automated)	pH Units	N/A	ISO 17025	7.7	7.7	8.7
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10
Sulphate as SO_4	µg/l	100	ISO 17025	7910	92800	11100
Total Phenols						
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10
Speciated PAHs						
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Total PAH						
Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2	< 0.2
Heavy Metals / Metalloids						
Arsenic (dissolved)	µg/l	1	ISO 17025	< 1.0	6.7	6.6
Boron (dissolved)	µg/l	10	ISO 17025	30	85	10
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	< 0.4	0.7	5.6
Copper (dissolved)	µg/l	0.7	ISO 17025	2.2	5.3	14
Lead (dissolved)	µg/l	1	ISO 17025	< 1.0	< 1.0	62
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	< 0.3	0.5	2.4
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	2	11	41
Monoaromatics & Oxygenates						
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10	< 10	< 10

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Analytical Report Number: 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Your Order No: P4639JJ2633 7

Lab Sample Number				2423233	2423234	2423235
Sample Reference				WS1	WS3	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Petroleum Hydrocarbons						
TPH-CWG - Aliphatic >C5 - C6 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 HS_1D_AL	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) HS+EH_1D_AL_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C5 - C7 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_1D_AR	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_1D_AR_#1_#2_MS	µg/l	10	NONE	< 10	< 10	< 10

Analytical Report Number: 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Your Order No: P4639JJ2633 7

Lab Sample Number				2423233	2423234	2423235
Sample Reference				WS1	WS3	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
VOCs						
Chloromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Chloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Bromomethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-dichloroethene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-dichloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2-dichloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2-dichloropropane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Styrene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
ter-Butylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,3-dichlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
P-Isopropyltoluene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2-dichlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,4-dichlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Butylbenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0

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Analytical Report Number: 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Your Order No: P4639JJ2633 7

Lab Sample Number				2423233	2423234	2423235
Sample Reference				WS1	WS3	WS5
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
1,2,4-Trichlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	0.1	NONE	< 0.1	< 0.1	< 0.1
1,2,3-Trichlorobenzene	µg/l	1	NONE	< 1.0	< 1.0	< 1.0

U/S = Unsuitable Sample I/S = Insufficient Sample

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Analytical Report Number : 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
NRA Leachate Prep	10:1 extract with de-ionised water shaken for 24 hours then filtered.	In-house method based on National Rivers Authority	L020-PL	W	NONE
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Boron in leachate	Determination of boron in leachate. Sample acidified and followed by ICP-OES.	In-house method based on MEWAM	L039-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Monohydric phenols in leachate	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025
Sulphate in leachates	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	ISO 17025
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Volatile organic compounds in leachate	Determination of volatile organic compounds in leachate by headspace GC-MS	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

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Analytical Report Number : 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Sample Deviation Report

Analytical Report Number : 22-83851
Project / Site name: Units 1 15 Premier Estates Sussex Street Bristol BS2 0RA

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis.Please note that the associated result(s) may be unreliable and should be interpreted with care.

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS1	None Supplied	L	2423233	a	None Supplied	None Supplied	None Supplied
WS3	None Supplied	L	2423234	a	None Supplied	None Supplied	None Supplied
WS5	None Supplied	L	2423235	a	None Supplied	None Supplied	None Supplied
WS5	None Supplied	S	2423232	a	None Supplied	None Supplied	None Supplied

APPENDIX 4 – SOIL GAS MONITORING TEST RESULTS

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Unit 1-15 Premier Estates, Bristol	**Operative(s):** EEG	**Date:** 12/09/2022	**Time:** 11:05AM	**Round:** 1	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	Instrument Make	Serial No.	Date Last Calibrated
Analox	GA5000	G505801	01/10/2021
PID	Phocheck tiger	T-106448	01/03/2021
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Sunny	**Ground Conditions:** Dry	**Temperature:** 21°C
Barometric Pressure (mbar): 1009	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.0%CH_4, 0.2%CO_2, 20.6%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS1	+0.2	+0.2	1010	0.0	-	0.1	20.3	1.0	0.4	0	0	-	Dry	1.85
WS3	+0.1	+0.1	1010	0.0	-	0.8	19.0	1.1	0.8	0	0	-	Dry	1.68
WS4	+0.0	+0.0	1009	0.0	-	4.6	14.2	1.3	0.4	0	0	-	Dry	1.89

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Unit 1-15 Premier Estates, Bristol	**Operative(s):** HAH	**Date:** 16/09/2022	**Time:** 10:30am	**Round:** 2	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	Instrument Make	Serial No.	Date Last Calibrated
Analox	GA5000	G505801	01/10/2021
PID	Multirae PID	T-106448	01/03/2021
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Sunny	**Ground Conditions:** Dry	**Temperature:** 18°C
Barometric Pressure (mbar): 1018	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.2%CH_4, 0.1%CO_2, 21.1%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS1	+0.0	+0.0	1018	0.2	-	0.3	20.8	0.0	0.0	0	0	-	Dry	1.84
WS3	-0.0	-0.0	1018	0.2	-	0.4	20.6	0.0	0.0	0	0	-	Dry	1.67
WS4	+0.0	+0.0	1018	0.1	-	3.3	17.3	0.0	0.0	0	0	-	Dry	1.90

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Unit 1-15 Premier Estates, Bristol	**Operative(s):** RAY	**Date:** 23/09/2022	**Time:** 10:45AM	**Round:** 3	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000	G505801	01/10/2021
PID	Multirae PID	T-106448	01/03/2021
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Sunny with clouds	**Ground Conditions:** Dry	**Temperature:** 17°C
Barometric Pressure (mbar): 1015	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.0%CH_4, 0.1%CO_2, 23.7%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS1	+0.2	+0.2	1016	0.0	-	2.0	20.3	0.7	0.5	0	0	-	Dry	1.84
WS3	+0.1	+0.1	1015	0.0	-	0.4	23.2	0.6	0.3	0	0	-	Dry	1.65
WS4	+0.0	+0.0	1016	0.0	-	0.9	22.7	0.6	0.4	0	0	-	Dry	1.88

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET

Site: Unit 1-15 Premier Estates, Bristol	**Operative(s):** SEJ	**Date:** 30/09/2022	**Time:** 10:30AM	**Round:** 4	**Page:** 1

MONITORING EQUIPMENT

Instrument Type	**Instrument Make**	**Serial No.**	**Date Last Calibrated**
Analox	GA5000	G505801	01/10/2021
PID	Multirae PID	T-106448	01/03/2021
Dip Meter	GeoTech		

MONITORING CONDITIONS

Weather Conditions: Overcast	**Ground Conditions:** Dry	**Temperature:** 12°C
Barometric Pressure (mbar): 1005	**Barometric Pressure Trend (24hr):** Rising	**Ambient Concentration:** 0.2%CH_4, 0.1%CO_2, 21.3%O_2

MONITORING RESULTS

Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	CH_4 %	CH_4 % LEL	CO_2 %	O_2 %	VOC (ppm)		H_2S (ppm)	CO (ppm)	Depth to product (mbgl)	Depth to water (mbgl)	Depth to base of well (mbgl)
	Peak	Steady						Peak	Steady					
WS1	+0.1	+0.0	1006	0.1	-	0.1	21.0	0	0	0	0	-	Dry	1.84
WS3	+0.1	+0.1	1006	0.1	-	2.1	17.7	0	0	0	0	-	Dry	1.67
WS4	+0.0	+0.0	1005	0.2	-	1.5	18.4	0	0	0	0	-	Dry	1.90

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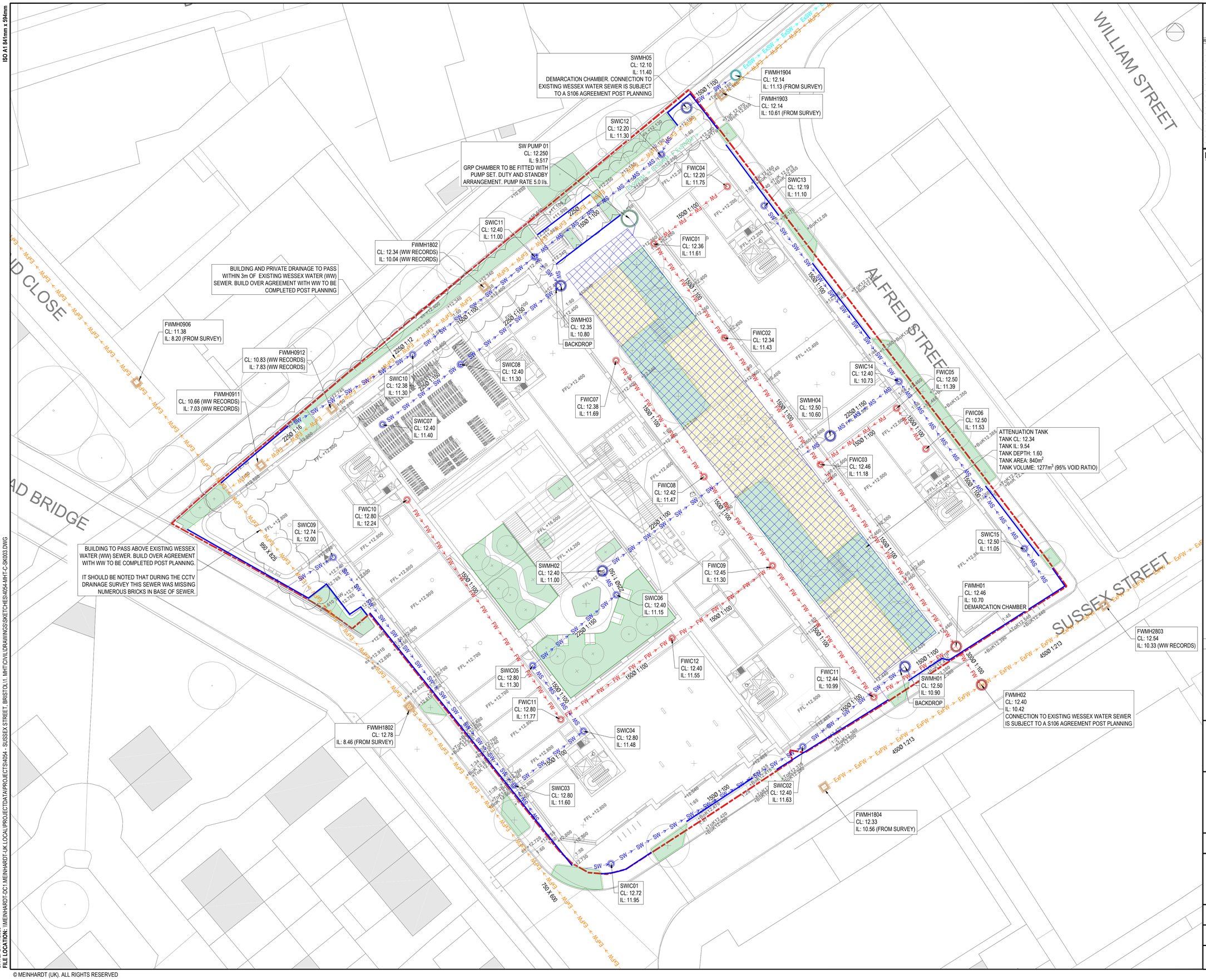
Appendix E – Meinhardt Drainage Strategy Drawings

ISO A1 841mm x 594mm



ISSUED FOR PLANNING

REV	DESCRIPTION	BY	DATE
I01	ISSUED FOR INFORMATION	JH	13.03.23
I02	ISSUED FOR INFORMATION	JH	14.03.23
I03	ISSUED FOR COMMENT	JH	17.03.23
I04	ISSUED FOR PLANNING	JH	24.03.23
I05	ISSUED FOR PLANNING	JH	31.03.23
I06	ISSUED FOR PLANNING	JH	21.11.23

NOTES:

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2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. THIS DRAWING IS FOR INFORMATION ONLY.
4. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND CONSULTANTS DRAWINGS AND SPECIFICATIONS.
5. THIS DRAWING IS BASED ON:
   - WESSEX WATER ASSET RECORDS DATED FEBRUARY 2023
   - MALTBY SURVEYS LTD TOPOGRAPHICAL SURVEY DATED NOVEMBER 2022 - 22/281/100/OVERVIEW DATED NOVEMBER 2022
   - LASER SURVEYS CCTV DRAINAGE SURVEY DATED APRIL 2023
   - ALLFORD HALL MONAGHAN MORRIS ARCHITECTURAL DRAWING 22096-AHMM-ZZ-GF-DR-A-PL100 DATED 10.11.23
   - CHURCHMAN THORNHILL FINCH LANDSCAPE ARCHITECTS DRAWINGS 651-CTF-XX-00-DR-L-1000 AND 651-CTF-XX-00-DR-L-1100 DATED 21.11.23

KEY:

- SITE BOUNDARY
- PROPOSED SURFACE WATER SEWER
- PROPOSED FOUL WATER SEWER
- EXISTING FOUL WATER SEWER
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SURFACE WATER MANHOLE
- EXISTING SURFACE WATER MANHOLE
- PROPOSED FOUL WATER MANHOLE
- EXISTING FOUL WATER MANHOLE
- PROPOSED SURFACE WATER PUMP STATION
- SURFACE WATER GULLY
- SURFACE WATER CHANNEL DRAIN. ASSUME ACO M150D CHANNELS.
- GREENBLUE URBAN ARBOR SYSTEM (INTEGRATED ATTENUATION TANK AND TREE CELLS)
- PERMEABLE PAVING
- SOFT LANDSCAPING

CDM RESIDUAL CIVIL / STRUCTURAL DESIGN RISKS

MEINHARDT
10 Aldersgate Street, London EC1A 4JU
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www.meinhardt.co.uk

PROJECT
SUSSEX STREET, BRISTOL

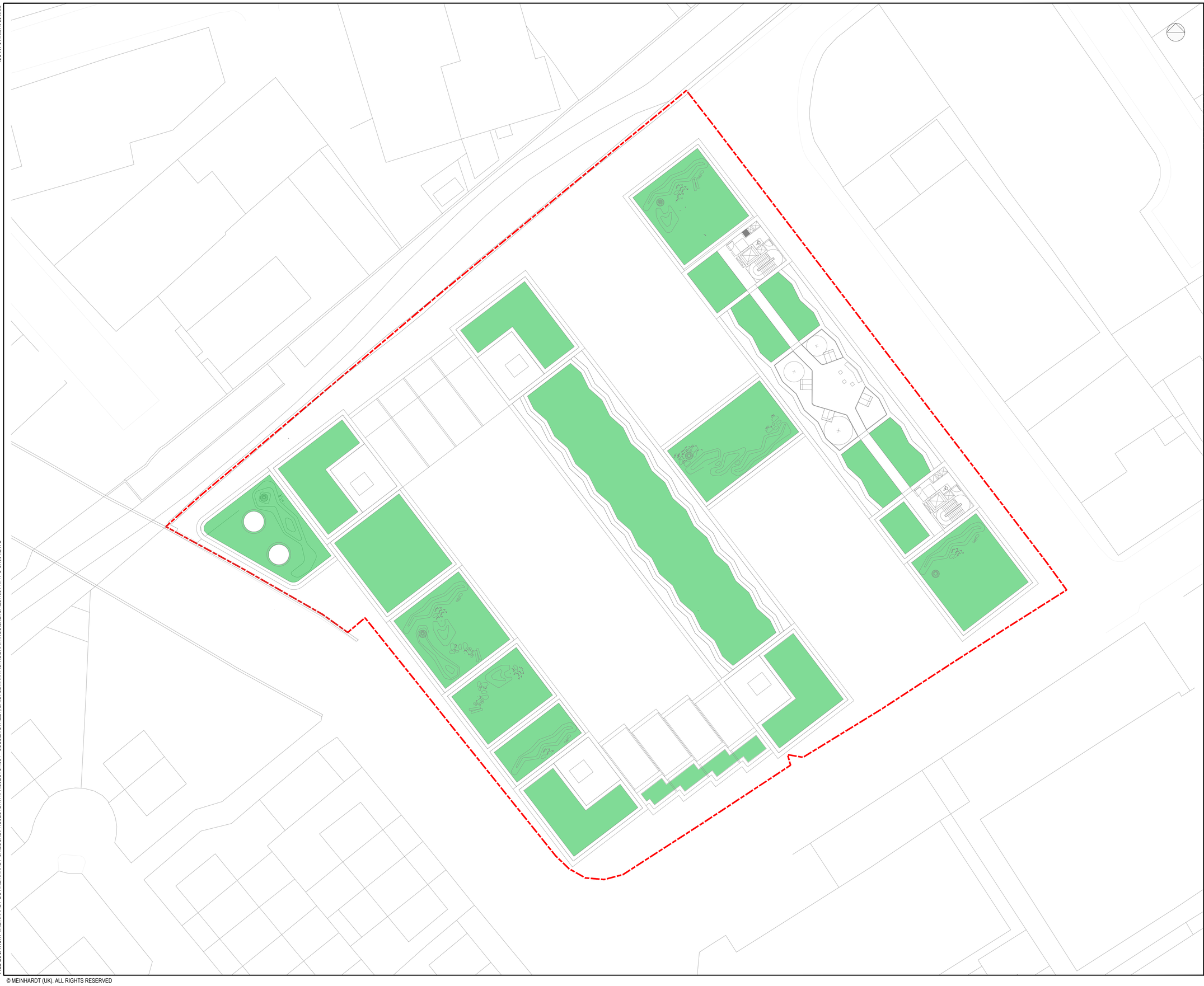
CLIENT
DOMINUS

TITLE
PROPOSED BELOW GROUND DRAINAGE STRATEGY

DISCIPLINE			SCALE
CIVIL			1:250
DRAWN	DESIGNED	CHECKED	APPROVED
JH	JH	GB	GB
DRAWING No			ISSUE
4054-MHT-C-SK003			I06

DATE: 21/11/2023
FILE LOCATION: \\MEINHARDT-DC1.MEINHARDT-UK.LOCAL\PROJECTDATA\PROJECTS\4054 - SUSSEX STREET, BRISTOL\1. MHT\CIVIL\DRAWINGS\SKETCHES\4054-MHT-C-SK003.DWG

ISO A1 841mm x 594mm



ISSUED FOR PLANNING

REV	DESCRIPTION	BY	DATE
I01	ISSUED FOR PLANNING	JH	24.03.23
I02	ISSUED FOR PLANNING	JH	31.03.23
I03	ISSUED FOR PLANNING	JH	21.11.23

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5. THIS DRAWING IS BASED ON:
   - CHURCHMAN THORNHILL FINCH LANDSCAPE ARCHITECTS DRAWINGS 651-CTF-XX-RL-DR-L-1000 DATED 21.11.23

KEY:

SITE BOUNDARY

BIODIVERSE GREEN AND BROWN ROOFS, REFER TO LANDSCAPE ARCHITECTS DRAWINGS FOR FURTHER INFORMATION

CDM RESIDUAL CIVIL / STRUCTURAL DESIGN RISKS

MEINHARDT
10 Aldersgate Street, London EC1A 4JU
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www.meinhardt.co.uk

PROJECT
SUSSEX STREET, BRISTOL

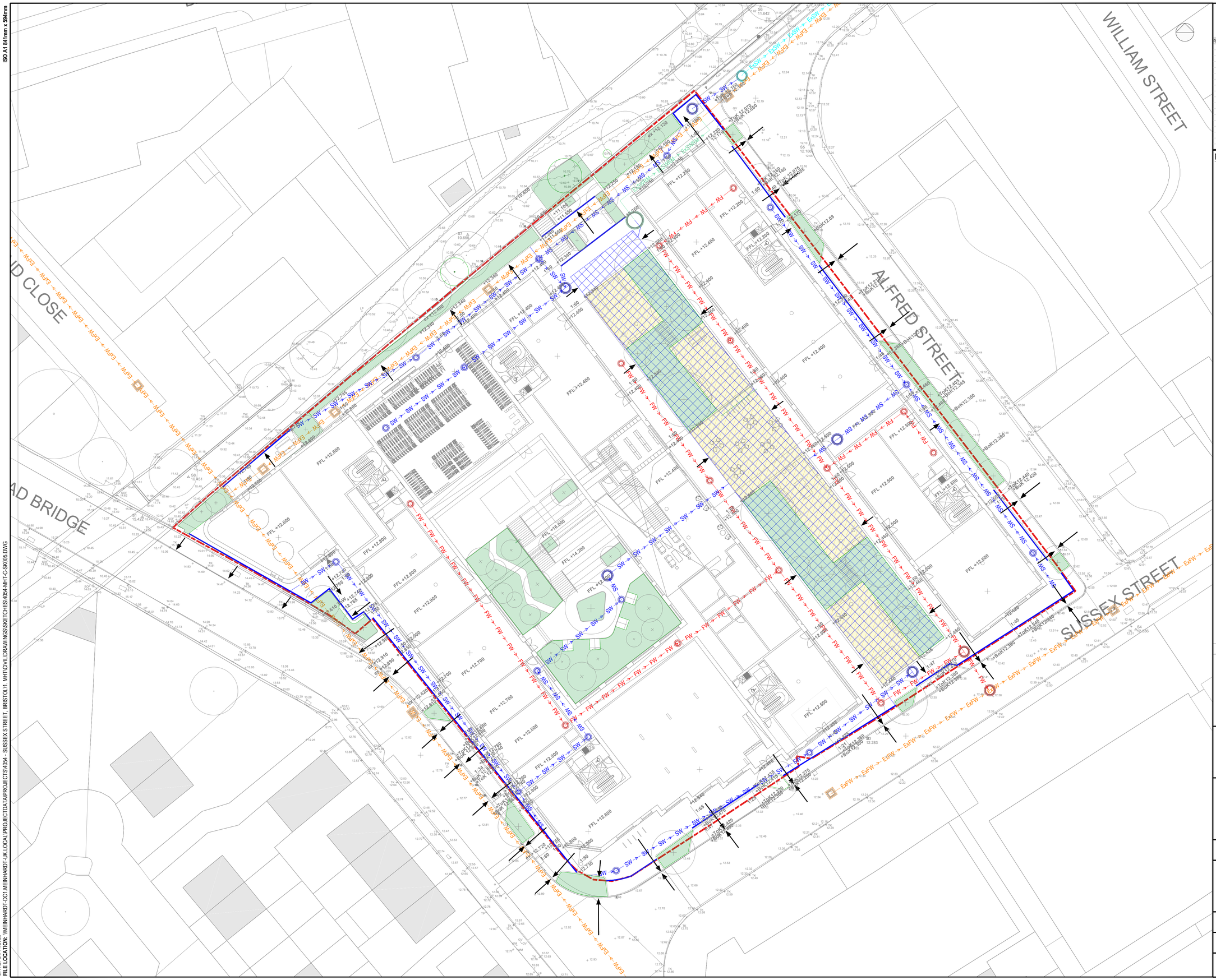
CLIENT
DOMINUS

TITLE
PROPOSED ROOF LEVEL LAYOUT

DISCIPLINE			SCALE
CIVIL			1:250
DRAWN	DESIGNED	CHECKED	APPROVED
JH	JH	GB	GB
DRAWING No			ISSUE
4054-MHT-C-SK004			I03

DATE: 21/11/2023
FILE LOCATION: \\MEINHARDT-DC1.MEINHARDT-UK.LOCAL\PROJECTDATA\PROJECTS\4054 - SUSSEX STREET, BRISTOL\11. MHTCIVIL\DRAWINGS\SKETCHES\4054-MHT-C-SK004.DWG

ISO A1 841mm x 594mm



ISSUED FOR PLANNING

REV	DESCRIPTION	BY	DATE
I01	ISSUED FOR PLANNING	JH	24.03.23
I02	ISSUED FOR PLANNING	JH	31.03.23
I03	ISSUED FOR PLANNING	JH	21.11.23

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   - LASER SURVEYS CCTV DRAINAGE SURVEY DATED APRIL 2023
   - ALLFORD HALL MONAGHAN MORRIS ARCHITECTURAL DRAWING 22096-AHMM-ZZ-GF-DR-A-PL100 DATED 10.11.23
   - CHURCHMAN THORNHILL FINCH LANDSCAPE ARCHITECTS DRAWINGS 651-CTF-XX-00-DR-L-1000 AND 651-CTF-XX-00-DR-L-1100 DATED 21.11.23

KEY:

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- GREENBLUE URBAN ARBOR SYSTEM (INTEGRATED ATTENUATION TANK AND TREE CELLS)
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- EXCEEDANCE ROUTES

CDM RESIDUAL CIVIL / STRUCTURAL DESIGN RISKS

MEINHARDT
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www.meinhardt.co.uk

PROJECT
SUSSEX STREET, BRISTOL

CLIENT
DOMINUS

TITLE
PROPOSED SURFACE WATER EXCEEDANCE ROUTES

DISCIPLINE			SCALE
CIVIL			1:250
DRAWN	DESIGNED	CHECKED	APPROVED
JH	JH	GB	GB
DRAWING No			ISSUE
4054-MHT-C-SK005			I03

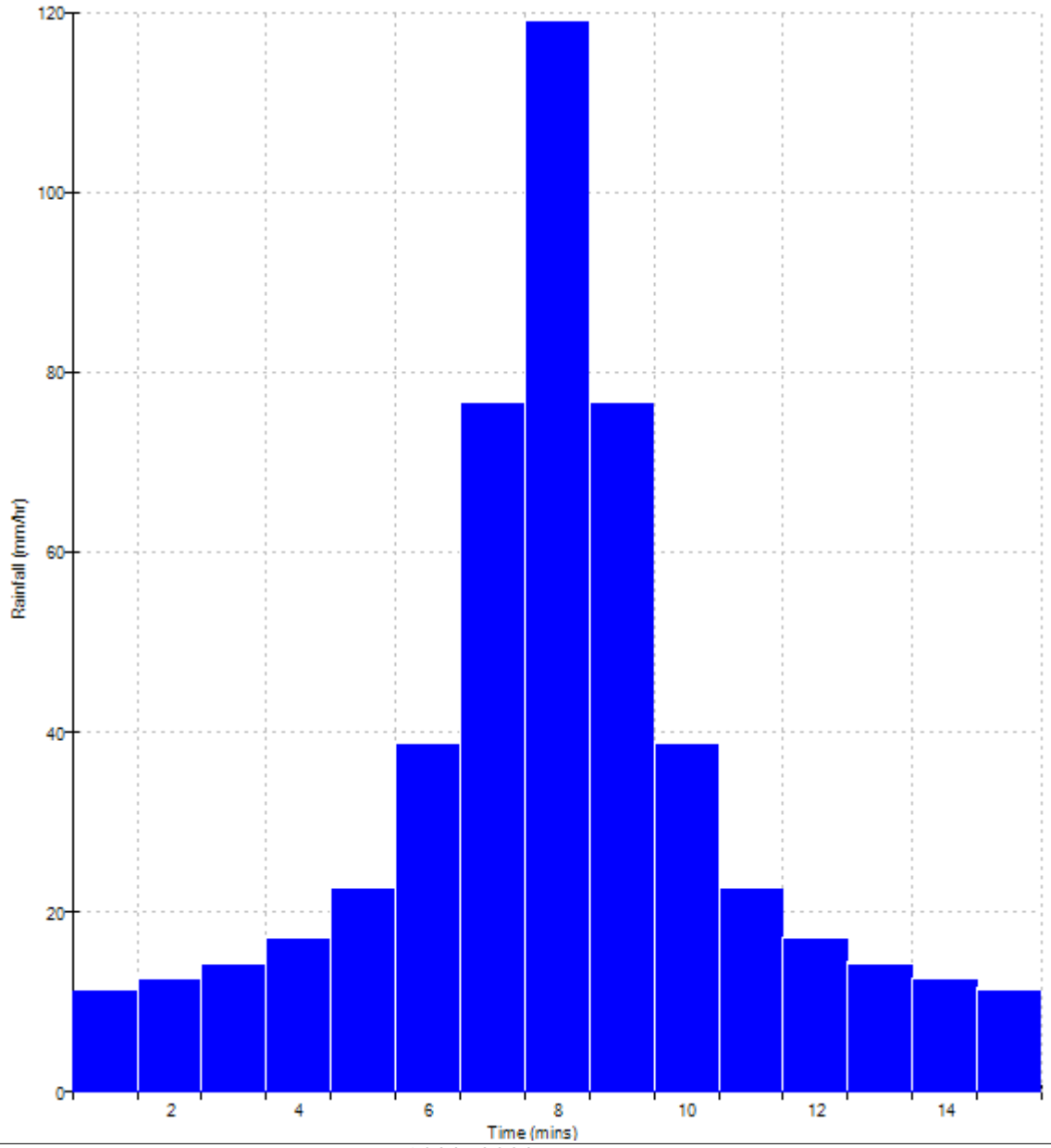
DATE: 21/11/2023
FILE LOCATION: \\MEINHARDT-DC1.MEINHARDT-UK.LOCAL\PROJECTDATA\PROJECTS\4054 - SUSSEX STREET, BRISTOL\11. MHT\CIVIL\DRAWINGS\SKETCHES\4054-MHT-C-SK005.DWG

Appendix F – Modelling Results

Rainfall profile

Storm duration (mins) 15

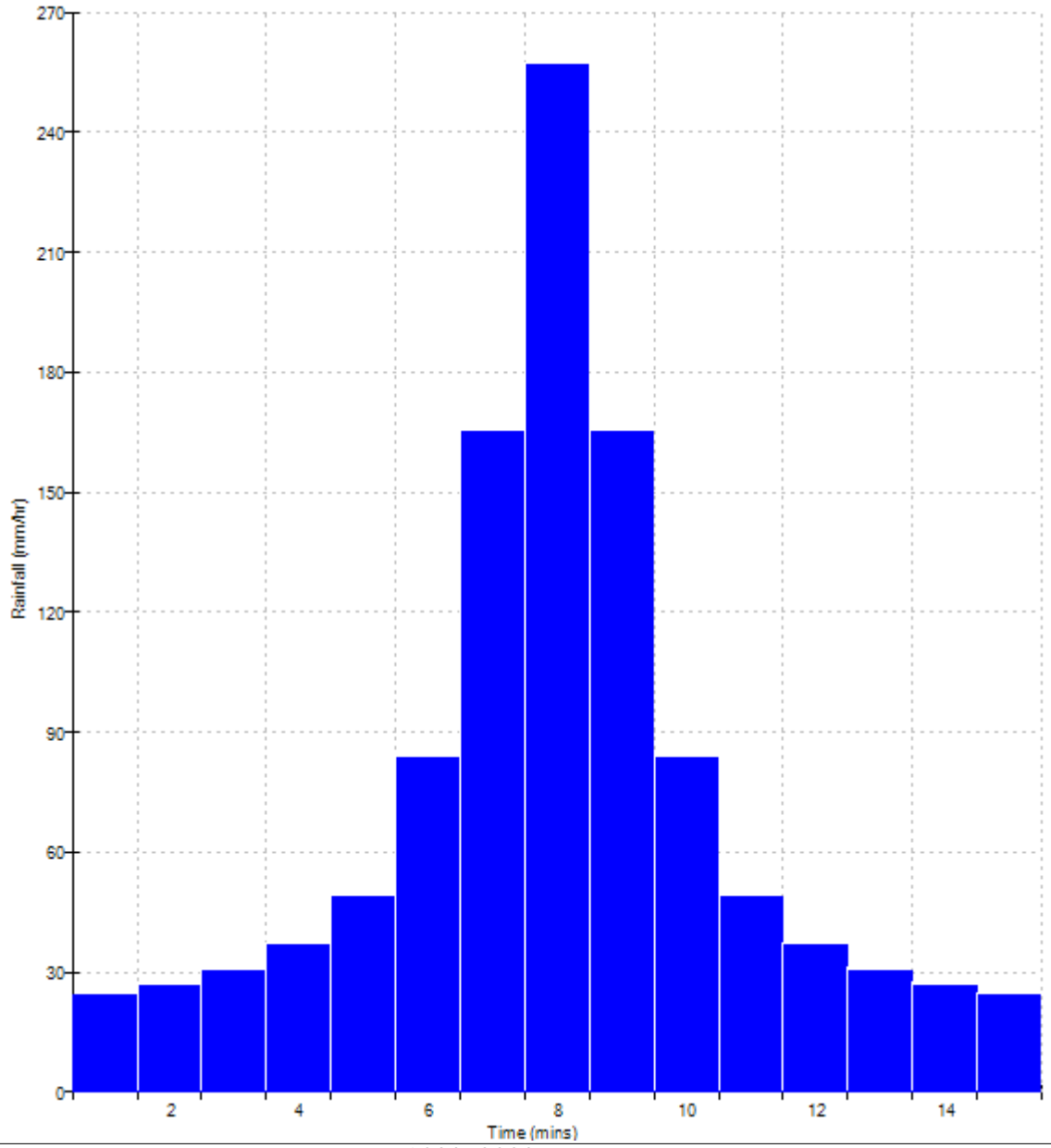
FEH Data	
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Peak Intensity (mm/hr)	118.908
Ave. Intensity (mm/hr)	33.647
Return Period (years)	2.0



Rainfall profile

Storm duration (mins) 15

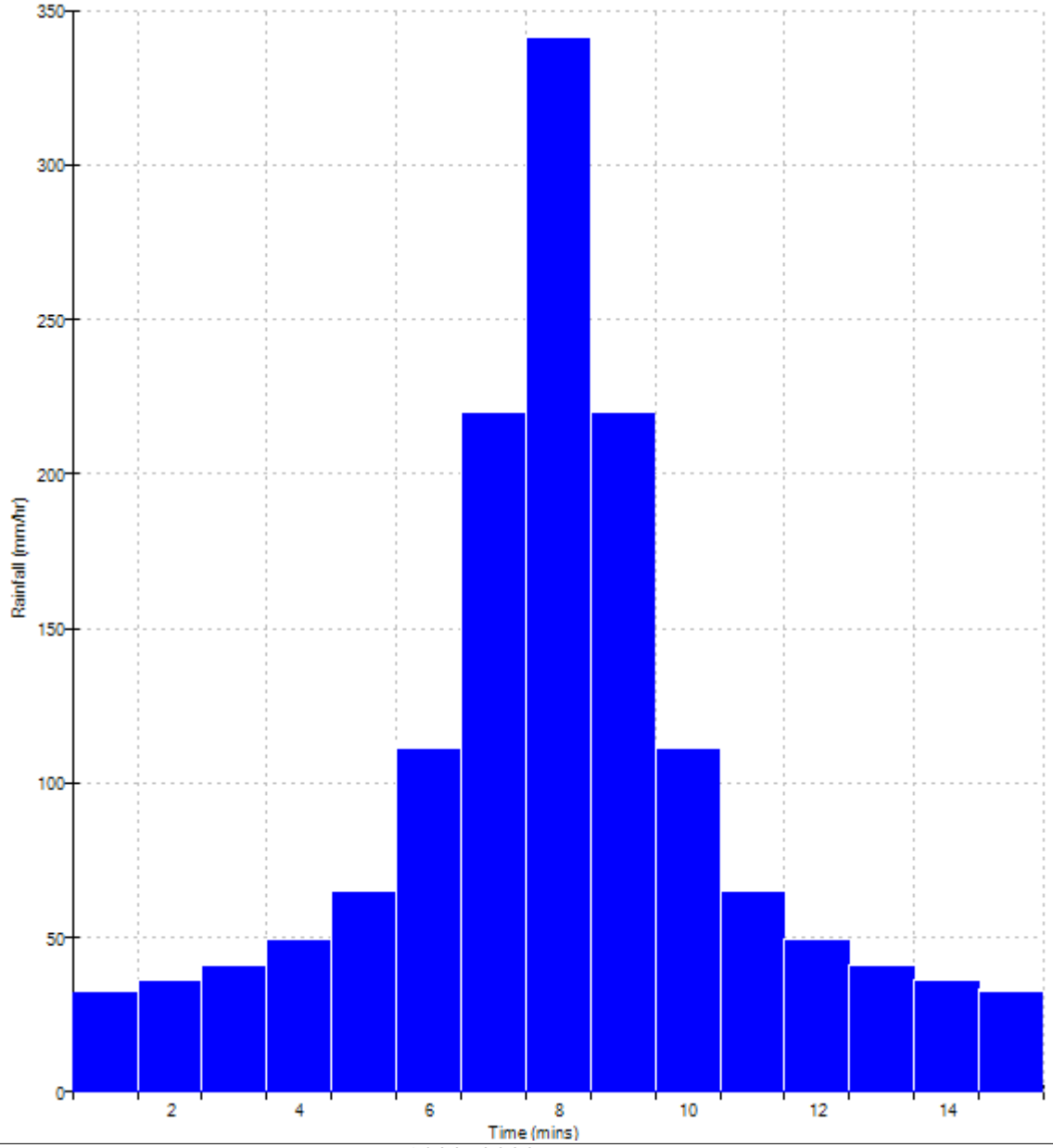
FEH Data	
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Peak Intensity (mm/hr)	256.800
Ave. Intensity (mm/hr)	72.666
Return Period (years)	30.0



Rainfall profile

Storm duration (mins) 15

FEH Data	
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Peak Intensity (mm/hr)	341.089
Ave. Intensity (mm/hr)	96.516
Return Period (years)	100.0



STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.250	0.250	0.250
2.000	-	-	100	0.250	0.250	0.250
3.000	-	-	100	0.250	0.250	0.250
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.750	0.750	0.750

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.002	S4	12.200	9.375	0.000	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	1.000
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Pump Manhole: S3, DS/PN: S1.002, Volume (m³): 4.5

Invert Level (m) 9.507

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	1.0000	0.600	3.0000	1.000	5.0000	2.000	5.0000
0.400	2.0000	0.800	5.0000	1.500	5.0000		

Storage Structures for Storm

Cellular Storage Manhole: S2, DS/PN: S1.001

Invert Level (m) 9.540 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	840.0	0.0	1.601	0.0	0.0
1.600	840.0	0.0			

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	2	+0%	30/15 Summer				11.206
S2.000	S2	15 Summer	2	+0%	100/15 Summer				11.347
S3.000	S3	15 Summer	2	+0%	100/15 Summer				11.152
S1.001	S2	1440 Winter	2	+0%	30/240 Summer				9.829
S1.002	S3	1440 Winter	2	+0%	30/120 Winter				9.836

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.094	0.000	0.79			47.7	OK	
S2.000	S2	-0.228	0.000	0.32			47.9	OK	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S3	-0.223	0.000	0.34			47.5	OK	
S1.001	S2	-0.086	0.000	0.02			1.9	OK	
S1.002	S3	-0.046	0.000	0.01			1.6	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	30	+0%	30/15 Summer				11.428
S2.000	S2	15 Summer	30	+0%	100/15 Summer				11.432
S3.000	S3	15 Summer	30	+0%	100/15 Summer				11.242
S1.001	S2	1440 Winter	30	+0%	30/240 Summer				10.086
S1.002	S3	1440 Summer	30	+0%	30/120 Winter				10.103

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.128	0.000	1.72			103.2	SURCHARGED	
S2.000	S2	-0.143	0.000	0.69			103.3	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S3	-0.133	0.000	0.73			102.6	OK	
S1.001	S2	0.171	0.000	0.03			2.9	SURCHARGED	
S1.002	S3	0.221	0.000	0.02			2.9	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	100	+0%	100/15 Summer				11.562
S2.000	S2	15 Summer	100	+0%					11.485
S3.000	S3	15 Summer	100	+0%					11.298
S1.001	S2	1440 Winter	100	+0%	100/60 Summer				10.257
S1.002	S3	1440 Winter	100	+0%	100/60 Summer				10.270

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.262	0.000	2.27			136.4	SURCHARGED	
S2.000	S2	-0.090	0.000	0.92			137.2	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S3	-0.077	0.000	0.97			136.3	OK	
S1.001	S2	0.342	0.000	0.04			4.5	SURCHARGED	
S1.002	S3	0.388	0.000	0.03			4.5	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 360144 172894 ST 60144 72894
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	50.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	100	+45%	30/15 Summer				11.898
S2.000	S2	15 Summer	100	+45%	100/15 Summer				11.786
S3.000	S3	15 Summer	100	+45%	100/15 Summer				11.528
S1.001	S2	1440 Winter	100	+45%	30/240 Summer				10.610
S1.002	S3	1440 Winter	100	+45%	30/120 Winter				10.630

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.598	0.000	3.30			197.9	SURCHARGED	
S2.000	S2	0.211	0.000	1.33			198.1	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S3	0.153	0.000	1.41			198.2	SURCHARGED	
S1.001	S2	0.695	0.000	0.06			5.7	SURCHARGED	
S1.002	S3	0.748	0.000	0.04			5.0	SURCHARGED	

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