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Project No

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Project

9a Mitford Road
Withington, Manchester

Title

Surface Water Management Report

Date

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Revision

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1. Introduction

CCS Consulting Ltd have prepared this surface water management report to discharge Manchester City Council planning conditions 9 and 11, for a new residential development at 9a Mitford Road, Withington, which states:

'9) Development shall not begin until a surface water drainage layout for the site, based on sustainable drainage principles has been submitted to and approved in writing by the local planning authority. The development shall be constructed and completed in accordance with the approved details.

Reason: To prevent the increased risk of flooding, to improve and protect water quality and ensure future maintenance of the surface water drainage system pursuant to policy EN17 of the Core Strategy.

11) Prior to the commencement of any development, a surface water drainage scheme, based on the hierarchy of drainage options in the National Planning Practice Guidance with evidence of an assessment of the site conditions shall be submitted to and approved in writing by the Local Planning Authority. The surface water drainage scheme must be in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards. In the event of surface water draining to the combined public sewer, the pass forward flow rate to the public sewer must be restricted to 6l/s. The development hereby permitted shall be carried out only in accordance with the approved drainage scheme.

Reason: To promote sustainable development, secure proper drainage and to manage the risk of flooding and pollution, pursuant to Core Strategy policies DM1 and EN14 and the guidance contained in the NPPF and NPPG'.

This report therefore describes and demonstrates how the surface water run-off rates and volume from the post development site will be managed to adhere to National and local planning policies, regulations, and relevant design guidance, which include:

- National Planning Policy Framework (NPPF), July 2021 Paragraphs 153-158 and 159-169;
- National Planning Practice Guidance (NPPG);
- Principles of Sustainable drainage systems (SuDS) set out by DEFRA (2011);
- CIRIA SuDS Manual C753 (2015);
- CIRIA (2010) Planning for SuDS;
- Non-Statutory Technical Standards for Sustainable Drainage Systems (DEFRA) (March 2015);
- Manchester City, Salford City and Trafford Councils Level 1 SFRA (May 2010);
- Manchester City, Salford City and Trafford Councils Level 2 SFRA (March 2011);
- Manchester City Council – Local Flood Risk Management Strategy (March 2014);
- Manchester Local Development Framework – Core Strategy Development Plan (July 2012).

Subsequently, Manchester City Council, acting as Lead Local Flood Authority (LLFA), need to be satisfied that the design and drainage principles of the proposed development will address the surface water management and risk of flooding within the site; the drainage is managed and maintained for its lifetime to prevent flooding; the development will not increase the risk of flooding to neighbouring land and property.

2. Planning Policies and Guidance

2.1. National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG)

The NPPF (July 2021) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. This document is used to form this surface water management report, with particular attention to Paragraphs 153 to 158 Planning for Climate Change, and Paragraphs 159 to 169 Planning for Flood Risk.

NPPG, Paragraph 051 states that sustainable drainage systems (SuDS) are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible, where they provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban run-off at source; and to combine water management with green space with benefits for amenity, recreation, and wildlife.

Further to this NPPG, Paragraph 080 states that the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable which (in order) are into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain, or another drainage system; to a combined sewer.

2.2. Flood and Water Management Act

The Flood and Water Management Act takes forward some of the proposals from three previous strategy documents published by the UK Government - Future Water (2008), Making Space for Water (2008) and the UK Government's response to the Sir Michael Pitt's Review of the summer 2007 floods. In doing so it gives the EA a strategic overview role for flood risk, and gives local authorities responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

2.3. Manchester Local Development Framework – Core Strategy Development Plan

Relevant Policy EN 08 states:

'All new development will be expected to be adaptable to climate change in terms of the design, layout, siting, and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should minimise flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rainwater permeability, and will be permitted to use green infrastructure elements such as green roofs'.

Relevant Policy EN 14 states:

'All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SUDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required'.

Relevant Policy EN 17 states:

'Development should avoid any adverse impact on water quality, including during the construction phase, and wherever possible should seek to enhance water quality, both chemical and ecological; Development should minimise surface water run-off from development and associated roads, and maximise the use of appropriate sustainable drainage systems, to minimise groundwater contamination, and to avoid pollutants reaching watercourses; Development close to a watercourse should also ensure that waste or litter cannot enter the watercourse from the site; Development should, where feasible and appropriate, seek to open up any culverted or hidden watercourse beneath the site to improve the ecological status of that watercourse'.

3. Site Setting and Description

3.1. Site Location

The development site is in a residential area of Withington, is approximately 2km south-east of Manchester City centre, approximately 350m west of Mauldeth Road train station, and is bound by No.9 Mitford Road to the north; a residential gardens and dwellings leading onto Amherst Road to the east; No.5 Derby Road to the south; and Mitford Road to the west. The address of the site is land between to No.9 Mitford Road and No.5 Derby Road, Withington, M14 6UN, with the co-ordinates of the centre of the site being E: 385435, N: 393380.

3.2. Existing Site

The area of the site being developed currently consists of a hard-standing driveway from Mitford Road (west of site) that leads to a hard-standing car park area (east of site), and grassed garden areas of No.5 Derby Road.

3.3. Proposed Development

The proposed site is shown on the plans in Appendix A, with a full description of the development site being stated by the Architect. In brief, as stated on the decision notice, and in relation to this surface water management report, the proposed development is the *'Erection of a four-storey building to form seven self-contained apartments'.*

The new residential building will be built partly over the existing driveway and grassed garden area, with sections of the driveway to the east remaining as pedestrian access.

3.4. Ground Conditions

A ground investigation and infiltration tests are yet to take place at the development site. However, data for the ground conditions can be sourced from the British Geological Survey (BGS) website, where it identifies the development site to have superficial deposits of Till, Devensian (diamicton), over bedrock consisting of Chester Formation (sandstone).

The BGS website also shows borehole log data from areas 200m south-west of the site in Mauldeth Road, which are in the same superficial deposit / strata. As shown in Appendix B the boreholes identify the strata of the ground to predominantly consist of clay over sandstone. The data between the boreholes is consistent, and therefore it is assumed that the ground at the development site predominantly consist of clay.

3.5. Waterbodies

There are no known waterbodies near the development site, with the nearest being Cringle Brook approximately 200m to the east, Shaw Brook approximately 500m to the south, and the River Mersey approximately 4km to the south-west.

3.6. Existing Drainage and Existing Discharge Destination

The United Utilities plan in Appendix C shows the nearest public sewer to the site to be a 300mm combined water sewer that flows from north to south within Mitford Road (west of site). There will be no drainage networks within the existing garden area, and no known surface water networks within the driveway area. It is assumed that surface water run-off from the driveway discharges onto Mitford Road and subsequently into the combined sewer via road gullies.

3.7. Surface Water Management Area

The surface water management area will consist of the new residential building only (external areas remaining as existing), which equates to 130m² / 0.013 ha.

The surface water run-off from driveway area equates to 60m² / 0.006 ha, and therefore the development will have an urban factor of 0.46 (60m² / 130m²) for the greenfield calculations, and a surface water run-off area of 0.006 ha for the pre-development calculations.

4. Surface Water Management Principles

The surface water for the development site is to be managed so that it adheres to the current national regulations and local authority requirements.

4.1. Run-Off Destination

Surface water run-off is to discharge to one or more of the following in the order of priority shown:

- Discharge into the ground (infiltration);
- Discharge to a surface water body;
- Discharge to a surface water sewer, highway drain or other drain;
- Discharge to combined sewer.

4.2. The Management Train

A concept fundamental to implementing a successful SuDS scheme is the management train. This is a sequence of SuDS components that serve to reduce run-off rates and volumes and reduce pollution. The hierarchy of techniques that are to be used for the surface water management of the development are:

- Prevention - Prevention of run-off by good site design and reduction of impermeable areas;
- Source Control - Dealing with water where and when it falls (e.g. infiltration techniques);
- Site Control - Management of water in the local area (e.g. swales, detention basins);
- Regional Control - Management of run-off from sites (e.g. balancing ponds, wetlands).

4.3. Design Principles

The design principles for the surface water management of the development will be to:

- Ensure that people, property, and critical infrastructure are protected from flooding;
- Ensure that the development does not increase flood risk off site;
- Ensure that SuDS can be economically maintained for the development.

4.4. Peak Surface Water Flow

Non-Statutory Technical Standards for Sustainable Drainage Systems states:

S2 *For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.*

S3 *For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event'.*

Planning condition 9 states:

'In the event of surface water draining to the combined public sewer, the pass forward flow rate to the public sewer must be restricted to 6l/s'.

The development is a brownfield site. Therefore, based on the above guidance and panning condition, the rates will be as low as possible, but will not exceed the pre-development rates or 6 l/s.

4.5. Volume Control

National Non-statutory technical standards for sustainable drainage systems states:

'S4 *Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.*

S5 *Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.*

S6 *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.*

4.6. Flood Risk within Development

National Non-statutory technical standards for sustainable drainage systems states:

*'**S7** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year rainfall event.*

S8 *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.*

S9 *The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property'.*

4.7. Pollution / Water Quality

The SuDS design for the development site will ensure that the quality of any receiving water body is not adversely affected and preferably enhanced in accordance with Ciria SuDS Manual C753, Chapter 4.

4.8. Designing for Exceedance

The development site design will be such that when SuDS features fail or are exceeded, exceedance flows do not cause flooding of properties on or off site. This is achieved by completely containing the surface water within the drainage system (including areas designed to hold or convey water) for all events up to a 1 in 30-year event. The design of the site ensures that flows from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that avoid risk to people and property both on and off site.

5. Surface Water Run-Off Destination

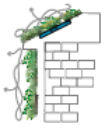
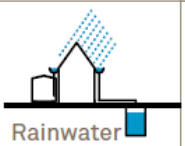
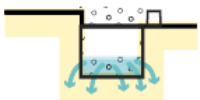
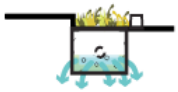
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

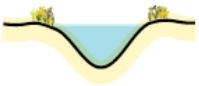
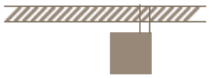
Run-Off Destination	Feasible / Required	Description
Discharge to Ground	No	BGS data identifies the ground at the site to predominantly consist of clay over sandstone. Clay is known to have exceptionally low or no infiltration value, and therefore discharge of surface water to clay is not feasible. The proposed residential building also occupies most of the development site (external areas remaining as existing). Approved Document H states that soakaways are to be at least 5m from a structure. This can't be achieved for the development, and therefore the use of soakaways to discharge the surface water to ground is not feasible.
Discharge to Surface Water Body	No	There are no known waterbodies near to the development site, and therefore this is not a feasible discharge destination.
Discharge to Surface Water Sewer	No	There are no known surface water sewers near to the development site, and therefore this is not a feasible discharge destination.
Discharge to Highway Drain or Other	No	There are no known highway drains near to the development site, and therefore this is not a feasible discharge destination.
Discharge to Combined Water Network	**Yes**	As the ground is not suitable for infiltration, there being inadequate areas for a soakaway, and there being no waterbodies, surface water sewers to highway drains near the site, the only alternative is to discharge to the 300mm combined water sewer in Mitford Road. **This will replicate the surface water run-off destination of the existing driveway areas of the site.**

6. SuDS Feasibility

To reduce the surface water run-off to the greenfield rate, SuDS methods are to be introduced to the post development design.

SuDS methods as per the Sustainable Drainage System (SuDS) hierarchy, and the Non-Statutory Technical Standards for Sustainable Drainage Systems – March 2015, that can be used are detailed below:

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	Building	Building integrated.
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	Building	Water storage (underground or above ground).
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	Open space	Dependant on runoff volumes and soils.
Filter Strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	Open space	Minimum length 5 metres.
Permeable paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	Street/open space	Can typically drain double its area.
 Bioretention area	A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	Street/open space	Typically surface area is 5-10% of drained area with storage below.

	Description	Setting	Required area
Swale	Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	Street/open space	Account for width to allow safe maintenancce typically 2-3 metres wide.
Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Open space	Could be above or below ground and sized to storage need.
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open space	Dependant on runoff volumes and soils.
Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open space	Typically 5-15% of drainage area to provide good treatment.
 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	Open space	Dependant on runoff volumes and soils.

The feasibility of the above SuDS methods for the post developed site are summarised in the table below:

SuDS Method	**Feasible Use**	**Description**
Green Roofs	No	The roof of the new building will be pitched, and therefore will not be suitable for green roofs.
Rainwater Harvesting	**Yes**	Rainwater harvesting for water re-use has not been considered for the development due to the cost of a dual pipe network being installed in an existing building with existing water main connections. However, water butts could potentially be installed at rainwater pipes with water re-used for irrigation.
Soakaway	No	BGS data identifies the ground at the site to predominantly consist of clay over sandstone. Clay is known to have exceptionally low or no infiltration value. The proposed residential building also occupies most of the development site (external areas remaining as existing). Approved Document H states that soakaways are to be at least 5m from a structure. This can't be achieved for the development, and therefore the use of soakaways to discharge the surface water to ground is not feasible.

Filter Strips	No	The development site is for a new building only, with the external areas remaining as existing. Therefore, there is no scope to incorporate filter drains into the sustainable drainage design.
Permeable Paving	No	The development site is for a new building only, with the external areas remaining as existing. Therefore, there is no scope to incorporate permeable paving into the sustainable drainage design.
Raised Planters	**Yes**	Raised planters can be installed at the rainwater down pipe location of the new building (where water butts aren't being used). The surface water from the rainwater pipe will percolate through the raised planter prior to discharge to the main drainage network. This will treat the surface water at source and act as a pollutant control.
Ponds / Swales / Bioretention Areas	No	The development site is for a new building only, with the external areas remaining as existing. Therefore, there is no scope to incorporate ponds, swales or bioretention areas into the sustainable drainage design.
Underground Storage	**Yes**	The surface water run-off from the development site will be restricted. The restricted rate will be lower than the surface water run-off rate, therefore there will be a requirement to have underground storage in the form of cellular units.

7. Development Greenfield Run-Off Rates and Volume

To minimise the surface water run-off from the new development areas of the site, it is preferred that the post development surface water run-off be restricted to the equivalent greenfield run-off rate and volumes.

7.1. Greenfield Run-Off Rate

The Flood Estimation Handbook (FEH) is often used for the calculation of the greenfield run-off rate, however, relevant documents state that to calculate the greenfield run-off rates on small catchments less than 25km², the IH 124 QBAR equation (and the equation for the instantaneous time to peak for the unit hydrograph approach) is to be used.

The IH method is based on the Flood Studies Report (FSR) approach and is developed for use on catchments less than 25km². It yields the Mean Annual Maximum Flood (QBAR). This reference also recommends the use Ciria C753 Table 24.2 to generate Growth Factors. These are used to convert QBAR to different return periods for different regions in the UK. The input variables to establish QBAR are:

Return Period (years)	Results based on a range of return periods and the specified RP;
Area	Catchment Area (ha) which is adjusted to km2 for use in the equation;
SAAR	Average annual rainfall in mm (1941-1970) from FSR figure II.3.1;
Soil	Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively;
Urban	Proportion of area urbanised expressed as a decimal;
Region Number	Region number of the catchment based on FSR Figure I.2.4.
QBAR(l/s)	

The output variables to establish QBAR are calculated using the following formula (equation yields m³/s):

QBAR = 0.00108 x AREA0.89 x SAAR1.17 x SOIL2.17

The IH 124 Variables (taken from FSR) that are specific to this site are as follows:

Area	=	50.00 ha (required area for calculation)
SAAR	=	860
Soil	=	0.450
Urban Factor	=	0.46
Region Number	=	10

The calculations in Appendix D, show the rate for 50.00ha is 517.0 l/s, but is to be reduced to reflect the surface water management area (0.013 ha) of the development site. Therefore, the QBAR (greenfield run-off) for development area has been calculated to be:

QBAR = 0.13 l/s (10.34 l/s/ha)

Ciria C753 Table 24.2 identifies the growth factors for each of the storm events, based on the known QBAR figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 10.

Based on the figures shown in the table, the growth factors, and the existing greenfield run-off rates for each of the storm events for the development areas of the site are as follows:

Storm Event	QBAR	Growth Factor (C753 Table 24.2)	Greenfield Run-off Rate
Q_2	0.13 l/s	0.87	**0.1 l/s**
Q_{30}	0.13 l/s	1.70	**0.2 l/s**
Q_{100}	0.13 l/s	2.08	**0.3 l/s**

7.2. Greenfield Run-Off Volume

The greenfield run-off volume for the 100-year, 6-hour storm event has also been calculated in the MicroDrainage software using the data from the Flood Estimation Handbook (FEH), with the results shown in Appendix D. The FEH data and variables used to calculate the greenfield run-off volume at the development site locations are as follows:

Site Location = GB 385700 393550 SJ 85700 93550

C (1km) = -0.026

D1 (1km) = 0.325

D2(1km) = 0.380

D3 (1km) = 0.312

E (1km) = 0.303

F (1km) = 2.466

Areal Reduction Factor = 1.000

Area = 396.750 ha

SAAR = 870

CWI = 102.733

SPR Host = 39.550

URBTEXT = 0.46

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix D), the greenfield run-off volume for the overall catchment area at the site location is:

$Q_{100\ (6\text{-Hour})}$ = 135,090.239m³

This figure is for the catchment area of 396.750 ha and is to be reduced to reflect the surface water management area of the development site which is 0.013 ha.

$Q_{100\ (6\text{-Hour})}$ = **4.43m³** (340.49m³/ha)

8. Pre-Development Surface Water Run-Off Rates and Volume

The pre-development surface water run-off rates and volume from the existing driveway area are to be calculated, so that the post development rates and volume do not exceed.

The calculations to determine the pre-development surface water run-off rates are based on the pre-development surface water run-off area of 0.006 ha, and the data given by the Flood Estimation Handbook (FEH).

The pre-development surface water run-off rates and volume have also been simulated in the MicroDrainage software (Appendix E), where the variables used (FEH data) to calculate the surface water run-off rates and volumes are as follows:

Pre-Development Area	=	0.006 ha
Site Location	=	GB 385700 393550 SJ 85700 93550
C (1km)	=	-0.026
D1 (1km)	=	0.325
D2(1km)	=	0.380
D3 (1km)	=	0.312
E (1km)	=	0.303
F (1km)	=	2.466

Based on the above variables and computer software results, the pre-development surface water run-off rates will be as follows:

Q_1	=	0.7 l/s (15-minute storm duration*)
Q_{30}	=	2.5 l/s (15-minute storm duration*)
Q_{100}	=	3.8 l/s (15-minute storm duration*)

**The critical storm duration for each of the return period is 15 minutes.*

Based on the above variables for the surface water run-off from the pre-development impermeable area, it has been calculated that the pre-development surface water discharge volume for the pre-development site (at 6-hour storm events) are as follows:

Q_{100}	=	3.38m³ (360-minute storm duration)

9. Below Ground Drainage Networks and SW Management Calculations

9.1. Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The recommended allowances are taken from the Environment Agency guidance (Table 2) summarised in Table 4 below.

Applies across all of England	Total change anticipated for the 2020's	Total change anticipated for the 2050's	Total change anticipated for the 2080's
Upper End	10%	20%	**45%**
Central	5%	10%	20%

The baseline year is 1961 to 1990. It is anticipated the life span of the residential building will be approximately 80 years, and therefore will fall at least into the 2080's and will have rainfall intensity increase of **45%**.

9.2. Surface Water Network Calculations

The FEH data and variables used to calculate the required below ground network and attenuation volumes at the development site are as follows:

SW Management Area = 0.013 ha

Site Location = GB 385700 393550 SJ 85700 93550

C (1km) = -0.026

D1 (1km) = 0.325

D2(1km) = 0.380

D3 (1km) = 0.312

E (1km) = 0.303

F (1km) = 2.466

9.3. Surface Water Drainage Network and Management

As shown on the surface water management layout drawing in Appendix F, the proposed surface water network will consist of 150mm diameter pipes, 460mm diameter inspection chambers, a 1200m diameter flow control chamber containing a hydro-brake, 460mm diameter silt trap chambers, water butts, raised planters, and attenuation tank in the form of cellular units.

The surface water run-off from the new roof areas will discharge to the main network via the raised planters and water butts. The surface water network will flow towards the western boundary of the site and will discharge through a flow control chamber prior to discharge to the United Utilities 300mm diameter combined water sewer in Mitford Road.

The surface water will surcharge the drainage network when being restricted and will discharge back into the cellular units, where the water will be stored to prevent flooding. Post storm event, the water levels in the cellular units will drop and flow back to the network and through the control chamber to the combined water system.

9.4. Surface Water Run-Off Rate

For the surface water run-off from the surface water management area to be at the greenfield run-off rate, the surface water run-off is to be restricted to 0.1 l/s for the 1 in 1-year storm event; 0.2 l/s for the 1 in 30-year storm event, and 0.3 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase (climate change).

For the surface water run-off to be a reduction of or equivalent to the pre-development rates, the post development run-off is to be restricted to at less than 0.7 l/s for the 1 in 1-year storm event; 2.5 l/s for the 1 in 30-year storm event, and 3.8 l/s for the 1 in 100-year storm event including 40% rainfall intensity increase (climate change).

For the surface water run-off from the surface water management area to meet the local authority planning condition requirements, they are to be reduced to at least 6 l/s.

An assessment of the suitable flow control opening, and subsequent surface water discharge needs to assessed, where Ciria document C753 – The SuDS Manual states that: *'the flow controls / orifice design should be designed so that it has simplicity on operation, and has resistance to clogging, blocking or mechanical failure'.*

And the previous Ciria SuDS Manual (C697) states that: *'the limiting discharge rate is to consider a minimum practical orifice size. The minimum size of opening in an orifice plate or vortex control to provide an acceptable risk of blockage is often accepted to be 75mm'.*

The flow controls therefore are to be a suitable diameter where the surface water run-off discharge from the development area of the site will be a size where the likelihood of blockage and subsequent flooding is reduced.

It is deemed that reducing the rates to the equivalent greenfield (0.1 l/s – 0.3 l/s) will result in the control opening being too small to prevent blockage, and therefore, the aim of the flow control will be to reduce the post development run-off rates to the equivalent to or less than the pre-development run-off rates.

To achieve this, it is proposed to use a complex flow control chamber, where a hydro-brake at the invert level of the chamber will restrict the surface water during 1-year storm event, and an orifice plate set higher in the chamber, will allow additional surface water flow from the chamber during the 100-year + 40% climate change storm events.

As shown in the output calculation from the MicroDrainage computer software in Appendix G, if the hydro-brake opening is set at 75mm, with a design head of 0.60m, and a design flow of 2.1 l/s, and an orifice is set 0.750m above the hydro-brake with a 75mm opening, the maximum surface water run-off rates for each storm event will be as follows:

Strom	**-**	**Rate**	**-**	**Critical Storm Event**
Q_1	-	1.6 l/s	-	15-minute winter storm duration
Q_{30}	-	2.1 l/s	-	15-minute winter storm duration
$Q_{100 + CC}$	-	2.3 l/s	-	15-minute winter storm duration

A summary of the post development surface water run-off rates compared to the greenfield and pre-development rates are as follows:

Greenfield Rate to Post Development Rate

Strom	**-**	**Greenfield**	**-**	**Post Dev**	**-**	**Difference**
Q_1	-	0.1 l/s	-	1.6 l/s	-	16.0 x Greenfield
Q_{30}	-	0.2 l/s	-	2.1 l/s	-	10.5 x Greenfield
Q_{100}	-	0.3 l/s	-	2.3 l/s	-	7.7 x Greenfield

Pre-Development Rate to Post Development Rate

Strom	-	Pre-Dev	-	Post Dev	-	Difference
Q_1	-	0.7 l/s	-	1.6 l/s	-	2.3 x Pre-Development
Q_{30}	-	2.5 l/s	-	2.1 l/s	-	16% Reduction
Q_{100}	-	3.8 l/s	-	2.3 l/s	-	40% Reduction

The results show that the post development run-off rates exceed the greenfield rates (as detailed previously) and 1-year pre-development rate, but are between 16% and 40% reduction of the 30-year and 100-year pre-development rates, respectively, and less than the 6 l/s stated in the local authority planning condition.

As the rates are reduced to as low as possible with practical flow control opening (minimum 75mm), and exceed the required maxim rate of 6.0 l/s, they are deemed to be acceptable.

9.5. Surface Water Run-Off Volume

The surface water run-off volumes for the post development site have also been calculated for 1 in 100-Year the 6-hour duration (Inc. 40% RII), in the MicroDrainage calculation in Appendix G, where the volume equates to:

$Q_{100\ (6\text{-Hour})}$ = 15.42 l/s

A summary of the post development run-off volumes compared to the greenfield and pre-development are as follows:

Greenfield Volume to Post Development Volume

Strom	-	Greenfield	-	Post Dev	-	Difference
Q_{100}	-	4.43m³	-	15.37m³	-	3.5 x Greenfield

Pre-Development Volume to Post Development Volume

Strom	-	Pre-Dev	-	Post Dev	-	Difference
Q_{100}	-	3.38m³	-	15.37m³	-	4.5 x Pre-Development

The post development surface water run-off volume exceeds the greenfield and pre-development volume. However, as the run-off rate has been reduced to a 45% reduction of the pre-development, the rate at which the volume of water is discharged off the site will not adversely affect flood risk. Therefore, the volume still meets the requirements of the Non-Statutory Technical Standards for Sustainable Drainage Systems.

9.6. Surface Water Attenuation Calculations

As stated above, the post development run-off rates are restricted, there will be a requirement for surface water attenuation.

Ciria SuDS Manual 2015, Paragraph 10.2.4 states that: *'Exceedance flows (i.e. flows in excess of those for which the system is designed) should be managed safely in above-ground space such that risks to people and property are acceptable'.*

And PPS25 Practice Guidance Paragraph 5.51 previously stated that: *'For events with a return-period in excess of 30 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property, and avoid creating hazards to access and egress routes. No flooding of property should occur as a result of a one in 100-year storm event (including an appropriate allowance for climate change)'.*

As detailed in the MicroDrainage calculations (Appendix G) and surface water management layout (Appendix F) the

attenuation volumes for the cellular units are as follows

Attenuation Tank - Cellular Units

Tank Length	-	6.00m
Tank With	-	1.00m
Total Tank Areas	-	6.00m²
Tank Depth	-	0.80m
Tank Porosity	-	0.95
Attenuation Volume	-	**4.56m³**
Total Tank Volume	-	**4.80m³**

The MicroDrainage calculations (Appendix G) show no flooding will occur from the network for all storms up to and including the 1 in 100-year event + 40% climate change, when reduced to the equivalent and betterment of the pre-development rates.

10. Maintenance Requirements

Details of the maintenance required, and the parties to carry out the maintenance of all drainage aspects, to ensure that the SuDS methods are working affectively, and subsequently reducing the risk of flooding on the site are as follows:

The management and maintenance of the surface water drainage networks and SuDS features will be by contractors appointed by the owners / residents of the new residential units, where payments of the works will form part of the property deeds and / or rental agreements, and will form part of the overall ground rent for the overall development site and communal areas.

This is common practice for multi-unit residential buildings / development. The maintenance and management will be carried out as follows:

10.1. Surface Water Drainage Network and Flow Control

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from manholes (where may cause risk performance)	Monthly
Where rainfall into network from above, check surface or filter for blockage or silt, algae, or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Repair/check all inlets, outlets, and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

10.2. Water Butts and Raised Planters

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from / on surface of raised planter or inside water butts (where may cause risk performance)	Monthly
Rainfall infiltration into raised planter is ensured working effectively.	As required, but at least twice a year

10.3. Linked and Further Maintenance Activities

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance for the new residential landscaped / garden areas. A log of all maintenance activities is to be kept and made available to the local planning authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.

11. Surface Water Design Exceedance

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur.

Surface water flow paths to follow existing and proposed ground topography, where water will flow towards the western and will discharge into Mitford Road.

Flood water will flow away from the new residential building, and will be contained within Mitford Road to the upstand kerbs and road gradient (surface water flows within road channels). Surface water ill not flow directly towards existing dwellings / properties outside the development boundary prior to discharge to Mitford Road.

12. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment.

12.1. Roof Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level = Very Low

C753 Table 26.2 Pollution Hazard Index:

Total Suspended Solid (TSS) = 0.2

Metals = 0.2

Hydrocarbons = 0.05

Pollution Hazard Index = **0.45**

12.2. Roof Areas Pollutant Mitigation

Mitigation Measures:

Raised Planters

The Pollutant Mitigation Indices:

Total Suspended Solid (TSS)	=	0.4
Metals	=	0.4
Hydrocarbons	=	0.4
Pollution Hazard Index	=	**1.20**

The mitigation indices is greater than the pollution hazard index, and therefore suitable water quality is achieved.

13. Development Management and Construction Phase

All existing drainage networks within the development area are to be maintained during construction. The cellular units and flow control chamber are to be the first part of the drainage network to be built. This will ensure that the surface water discharge is suitably restricted without flooding.

13.1. Construction Environment Management Plan

Full details of the construction environment management plan (CEMP) has to be confirmed by the chosen contractor who have been appointed for the development. However, it will conform to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31, and will be as follows:

13.2. Construction Access

The main construction traffic will access the site from the west (Mitford Road).

13.3. Sediments and Traps

Sediment basins and traps are to be installed before any major site earthworks take place, with further sediment traps and silt fences being installed as the earthworks progresses. This will keep sediment contained on site at appropriate locations.

13.4. Run-Off Control Measures

Run-off control measures are to be used in conjunction with sediment traps to divert water around planned earthworks areas to remove silts. Any surface water upstream of the site is to be diverted around the development areas, and to discharge to the existing combined water sewer system.

13.5. Main Surface Water Run-Off Systems

The cellular units, flow control chamber and outfall to are to be built prior to any phase of construction of site. Surface water from each of the phased area is to discharge to the new drainage network, where the water is adequately restricted, and water quality maintained before discharging to the brook. Temporary inlet and outlet protection measures and appropriate silt traps are to be installed to prevent silt ingress into the main drainage network.

14. Conclusion / Summary

14.1. SuDS Principles and Discharge Destination

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being water buts, raised planters, cellular units, and a flow control chamber, and the surface water destination being to a combined water sewer.

14.2. Peak Flow Control

The post development run-off rates exceed the greenfield rates (as detailed previously) and 1-year pre-development rate, but are between 16% and 40% reduction of the 30-year and 100-year pre-development rates, respectively, and less than the 6 l/s stated in the local authority planning condition.

As the rates are reduced to as low as possible with practical flow control opening (minimum 75mm), and exceed the required maxim rate of 6.0 l/s, they are deemed to be acceptable.

14.3. Volume Control

The post development surface water run-off volume exceeds the greenfield and pre-development volume. However, as the run-off rate has been reduced to a 45% reduction of the pre-development, the rate at which the volume of water is discharged off the site will not adversely affect flood risk. Therefore, the volume still meets the requirements of the Non-Statutory Technical Standards for Sustainable Drainage Systems.

14.4. Flood Risk within the Development

The below ground cellular unit structures will be suitably sized so that no flooding occurs form any part of the network for up to and including the 100-year + 40% climate change event.

14.5. Maintenance

The management and maintenance of the surface water drainage networks and SuDS features will be by contractors appointed by the owners / residents of the new residential units, where payments of the works will form part of the property deeds and / or rental agreements, and will form part of the overall ground rent for the overall development site and communal areas.

14.6. Surface Water Design Exceedance

Surface water flow paths to follow existing and proposed ground topography, where water will flow towards the western and will discharge into Mitford Road. Flood water will flow away from the new residential building, and will be contained within Mitford Road to the upstand kerbs and road gradient (surface water flows within road channels). Surface water ill not flow directly towards existing dwellings / properties outside the development boundary prior to discharge to Mitford Road.

14.7. Water Quality

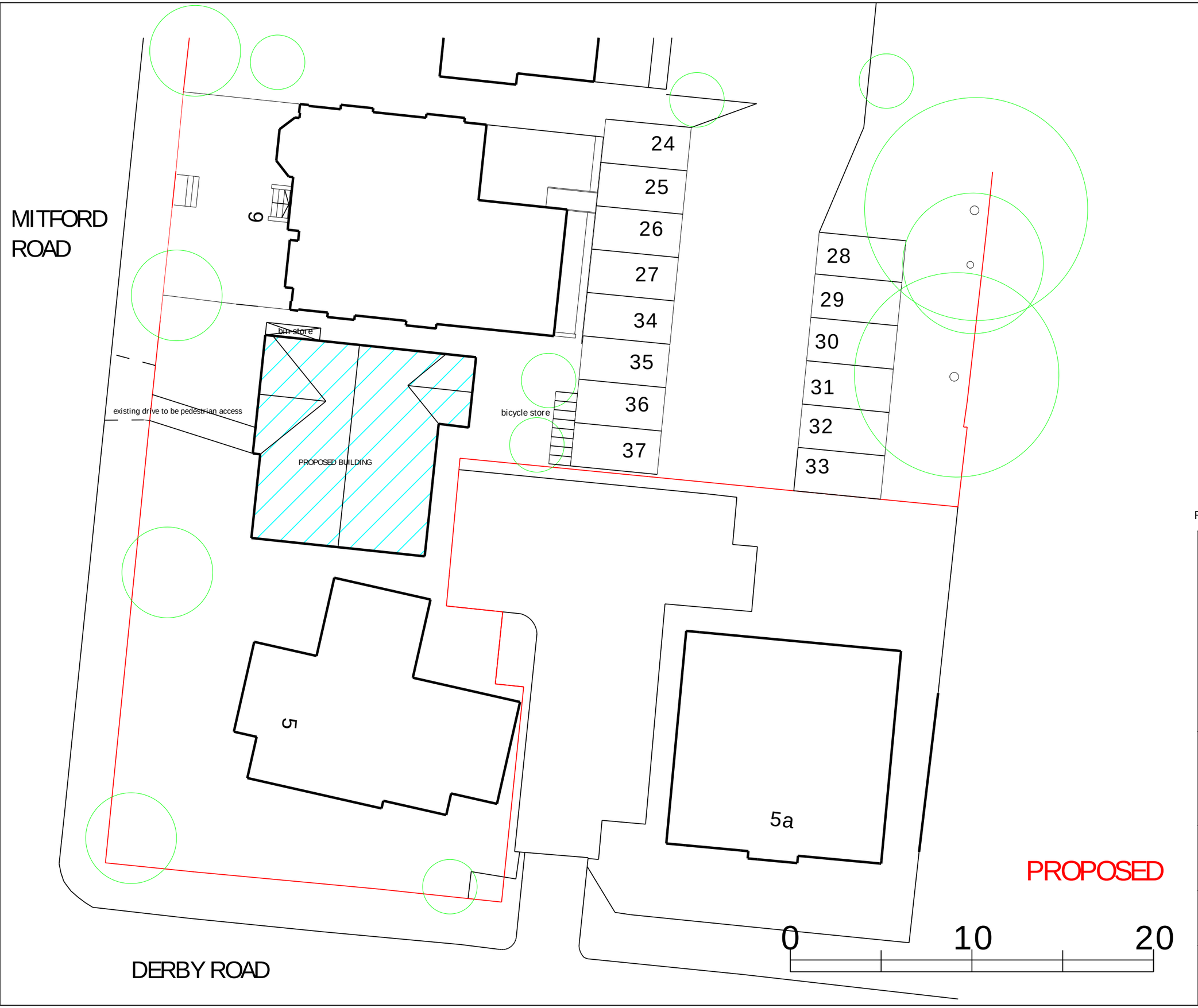
The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment. The mitigation indices is greater than the pollution hazard index, and therefore suitable water quality is achieved.

14.8. Development Management and Construction Phase

All existing drainage networks within the development area are to be maintained during construction. The cellular units and flow control chamber are to be the first part of the drainage network to be built. This will ensure that the surface water discharge is suitably restricted without pollutants or flooding. Full details of the construction environment management plan (CEMP) has to be confirmed by the chosen contractor, and will conform to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31.

Appendix A

Proposed Site Plans



RevA Date 20-12-19 Bicycle and bin store positioned

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PROJECT
9a Mitford Road
Fallowfield
Manchester M14 6UN

DRAWING
Scheme E Site Plan

DRAWING NUMBER
L619 / 18RevA

DATE 20-09-19

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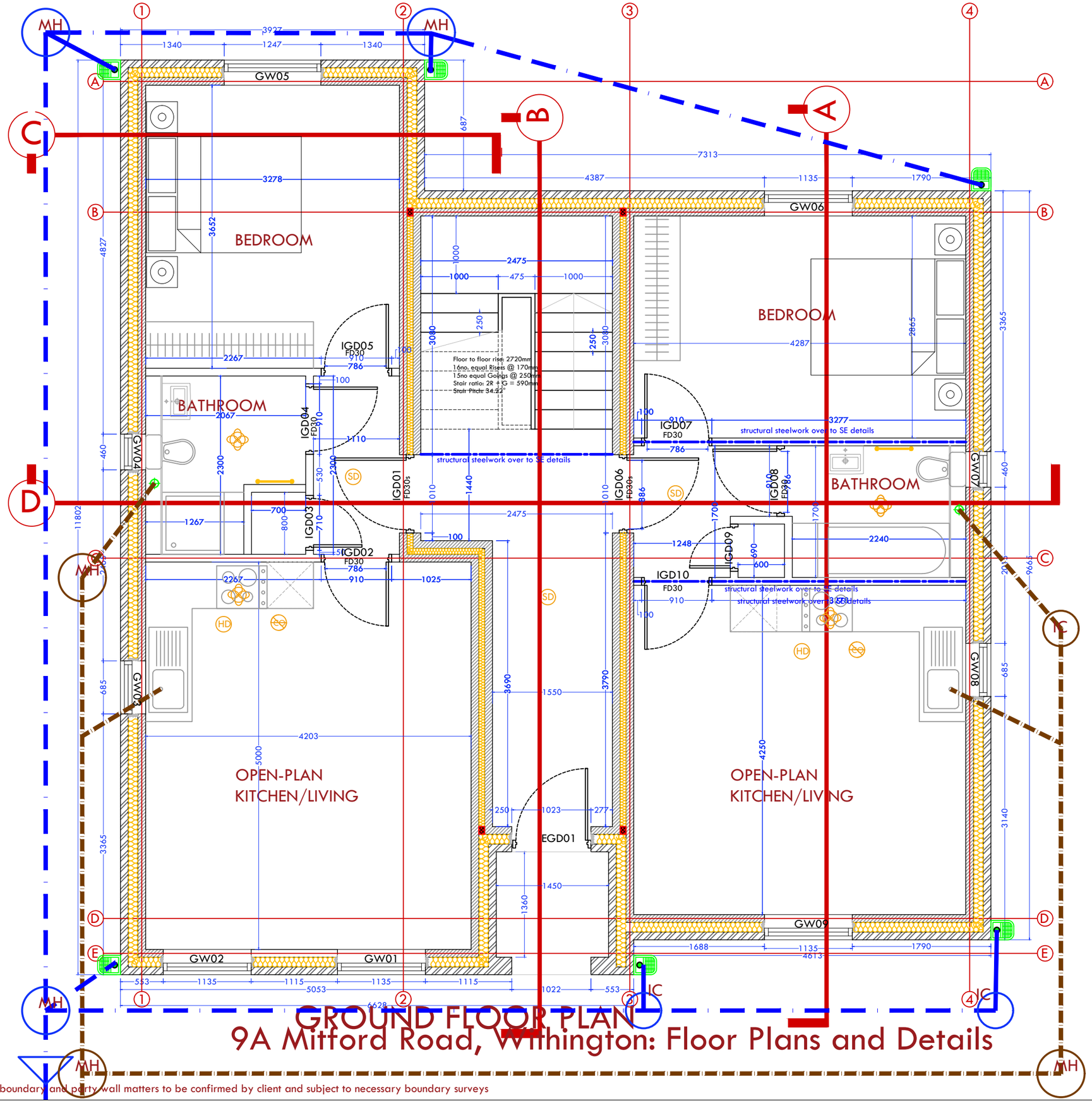

GROUND FLOOR PLAN
9A Mitford Road, Withington: Floor Plans and Details

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys

WALL TYPES

BRICK CAVITY WALL
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
125mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm brickwork to LPA approval
U-Value: 0.22W/m^{2}k

PARTY/SEPARATING CAVITY WALL
(Robust Detail Ref E-WM-17)
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
75mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm medium density blockwork to SE detail
1x12.5mm Gyproc Wallboard* on dabs
3mm Skim finish
U-Value: 0.28W/m^{2}k

STUD PARTITION
3mm Skim finish
12.5mm Gyproc Wallboard* on dabs or similar approved
Gypframe C studs @600mm c/c with 25mm Isover Acoustic Partition Roll in the cavity
12.5mm Gyproc Wallboard* on dabs or similar approved
3mm Skim finish

*Plasterboard in wet/shower rooms to be 12.5mm Gyproc Moisture Resistant Boards or similar approved.

LEGEND

- SD — SMOKE DETECTORS REQUIRED TO COMPLY WITH APPROVED DOCUMENT B1.
- HD — HEAT DETECTOR REQUIRED TO COMPLY WITH APPROVED DOCUMENT B1.
- CEILING OR WALL MOUNTED EXTRACTOR FAN.
- CO — CARBON MONOXIDE DETECTOR (BATTERY OPERATED)
- HEATED TOWEL / STEEL PANEL RADIATOR- STYLE TBC BY CLIENT.
- Ø75mm RWP with access gulley
- Back Inlet Gulley
- Ø110mm SVP
- Ø75mm Rain Water Pipe

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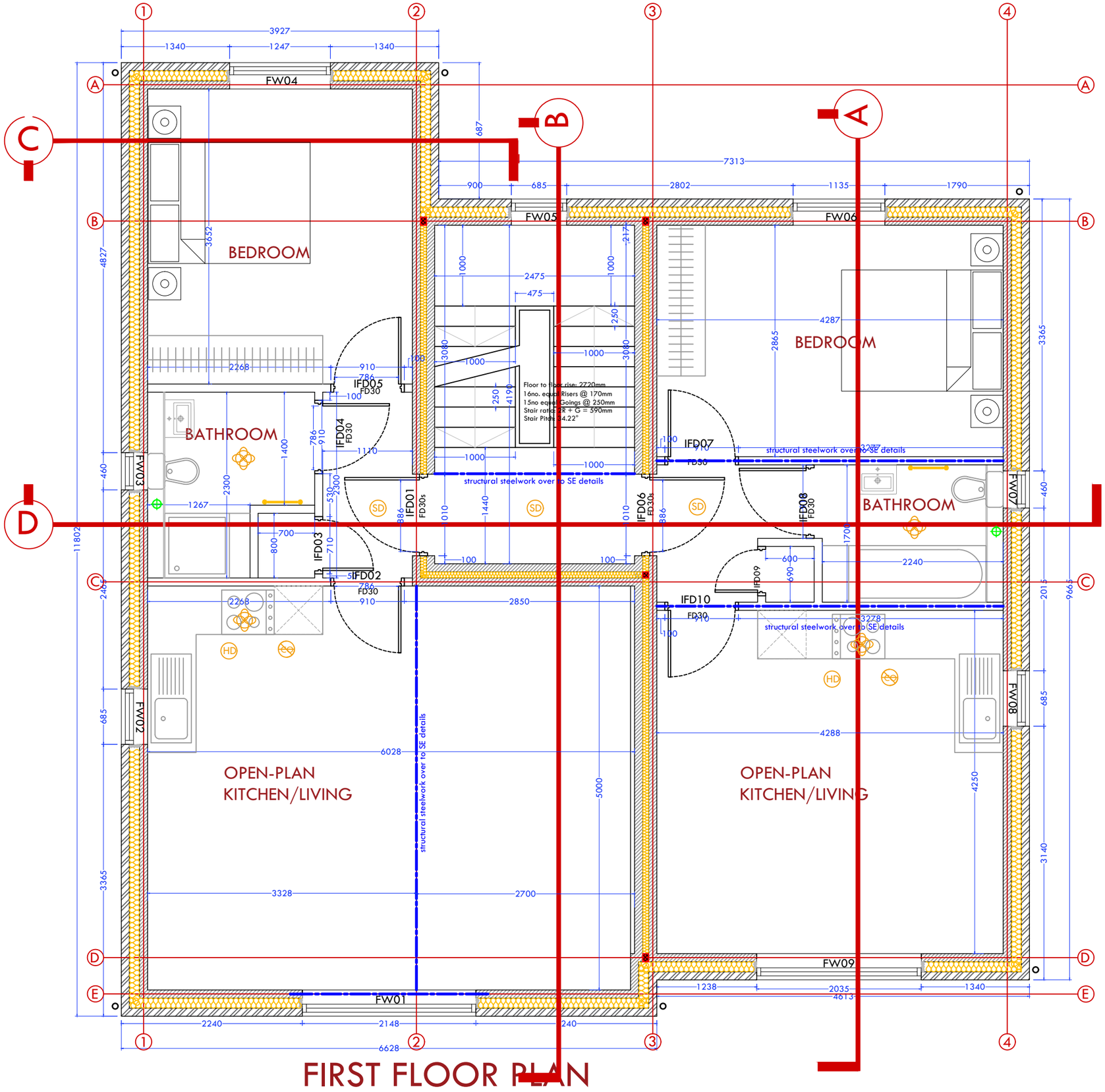
9a Mitford Road
Fallowfield
Manchester M14 6UN

DRAWING: Ground Floor Plan
SCALE: 1:50

DRAWING NUMBER: L619/30

DATE: 24/05/2022



FIRST FLOOR PLAN

WALL TYPES

BRICK CAVITY WALL
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
125mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm brickwork to LPA approval
U-Value: 0.22W/m^{2}k

PARTY/SEPARATING CAVITY WALL
(Robust Detail Ref E-WM-17)
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
75mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm medium density blockwork to SE detail
1x12.5mm Gyproc Wallboard* on dabs
3mm Skim finish
U-Value: 0.28W/m^{2}k

STUD PARTITION
3mm Skim finish
12.5mm Gyproc Wallboard* on dabs or similar approved
Gypframe C studs @600mm c/c with 25mm Isover Acoustic Partition Roll in the cavity
12.5mm Gyproc Wallboard* on dabs or similar approved
3mm Skim finish

*Plasterboard in wet/shower rooms to be 12.5mm Gyproc Moisture Resistant Boards or similar approved.

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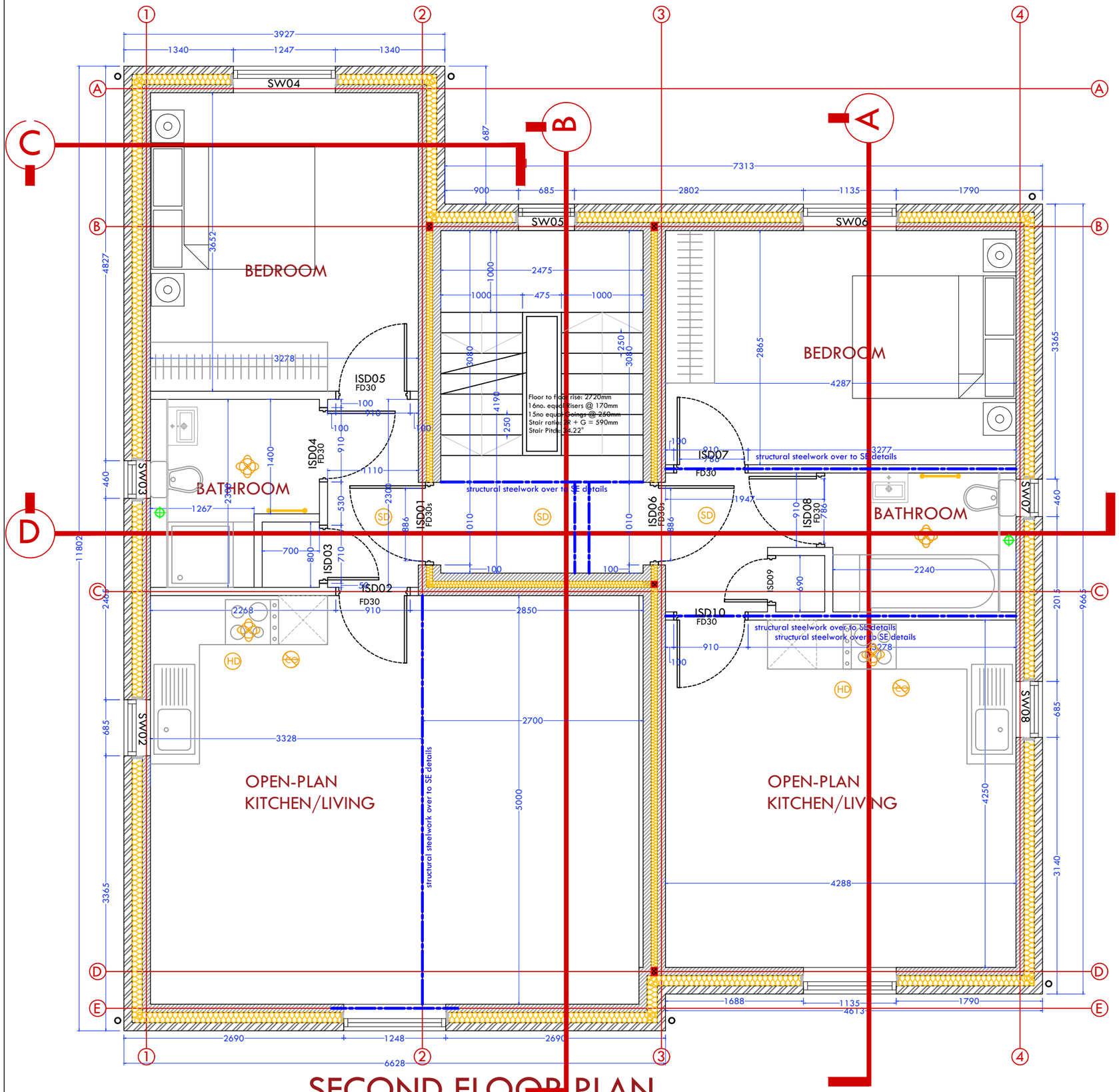
DRAWING: First Floor Plan
SCALE: 1:50

DRAWING NUMBER
L619/31

DATE
24/05/2022

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys



SECOND FLOOR PLAN
9A Mitford Road, Withington: Floor Plans and Details

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys

WALL TYPES

BRICK CAVITY WALL
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
125mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm brickwork to LPA approval
U-Value: 0.22W/m^{2}k

PARTY/SEPARATING CAVITY WALL
(Robust Detail Ref E-WM-17)
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
75mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm medium density blockwork to SE detail
1x12.5mm Gyproc Wallboard* on dabs
3mm Skim finish
U-Value: 0.28W/m^{2}k

STUD PARTITION
3mm Skim finish
12.5mm Gyproc Wallboard* on dabs or similar approved
Gypframe C studs @600mm c/c with 25mm Isover Acoustic Partition Roll in the cavity
12.5mm Gyproc Wallboard* on dabs or similar approved
3mm Skim finish

*Plasterboard in wet/shower rooms to be 12.5mm Gyproc Moisture Resistant Boards or similar approved.

LEGEND

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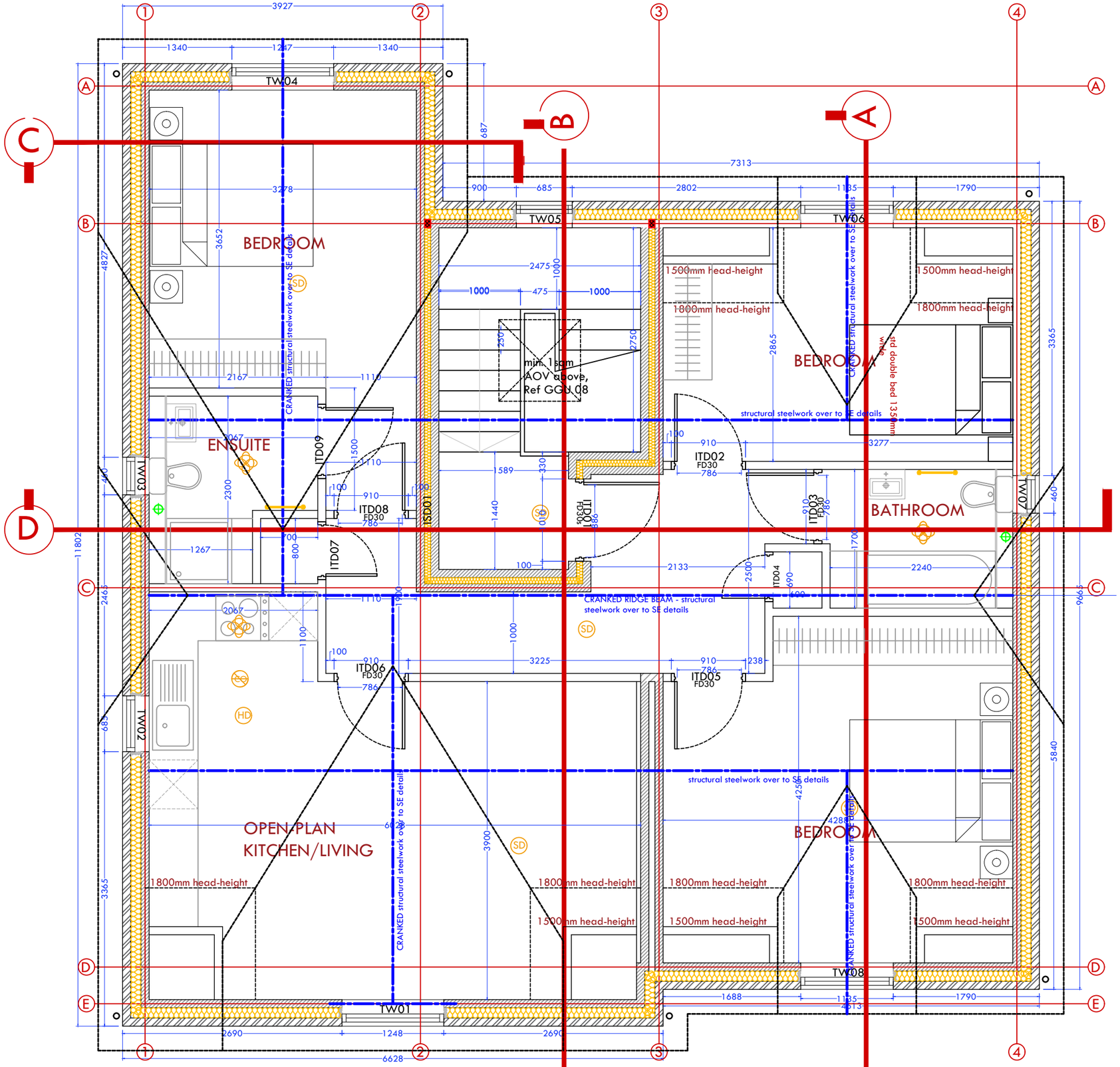
DRAWING	SCALE
Second Floor Plan	1:50

DRAWING NUMBER
L619/32

DATE
24/05/2022



THIRD FLOOR PLAN

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys

WALL TYPES

BRICK CAVITY WALL
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
125mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm brickwork to LPA approval
U-Value: 0.22W/m^{2}k

PARTY/SEPARATING CAVITY WALL
(Robust Detail Ref E-WM-17)
3mm Skim finish
1x12.5mm Gyproc Wallboard* on dabs
100mm medium density blockwork to SE detail
75mm cavity fully-filled with Knauf Dritherm 32 mineral wool slab
100mm medium density blockwork to SE detail
1x12.5mm Gyproc Wallboard* on dabs
3mm Skim finish
U-Value: 0.28W/m^{2}k

STUD PARTITION
3mm Skim finish
12.5mm Gyproc Wallboard* on dabs or similar approved
Gypframe C studs @600mm c/c with 25mm Isover Acoustic Partition Roll in the cavity
12.5mm Gyproc Wallboard* on dabs or similar approved
3mm Skim finish

*Plasterboard in wet/shower rooms to be 12.5mm Gyproc Moisture Resistant Boards or similar approved.

LEGEND

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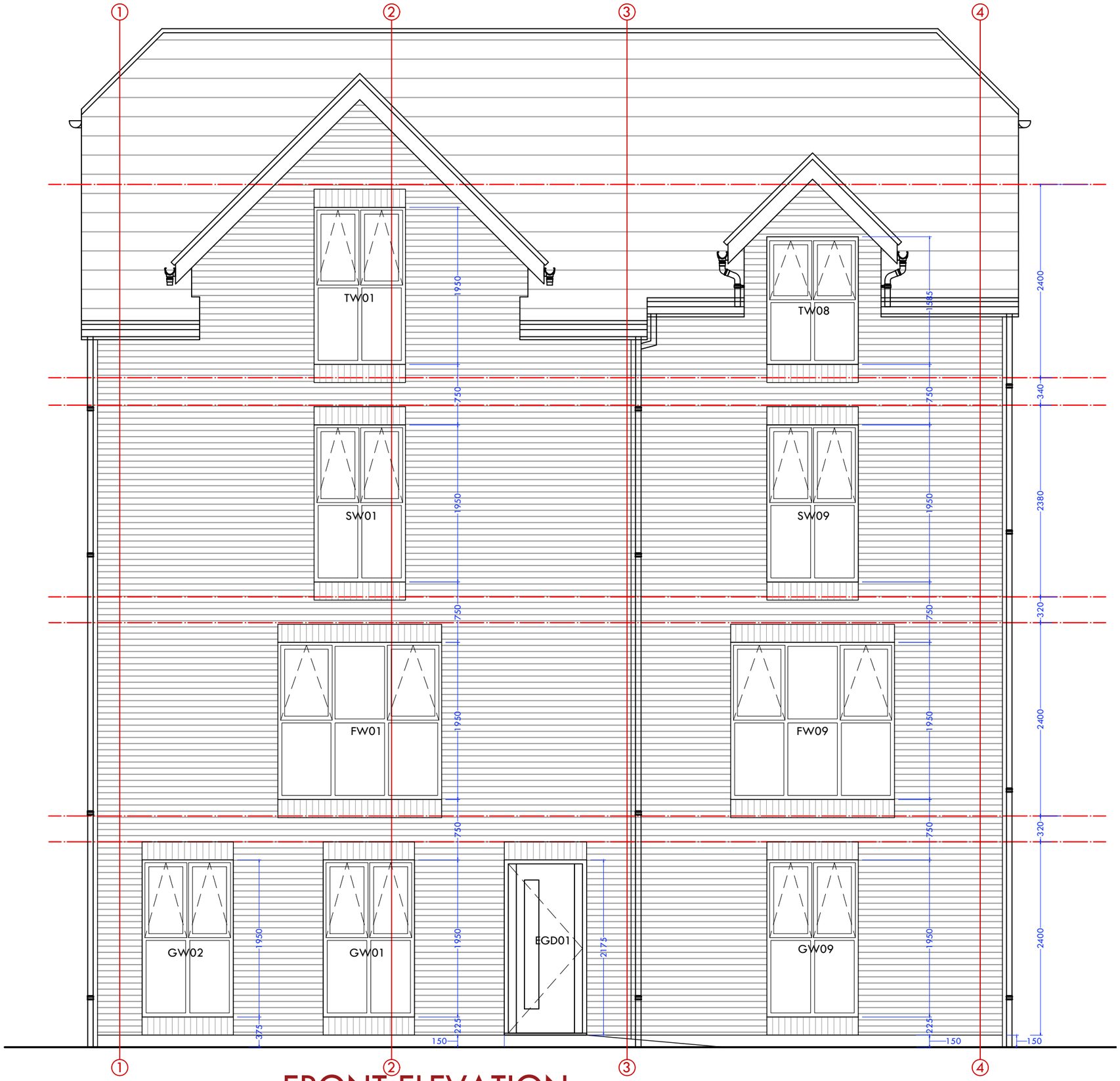
DRAWING	SCALE
Third Floor Plan	1:50

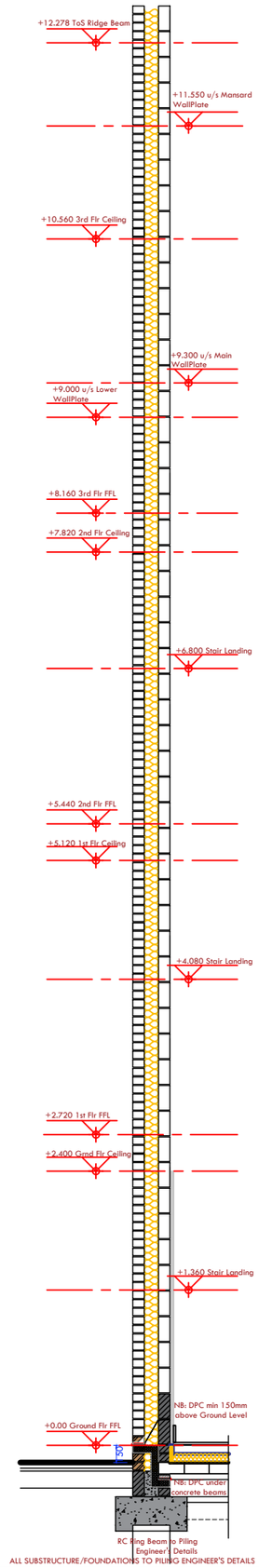
DRAWING NUMBER
L619/33

DATE
24/05/2022



FRONT ELEVATION

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys



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Manchester M16 9HA
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M 07710 539748
E info@leearchitects.co.uk

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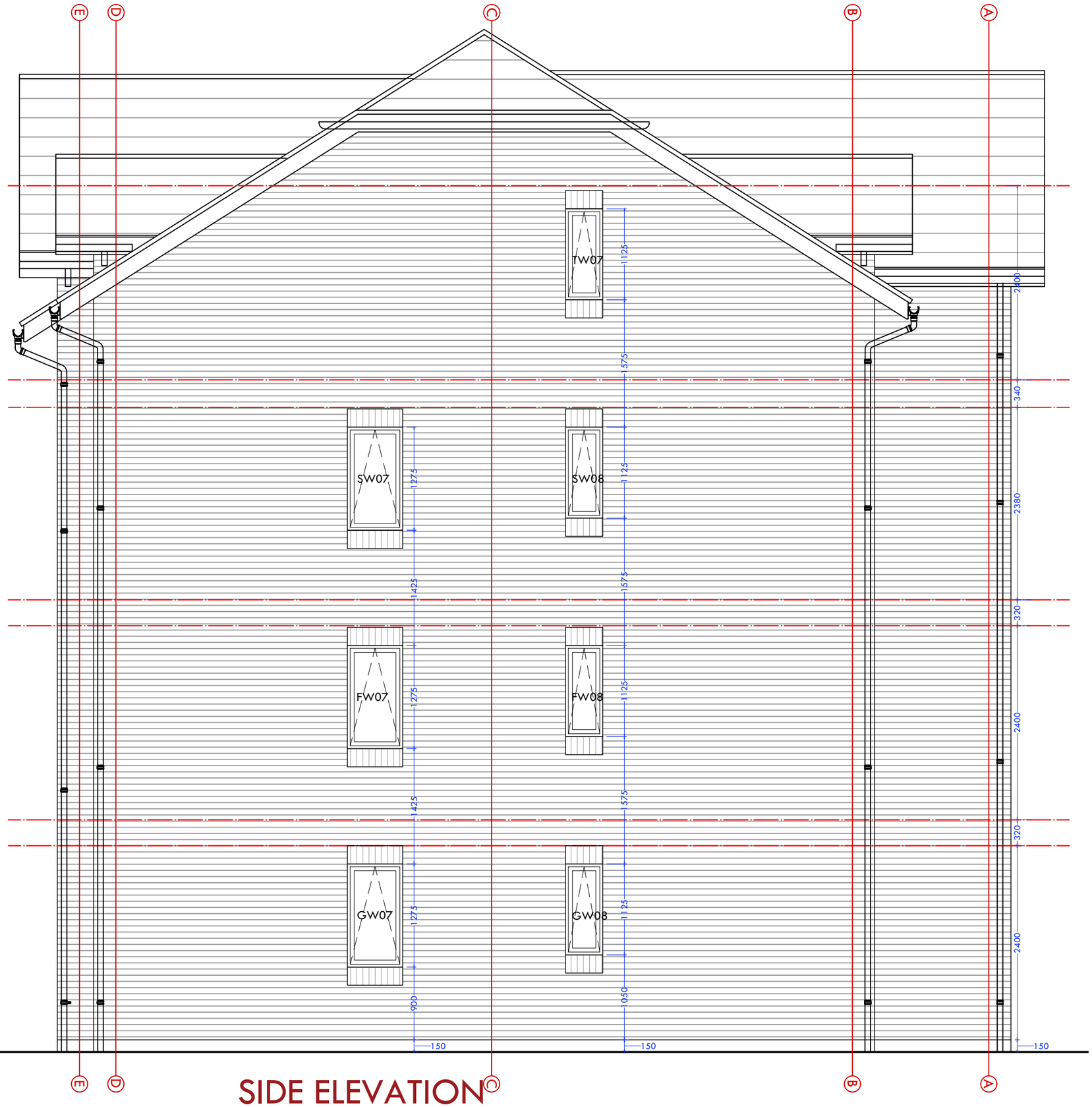
CLIENT

PROJECT
9a Mitford Road
Fallowfield
Manchester M14 6UN

DRAWING	SCALE
Front Elevation	1:50

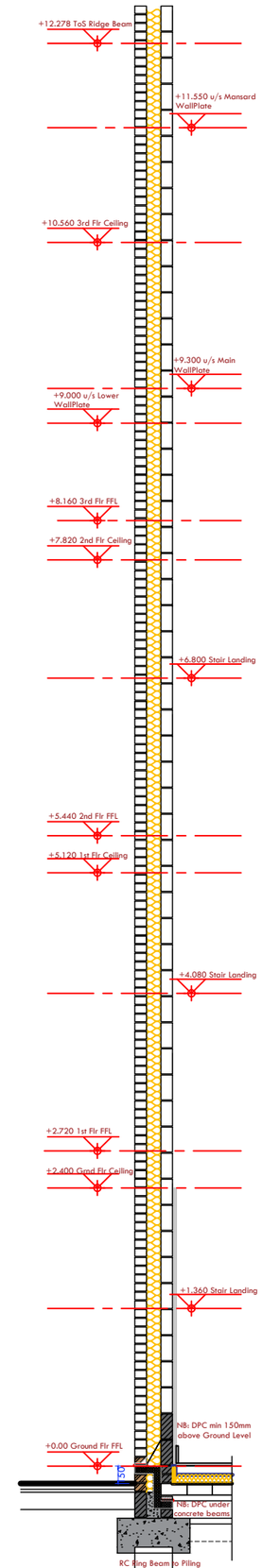
DRAWING NUMBER
L619/35

DATE
24/05/2022



SIDE ELEVATION

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys



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Manchester M14 6UN

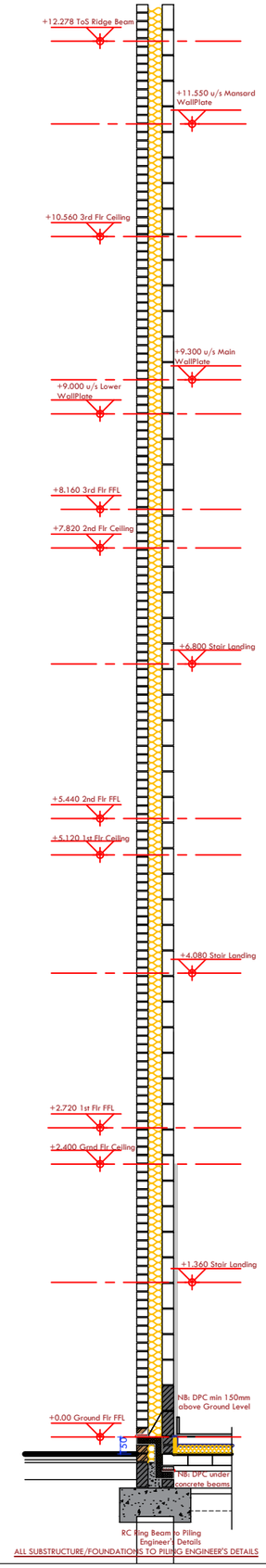
DRAWING	SCALE
Side Elevation	1:50

DRAWING NUMBER
L619/36

DATE
24/05/2022

REAR ELEVATION

NB: All boundary and party wall matters to be confirmed by client and subject to necessary boundary surveys



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CLIENT

PROJECT
9a Mitford Road
Fallowfield
Manchester M14 6UN

DRAWING	SCALE
Rear Elevation	1:50

DRAWING NUMBER
L619/38

DATE
22/05/2022

Appendix B

British Geological Survey Data

8589SW 8488 9329 413

STRATA SURVEYS LIMITED

Location **Mauldeth Road, Manchester**

Borehole No. **BH2**

Client: **Manchester City Council**

Project Ref.:

Sheet 1 of 1

Job No.: **MEDC 97-1**

Equipment and methods **Light cable percussion**

Drilled by CB

Ground level m AOD

Start Date: 18/01/97 End Date: 18/01/9 Final Depth: 5.00

Co-ordinates: E N

CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS Depth (m) from	to	SAMPLE Type & No	SPT (N) {Cu}	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
			0.30		D 1		Made Ground (75mm bituminous surfacing . over 175mm of stone setts. over ash and clinker)	(0.40) 0.40		
							Made Ground (firm-stiff yellow orange brown Clay Fill with ashescinders and brick pieces)			
			1.20	1.65	U 1			(1.40)		
			1.70	1.70	D 2			1.80		
			2.00	2.45	U 2	{113}	stiff to very stiff brown silty and sandy CLAY with stone and coal inclusions			
			2.50	2.50	D 3					
			3.00	3.45	U 3	{269}		(2.30)		
			3.50	3.50	D 4					
			4.10	4.50	B 1			4.10		
			4.50	5.00	S 1	(13)	medium dense orange and brown weathered SANDSTONE	(0.90)		
		{18/01/97}					**Borehole Completed**	5.00		

Remarks

1) No water encountered during boring.

Diameter (mm)	Depth (m)
150	5.00

Date Borehole Backfilled :

18/01/97

Logged by

MJC

FIG No.

British Geological Survey

SSL - cable per - 08/96 Rev a1

SS898W 8486 9325. 414.

STRATA SURVEYS LIMITED

Location **Mauldeth Road, Manchester**

Borehole No. **BH3**

Client: **Manchester City Council**

Project Ref.:

Sheet 1 of 1

Job No.: **MEDC 97-1**

Equipment and methods **Light cable percussion.**

Drilled by CB

Ground level m AOD

Start Date: 20/01/97 End Date: 20/01/9 Final Depth: 6.00

Co-ordinates: E N

CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS Depth (m) from	to	SAMPLE Type & No	SPT (N) {Cu}	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
							Made Ground (75mm bituminous surfacing. over stone setts to 0.25m, over 150mm ash)	(0.40) 0.40		
			0.50		D 1		Made Ground (firm to stiff brown/grey/black Clay Fill with ashes cinders stones sand etc.)	(1.10) 1.50		
			1.20	1.65	U 1					
			1.70	1.70	D 2		stiff to very stiff brown silty sandy CLAY with grey fissures stone and coal inclusions and occasional lenes of sand.	(2.00) 3.50		
			2.00	2.45	U 2	{113}				
			2.60		D 3					
			3.00	3.40	U 3	{187}				
			3.50	4.00	B 1	(42)				
			3.50	3.95	S 1		dense and very dense orange/brown weathered SANDSTONE.	(2.50) 6.00		
			4.50	5.00	B 2	(95)				
			4.50	4.95	S 2					
			5.50	5.65	S 3	(300)				
		{20/01/97}					**Borehole Completed**			

Remarks

Diameter (mm)	Depth (m)
150	5.00

1) Borehole noted as "wet" at 4.0m.
2) SPT at 5.5m 50 blows in initial 150mm seating drive.

Logged by MJC

Date Borehole Backfilled : 20/01/97

FIG No.

British Geological Survey

85895W 8499 9320 4.12

STRATA SURVEYS LIMITED

Location: **Mauldeth Road, Manchester**

Borehole No: **BH1**

Client: **Manchester City Council**

Project Ref.:

Sheet 1 of 1

Job No.: **MEDC 97-1**

Equipment and methods: **Light cable percussion**

Drilled by: CB

Ground level: m AOD

Start Date: 21/01/97 End Date: 21/01/9 Final Depth: 5.30

Co-ordinates: E N

Casing Depth (m)	Water Depth (m)	Field Records	Sample Depth (m) from	to	Sample Type	No	SPT (N) {Cu}	Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
								Made Ground (75mm bituminous surfacing, over 175mm concrete, over 250mm of brown ash)	(0.50) 0.50		
			0.60	0.60	D	1		Made Ground (clay bound ashes cinders brick pieces)	(0.40) 0.90		
			1.20	1.60	U	1		stiff to very stiff brown silty and sandy CLAY with grey fissures .. some coal inclusions	(1.80)		
			2.20	2.60	U	2	{214}				
			2.70	2.70	D	2			2.70		
			3.00	3.50	B	1	(36)	brown and orange dense weathered SANDSTONE			
			3.00	3.45	S	1					
			4.00	4.50	B	2	(84)		(2.60)		
			4.00	4.45	S	2					
			5.00	5.30	S	3	(110)				
		{21/01/97}						**Borehole Completed**	5.30		

Remarks

Diameter (mm)	Depth (m)
150	4.50

1) No water encountered during boring.
2) SPT at 5.0m 55 blows for 150mmpenetration excluding the seating drive.

Logged by: MJC

Date Borehole Backfilled :

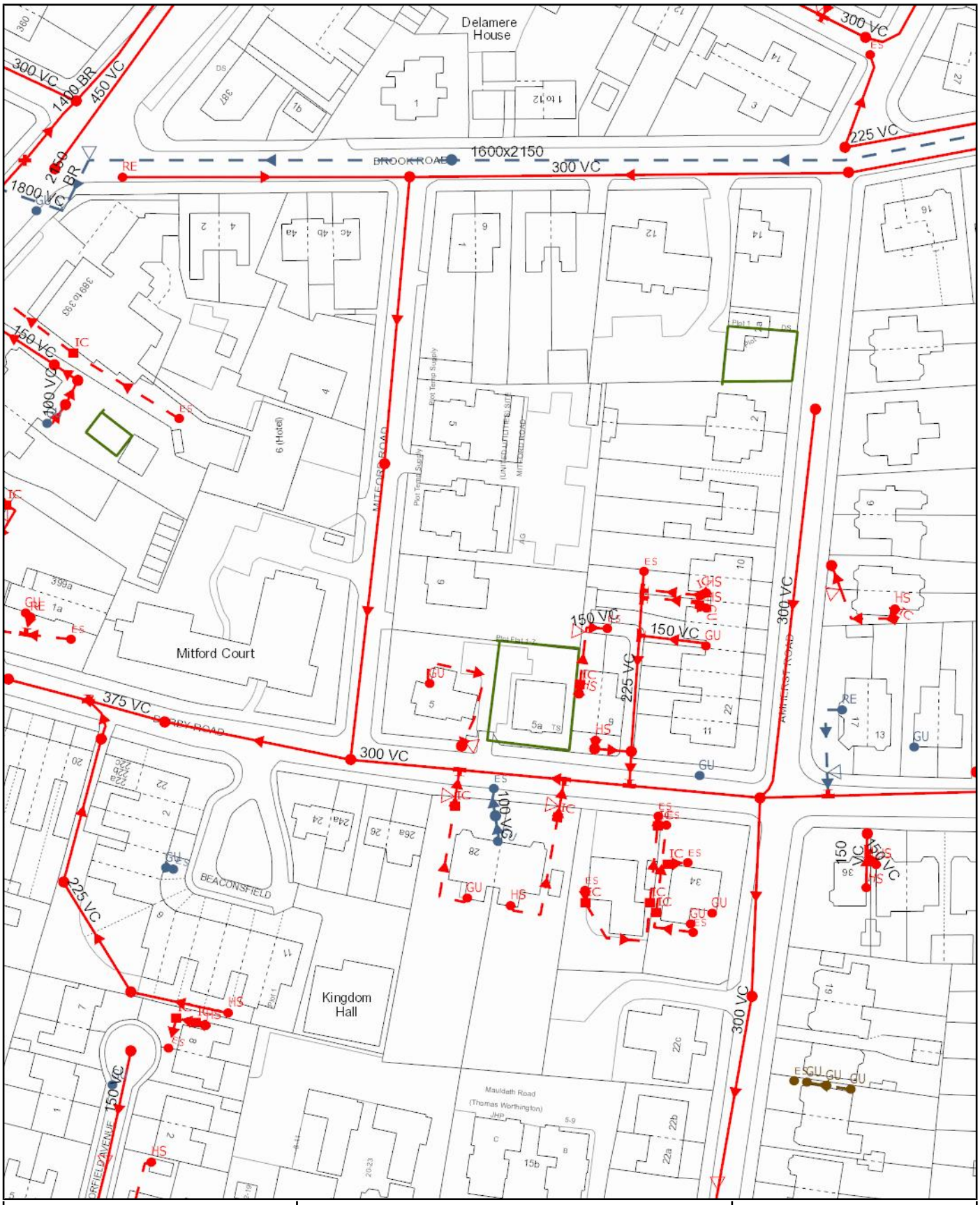
21/01/97

FIG No.

British Geological Survey

Appendix C

United Utilities Asset Plan



Scale: 1:1250 **Date:** 31/08/2022	**SEWER RECORDS**	United Utilities Water for the North West
Address or Site Reference:	9 DERBY ROAD, MANCHESTER, M14 6UN	
Printed by:	Property Searches	

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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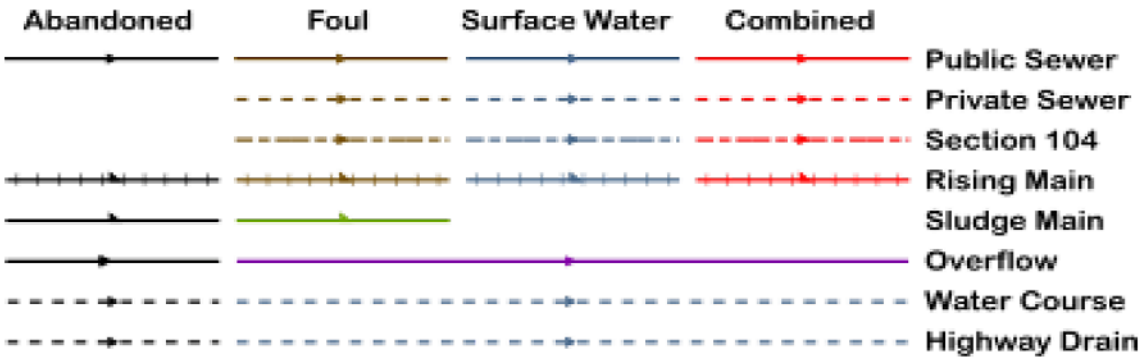
United Utilities
Water for the North West

Wastewater Symbology



All point assets follow the standard colour convention: red – combined, brown - foul, blue – surface water, purple - overflow

- Manhole
- HS Head of System
- ES Extent of Survey
- RE Rodding Eye
- IN Inlet
- DP Discharge Point
- HY Vortex
- PE Penstock
- WO Washout Chamber
- VA Valve
- AV Air Valve
- NRV Non Return Valve
- SO Soakaway
- GU Gully
- CA Cascade
- FM Flow Meter
- HA Hatch Box
- OI Oil Interceptor
- SM Summit
- DS Drop Shaft
- OP Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- IC Inspection Chamber
- Bifurcation Chamber
- LH Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- T Network Storage Tank
- V Sewer Overflow
- WwTW Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

Appendix D

Greenfield Run-Off Rates and Volume Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	50.000	Urban	0.460
SAAR (mm)	860	Region Number	Region 10

Results	**l/s**
QBAR Rural	279.5
QBAR Urban	517.0
Q1 year	449.8
Q1 year	449.8
Q2 years	511.0
Q5 years	626.6
Q10 years	696.5
Q20 years	760.9
Q25 years	778.1
Q30 years	790.3
Q50 years	825.5
Q100 years	888.1
Q200 years	969.0
Q250 years	994.1
Q1000 years	1152.9

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Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Areal Reduction Factor	1.00
Area (ha)	396.750
SAAR (mm)	870
CWI	120.733
SPR Host	39.550
URBEXT (USER)	0.4600

Results

Percentage Runoff (%)	50.66
Greenfield Runoff Volume (m^3)	135090.239

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Appendix E

Pre-Development Run-Off Rates and Volume Calculations

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	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
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

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location GB 385700 393550 SJ 85700 93550	

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Synthetic Rainfall Details

C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					9.017
1.001	2	15 Winter	1	+0%					8.978

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

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
1.000	1	-0.133	0.000	0.03			0.4	OK	
1.001	2	-0.122	0.000	0.08			0.7	OK	

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					9.030
1.001	2	15 Winter	30	+0%					9.004

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

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
1.000	1	-0.120	0.000	0.09			1.2	OK	
1.001	2	-0.096	0.000	0.28			2.5	OK	

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+0%					9.037
1.001	2	15 Winter	100	+0%					9.019

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

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
1.000	1	-0.113	0.000	0.13			1.9	OK	
1.001	2	-0.081	0.000	0.42			3.8	OK	

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Summary Wizard of 360 minute 100 year Winter I+0% 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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+0%	10.000	9.010	-0.140	0.000	0.01
1.001	2	360 minute 100 year Winter I+0%	10.000	8.972	-0.128	0.000	0.04

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	1		1.694	0.2	OK

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Summary Wizard of 360 minute 100 year Winter I+0% for Storm

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.001	2		3.381	0.4	OK

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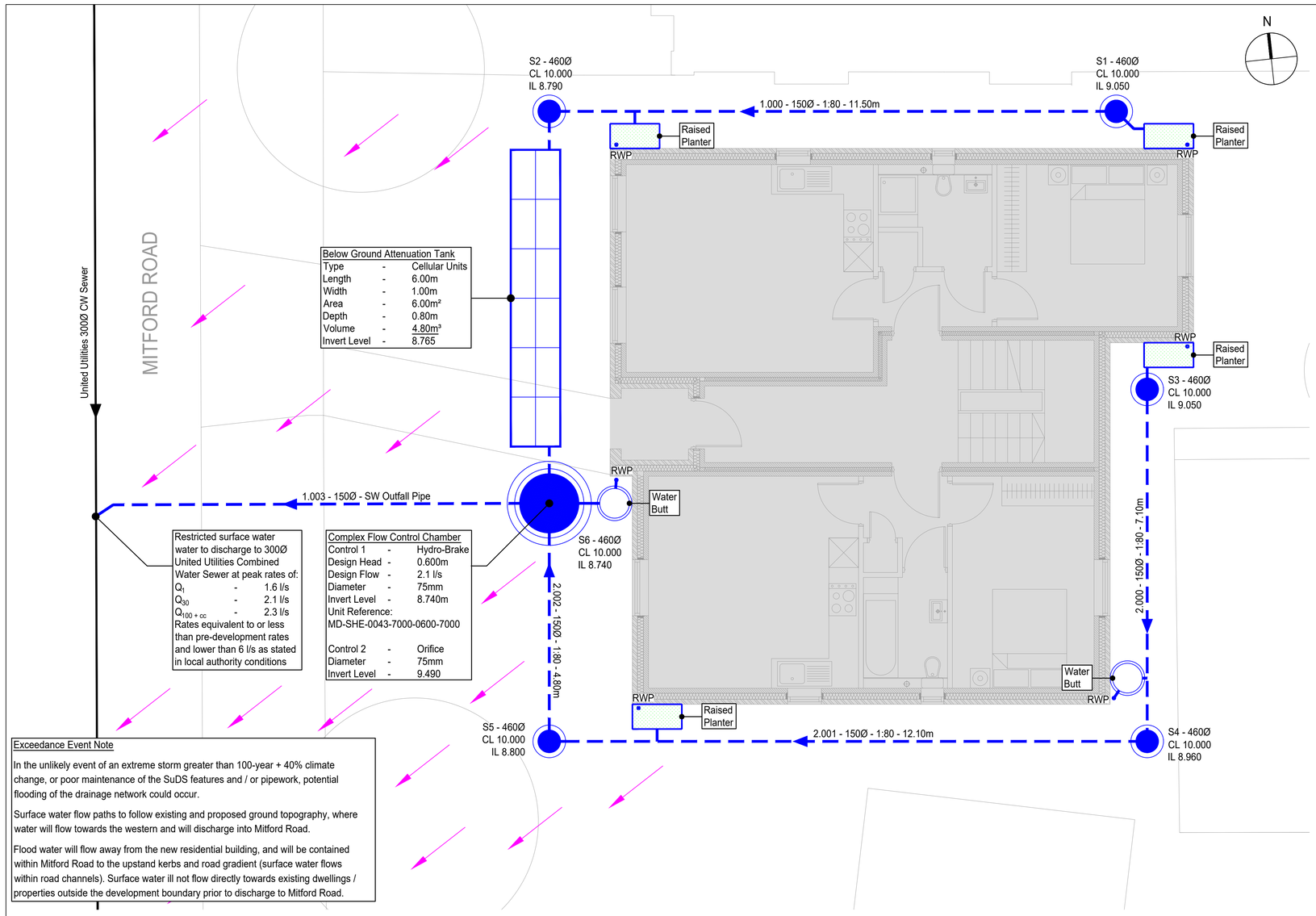
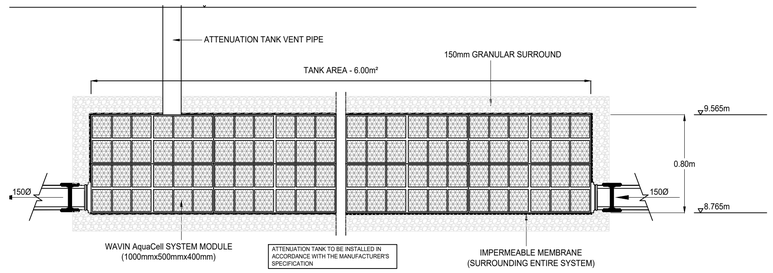
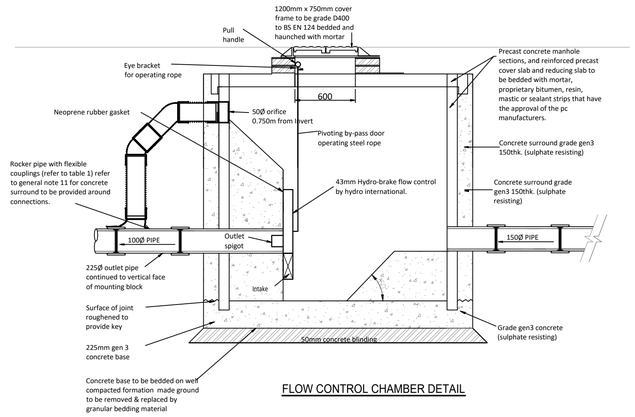
Appendix F

Surface Water Management Layout





ATTENUATION TANK DETAIL



FLOW CONTROL CHAMBER DETAIL

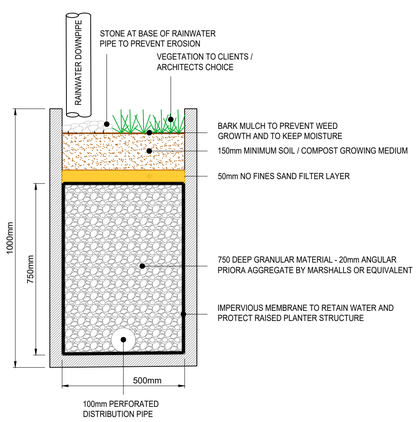
Exceedance Event Note

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur.

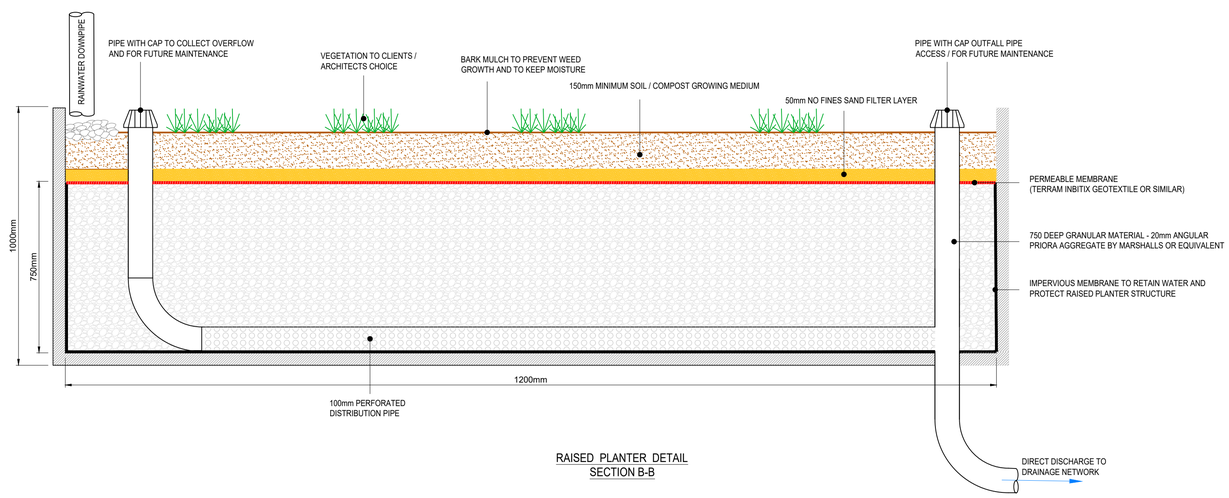
Surface water flow paths to follow existing and proposed ground topography, where water will flow towards the western and will discharge into Mitford Road.

Flood water will flow away from the new residential building, and will be contained within Mitford Road to the upstand kerbs and road gradient (surface water flows within road channels). Surface water ill not flow directly towards existing dwellings / properties outside the development boundary prior to discharge to Mitford Road.

NOTE
Datum set at 10.15m for finished floor level. Drainage to be installed to depths shown, but to true AOD levels.



RAISED PLANTER
SECTION A-A



RAISED PLANTER DETAIL
SECTION B-B

rev	amendments	by	date
P2	Issued for Approval	MDS	25.10.22
P1	Issued for Approval	MDS	08.09.22

ccs consulting

Client:
A&J Construction Mcr Ltd

Project:
9a Mitford Road
Withington, Manchester

Title:
Surface Water
Management Layout

Drawing Status:	Date Created:	Drawing Scale:
Approval	Sept '22	1:50@A1

21-2292 / A1 / 100 P2

Project Leader:	Drawn By:	Initial Review:
LS	MS	LS

A1

Appendix G

Surface Water Network / Management Calculations

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	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	45
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	0.000
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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.010	4-8	0.003

Total Area Contributing (ha) = 0.013

Total Pipe Volume (m^3) = 0.875

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	10.000	1.060	Open Manhole	460	1.000	8.940	150				
S2	10.000	1.210	Open Manhole	460	1.001	8.790	150	1.000	8.790	150	
S3	10.000	0.950	Open Manhole	460	2.000	9.050	150				
S4	10.000	1.040	Open Manhole	460	2.001	8.960	150	2.000	8.960	150	
S5	10.000	1.200	Open Manhole	460	2.002	8.800	150	2.001	8.800	150	
S6	10.000	1.260	Open Manhole	1200	1.002	8.740	150	1.001	8.740	150	
								2.002	8.740	150	
CW Sewer	10.000	1.385	Open Manhole	0		OUTFALL		1.002	8.615	150	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S1	10.000	8.940	0.910	Open Manhole	460
1.001	o	150	S2	10.000	8.790	1.060	Open Manhole	460
2.000	o	150	S3	10.000	9.050	0.800	Open Manhole	460
2.001	o	150	S4	10.000	8.960	0.890	Open Manhole	460
2.002	o	150	S5	10.000	8.800	1.050	Open Manhole	460
1.002	o	150	S6	10.000	8.740	1.110	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	11.500	76.7	S2	10.000	8.790	1.060	Open Manhole	460
1.001	4.000	80.0	S6	10.000	8.740	1.110	Open Manhole	1200
2.000	7.100	78.9	S4	10.000	8.960	0.890	Open Manhole	460
2.001	12.100	75.6	S5	10.000	8.800	1.050	Open Manhole	460
2.002	4.800	80.0	S6	10.000	8.740	1.110	Open Manhole	1200
1.002	10.000	80.0	CW Sewer	10.000	8.615	1.235	Open Manhole	0

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)
1.002	CW Sewer	10.000	8.615	0.000	0	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	45.000
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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Storage Structures for Storm

Cellular Storage Manhole: S6, DS/PN: 1.002

Invert Level (m) 8.765 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	6.0	0.0	2.600	0.0	0.0
0.200	6.0	0.0	2.800	0.0	0.0
0.400	6.0	0.0	3.000	0.0	0.0
0.600	6.0	0.0	3.200	0.0	0.0
0.800	6.0	0.0	3.400	0.0	0.0
1.000	0.0	0.0	3.600	0.0	0.0
1.200	0.0	0.0	3.800	0.0	0.0
1.400	0.0	0.0	4.000	0.0	0.0
1.600	0.0	0.0	4.200	0.0	0.0
1.800	0.0	0.0	4.400	0.0	0.0
2.000	0.0	0.0	4.600	0.0	0.0
2.200	0.0	0.0	4.800	0.0	0.0
2.400	0.0	0.0	5.000	0.0	0.0

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1 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	45.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	1	+0%	100/15 Summer				8.962
1.001	S2	15 Winter	1	+0%	30/15 Summer				8.819
2.000	S3	15 Winter	1	+0%	100/15 Summer				9.070
2.001	S4	15 Winter	1	+0%	100/15 Summer				8.984
2.002	S5	15 Winter	1	+0%	30/15 Summer				8.831
1.002	S6	15 Winter	1	+0%	30/15 Summer				8.815

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

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
1.000	S1	-0.128	0.000	0.05			1.0	OK	
1.001	S2	-0.121	0.000	0.07			0.9	OK	
2.000	S3	-0.130	0.000	0.04			0.8	OK	
2.001	S4	-0.126	0.000	0.06			1.1	OK	
2.002	S5	-0.119	0.000	0.09			1.4	OK	
1.002	S6	-0.075	0.000	0.09		7	1.6	OK	

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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 45.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	30	+0%	100/15 Summer				9.020
1.001	S2	15 Winter	30	+0%	30/15 Summer				9.017
2.000	S3	15 Winter	30	+0%	100/15 Summer				9.088
2.001	S4	15 Winter	30	+0%	100/15 Summer				9.022
2.002	S5	15 Winter	30	+0%	30/15 Summer				9.018
1.002	S6	15 Winter	30	+0%	30/15 Summer				9.016

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

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
1.000	S1	-0.070	0.000	0.16			3.0	OK	
1.001	S2	0.077	0.000	0.17			2.4	SURCHARGED	
2.000	S3	-0.112	0.000	0.14			2.4	OK	
2.001	S4	-0.088	0.000	0.20			3.7	OK	
2.002	S5	0.068	0.000	0.28			4.3	SURCHARGED	
1.002	S6	0.126	0.000	0.12		14	2.1	SURCHARGED	

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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 45.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location GB 385700 393550 SJ 85700 93550	
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	100	+45%	100/15 Summer				9.499
1.001	S2	15 Winter	100	+45%	30/15 Summer				9.494
2.000	S3	15 Winter	100	+45%	100/15 Summer				9.503
2.001	S4	15 Winter	100	+45%	100/15 Summer				9.500
2.002	S5	15 Winter	100	+45%	30/15 Summer				9.496
1.002	S6	15 Winter	100	+45%	30/15 Summer				9.492

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

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
1.000	S1	0.409	0.000	0.33			6.1	SURCHARGED	
1.001	S2	0.554	0.000	0.40			5.6	SURCHARGED	
2.000	S3	0.303	0.000	0.29			4.9	SURCHARGED	
2.001	S4	0.390	0.000	0.37			6.8	SURCHARGED	
2.002	S5	0.546	0.000	0.57			8.8	SURCHARGED	
1.002	S6	0.602	0.000	0.13		28	2.3	SURCHARGED	

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	45.000
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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 385700 393550 SJ 85700 93550
C (1km)	-0.026
D1 (1km)	0.325
D2 (1km)	0.380
D3 (1km)	0.312
E (1km)	0.303
F (1km)	2.446
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Summary Wizard of 360 minute 100 year Winter I+45% for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 45.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 1999
Site Location GB 385700 393550 SJ 85700 93550
C (1km) -0.026
D1 (1km) 0.325
D2 (1km) 0.380
D3 (1km) 0.312
E (1km) 0.303
F (1km) 2.446
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	360 minute 100 year Winter I+45%	10.000	8.959	-0.131	0.000	0.04
1.001	S2	360 minute 100 year Winter I+45%	10.000	8.826	-0.114	0.000	0.05
2.000	S3	360 minute 100 year Winter I+45%	10.000	9.067	-0.133	0.000	0.03
2.001	S4	360 minute 100 year Winter I+45%	10.000	8.980	-0.130	0.000	0.04
2.002	S5	360 minute 100 year Winter I+45%	10.000	8.832	-0.118	0.000	0.07
1.002	S6	360 minute 100 year Winter I+45%	10.000	8.824	-0.066	0.000	0.10

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Summary Wizard of 360 minute 100 year Winter I+45% for Storm

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	S1		5.935	0.7	OK
1.001	S2		5.934	0.7	OK
2.000	S3		4.748	0.6	OK
2.001	S4		7.123	0.8	OK
2.002	S5		9.496	1.1	OK
1.002	S6		15.424	1.8	OK

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