



RIDGE

**BIRCH BUSINESS PARK UNIT B
FLOOD RISK ASSESSMENT &
DRAINAGE STRATEGY REPORT**

September 2021

BIRCH BUSINESS PARK UNIT B FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY REPORT

Prepared for

YEARGATE LIMITED

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1. EXECUTIVE SUMMARY

This report details the Flood Risk and Drainage Strategy for a proposed commercial development at Birch Business Park, Heywood. Table 1 below provides a summary of the Flood Risk and Drainage/SuDS Strategy for the scheme.

Table 1 – Drainage / SuDS Summary

Item	Brief Description
Flood Zone	Fluvial Flood Zone 1 (Low Risk). At low risk of flooding from all other sources.
Geology	British Geological Survey (BGS) mapping and borehole information indicates that the site is underlain by silty, sandy, clay.
Infiltration Rate	The presence of cohesive underlying geology and contamination mean infiltration is not a viable solution.
Nearest Watercourses	There is an existing unnamed watercourse to the east of the site – the current private drainage system for the Business Park discharges into this watercourse.
Nearest Adopted Sewers	No existing adopted sewers in close proximity to the site.
Surface Water Outfall and SuDS Hierarchal Approach	Based on the above, surface water from the development will discharge into existing Business Park surface water drainage before outfalling into the watercourse to the east via an existing connection.
Existing Discharge Rate	Site is predominantly hardstanding and classed as brownfield.
Proposed Discharge Rate	Runoff will be restricted to 50% of existing surface water discharge rates
Allowance for Climate Change	40% - based on a commercial <50-year design life.
Proposed Attenuation Method and Volume	Geo-cellular Storage 866 m³ to contain the 100year + 20% event.
SuDS features	Geo-cellular storage.
Maintenance Responsibility	Business Park existing Management Company – Yeargate Ltd
Foul Drainage Outfall	Existing Business Park foul drainage before discharging to onsite sewage treatment plant and ultimately the watercourse to the east.

There is no residual flood risk from the development site to the surrounding district due to the reduction of existing storm water flow rates. Therefore, the development does not increase the risk of flooding to the other adjacent properties and roads. Out of chamber or gully flooding for the extreme 100-year plus climate change event may occur within the development site and is classed as exceedance flows. Flood water from this event will be contained within the development site and directed away from the building to the external hard and soft landscaped areas.

2. INTRODUCTION

- 2.1 Ridge & Partners LLP have been appointed by Yeagate Limited to prepare this Flood Risk Assessment and Drainage Strategy Report to support a full planning application for use Classes (g)(iii) (a – offices, b – research & development, c – light industrial), B2 (General Industrial) and B8 (Storage & Distribution along with access and associated landscaping at Birch Business Park, Heywood. The assessment has been undertaken in line with the 'National Planning Policy Framework 2021' (NPPF), plus the accompanying 'Flood Risk and Coastal Change' chapter of the National Planning Practice Guidance.
- 2.2 This report has been commissioned by Yeagate Limited and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A.
- 2.3 The report has been commissioned to identify any drainage-related issues associated with the proposed development and which are subsequently addressed within this report;
- Identify available data relating to flood risk at the site.
 - Determine whether the site is at risk from flooding from all sources, including from breach or overtopping of any existing flood defences, surface water flooding and/or groundwater flooding.
 - Consider the flood risk from all other sources.
 - Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
 - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
 - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
 - Devise an appropriate outline foul water drainage strategy.
 - Consider the recommendations of Rochdale Borough Council Strategic Flood Risk Assessment (SFRA).
 - Assess mitigation measures & off-site impacts and define any residual risks.

3. PLANNING POLICY AND CONSULTATION

3.1. Planning Policy Framework

3.1.1 The flood maps provided by the Environment Agency (EA) locate the site within Flood Zone 1, i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 in any year (<0.1%). As a requirement of the NPPF (2021) and accompanying National Planning Practice Guidance (NPPG), the proposed development has to satisfy the requirements of the Sequential Test and where applicable the Exception Test.

3.1.2 Sequential Test:

Under the NPPF (2021), Zone 1 is defined as low probability flood risk. The proposal is for a new Commercial Development, which in line with Table 2 is classified as 'Less Vulnerable'.

Placing both these criteria into Table 3 (Flood Risk Vulnerability and Flood Zone 'Compatibility'), Less Vulnerable development in Flood Zone 1 determines that 'Development is Appropriate'.

3.1.3 Exception Test:

As the Sequential test is passed, the Exception test is not required.

3.2. Strategic Flood Risk Assessment (SFRA)

3.2.1 SFRA's assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area; how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that Regional Planning Bodies (RPB's) or Local Planning Authorities (LPA's) should prepare SFRA's in consultation with the EA.

3.2.2 In March 2009, JBA Consulting was commissioned by Bury Metropolitan Borough Council, Rochdale Metropolitan Borough Council and Oldham Metropolitan Borough Councils to undertake a Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) leading on from the Greater Manchester Sub-Regional SFRA completed in August 2008. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

3.2.3 A summary of the main elements from the SFRA associated with the development site is detailed below. The full report can be found on the Rochdale Metropolitan Borough Council Website.

- SFRA provides a detailed understanding of flood risks across the borough from all sources.
- The main source of flood risk in Rochdale is fluvial flooding from the River Roch.

- The majority of flood defences along the River Roch are in good condition, providing a 1 in 100 year Standard of Protection to adjacent areas. During detailed modelling which included improved hydrological estimation, it was found that these defences also managed the 1 in 100 year plus climate change event, albeit with a reduced freeboard or factor of safety.
- There are a number of locations along Buckley Brook in Rochdale where defences are at a lower standard and are at risk of overtopping in the 1 in 100 year event. The immediate hazard is relatively small, however during larger events, flood flow paths form placing a number of key residential and proposed development sites at greater risk.
- Flood risk management strategies have been discussed in Rochdale, identifying the need to improve the quality of defences along Buckley Brook to reduce the impact of defences overtopping and the possibility of leaving proposed development sites upstream of central Rochdale open for flood storage.
- The River Roch catchment in Rochdale is relatively steep, which tends to promote surface water flooding. This is a particular problem in Littleborough and Heywood, both of which have been identified as Critical Drainage Areas.
- There are relatively few reported incidents of groundwater flooding in Bury, Rochdale and Oldham.
- Development should be designed so that there is no flooding to the development in a 1 in 30-year event and so that there is no property flooding in a 1 in 100 year plus climate change event Where possible SUDS should be implemented.

4. THE SITE

4.1. Site Details

4.1.1 The site details are summarised in Table 2 below:

Table 2: Site Referencing Information

Item	Brief Description
Site name	Birch Business Park Unit B
Site address and location	Birch Business Park, Whittle Lane, Heywood, OL10 2SX
Planning Authority	Rochdale Metropolitan Borough Council
Lead Local Flood Authority	Rochdale Metropolitan Borough Council
Drainage Statutory Undertaker	United Utilities
Site Area	2.47ha
Approximate Grid Reference	384060, 408194
General Locality	The site is approximately 4.8km to the south of Heywood Town Centre, situated in the southern portion of the existing Birch Business Park.

4.2. Site Description

- 4.2.1. There are existing warehouses currently on the site with associated hardstanding yard area and small grassed areas.
- 4.2.2. Whittle Lane borders the site to the south with Moss Hall Road to the west. The existing commercial units associated with Birch Business Park border the site to the north and east.
- 4.2.3. An aerial photograph of the existing site is shown in Figure 1 below. The red line boundary denotes the application boundary.

Figure 1: Aerial Photograph of Existing Site (Google, 2021)



4.3. Proposed Development

- 4.3.1. As discussed in the earlier sections, the report is prepared to support a full planning application for use Classes (g)(iii) (a – offices, b – research & development, c – light industrial), B2 (General Industrial) and B8 (Storage & Distribution along with access and associated landscaping at Birch Business Park, Heywood.
- 4.3.2. The current outline Architectural Master Plan in Appendix A provides an indication of the proposals of the site.

5. DEFINITION OF FLOOD HAZARD

5.1. Sources of information

The NPPF (2021) requires the developer to consider the impact of runoff generated by the proposed development onto the downstream catchment, and to assess the risk of runoff from the surrounding district impacting on the development footprint. Further, the report is to consider flood risk from all other sources. The following section defines the flood risk receptors and anticipated flood risk. Section 5 then discusses in further detail the probability of flooding and the likely impacts.

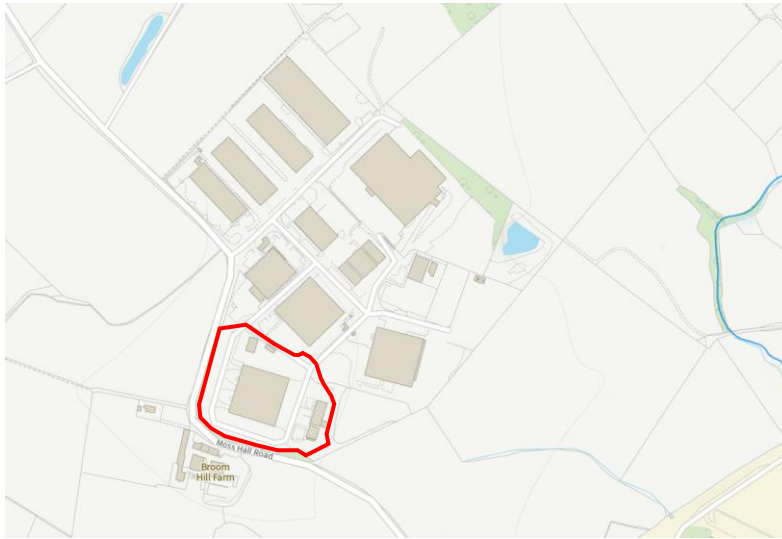
Table 2: Sources of information used in the identification of flood risk

Source of Information	Details
Environment Agency Flood Map	Indicative Flood Maps
United Utilities	Sewer Records
Historic Maps	From various websites
Rochdale Metropolitan Borough Council	Report & Various Maps from SFRA

5.2. Flooding from Rivers (Fluvial)

- 5.2.1 There are no EA main rivers in close proximity to the site. There is an existing watercourse along the eastern boundary of Birch Business Park.
- 5.2.2 Figure 2 below locates the site on the Environment Agency's indicative floodplain map. It is clear from this that the red line boundary sits outside of a fluvial generator of flood water from any identified water body. It is considered therefore that the site lays outside of the active 100-year and extreme event floodplains, thus lying within 'Flood Zone 1 Classification' in accordance with NPPF Guidance, i.e. probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is diminished to acceptable levels, removing the requirement for further investigation and assessment of the fluvial flood regime.

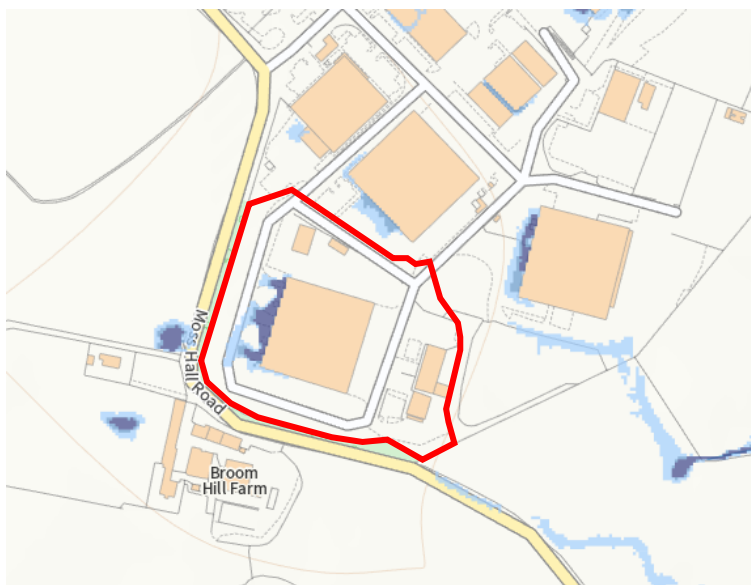
Figure 2 – The EA's 100-year Fluvial Floodplain Map



5.3. Flooding From Land (Overland Flow)

- 5.3.1 Any surface water runoff from the site is currently intercepted by the existing private drainage networks and conveyed away from the site by the existing network. Any surface water runoff from the surrounding area is intercepted by either the existing highway drainage or existing private drainage networks and conveyed away from the site.
- 5.3.2 A review of the EA Indicative Surface Water Flood Risk maps indicates that the site is predominantly at very low/low risk of surface water flooding as illustrated in figure 3 below. There is an area at high risk to the west of the existing building, this area corresponds with a topographical low point and the site is likely currently at risk of localised surface water ponding because of the topography.
- 5.3.3 There are no existing surface water flow routes through the site that would need to be maintained. As part of the proposed development the levels across the area of the new commercial development will ensure that all falls are away from the building, thus ensuring low risk surface water flooding.

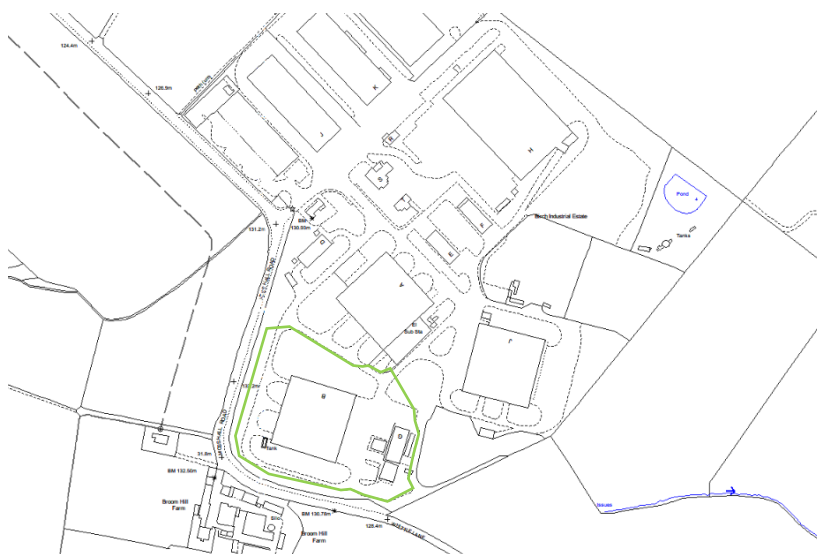
Figure 3 – The EA's Indicative Surface Water Flood Map



5.4. Flooding from Sewers and Private Drainage

- 5.4.1 The existing business park has a network of private drainage which is managed and maintained by a management company. Significant re-development has been occurring at the Business Park in recent years which has ensured all private drainage is designed and installed to current standards.
- 5.4.2 As shown in Figure 4 below there are no adopted United Utilities Sewers either on site or in the surrounding roads.

Figure 4 – Extract of United Utilities Sewer Records (2006)



5.5. Flooding from Groundwater

- 5.5.1 The development site is underlain by a variable thickness of Made Ground. The majority of the site is underlain by Glacial Till and Pennine Lower Coal Measures Formation. These are both Secondary A Aquifers which are classified as permeable layers capable of supporting water supplies at a local scale, and in some cases forming an important source of base flow to rivers.
- 5.5.2 According to the SFRA information there are relatively few reported incidents of groundwater flooding in the area.

5.6. Flooding from Artificial Sources

- 5.6.1 There are no canals or reservoirs in close proximity to the site. Therefore, the risk of flooding from artificial sources is considered to be diminished to acceptable levels, removing the requirement for further investigation and assessment.

6. ASSESSMENT OF FLOOD RISK ON DEVELOPMENT SITE (PROBABILITY)

6.1. Summary

Section 4 has defined the anticipated flood risks from all sources. Table 3 below considers each of the sources and defines in tabular format the Probability of Flood Risk associated to each and the likely impacts. Below is a table summary of the flood risks associated with the development site.

Table 3 – Flood Risk Summary

Source	Flood Risk	Likely Impacts	Remarks
Tidal	Low	Low	Site not tidally influenced.
Fluvial (Watercourse)	Low	Low	Site located in Flood Zone 1 (low risk).
Surface (Overland Flood Flow)	Low	Low	Indicative EA mapping shows site is at low risk. An area to the west of the existing building is shown to be subject to surface water ponding, the detailed levels analysis undertaken at detailed design will ensure this does not occur post-development.
Sewers	Low	Low	There are no UU sewers passing through the site.
Groundwater	Low	Low	No indication through SFRA or local borehole records that site at risk of groundwater flooding.
Artificial Sources	Low	Low	No artificial sources in close proximity.

7. OUTLINE DRAINAGE STRATEGY

7.1. Existing Surface Water Runoff

- 7.1.1. The site has positive drainage system and is classified as brownfield.
- 7.1.2. The existing flow from site has been estimated in the table below assuming a run off coefficient of 0.85. It has been estimated that 80% of the existing sites impermeable area is formally drained and the remaining hardstanding drains to soft landscaping areas.

Table 4: Brownfield Runoff Rates

Birch Business Park – Unit B	Site Area (m ²)	Impermeable Area (m ²)	Formally Drained Area (m ²)	Runoff Co-efficient	Rainfall Intensity (l/s/ha)	Runoff Rate (l/s)
30 Year	24,700	11,650	9,320	0.85	216.7	172
100 Year					279.6	221

7.2. Geology

- 7.2.1. Based on the site use, it is anticipated that the site is underlain by a variable thickness of Made Ground. According to British Geological Survey data, any Made Ground is expected to be underlain by Superficial strata comprising Glacial Till (comprised of sandy, silty boulder clay). These are then underlain by the Pennine Lower Coal Measures Formation comprised of mudstone, siltstone and sandstone.
- 7.2.2. Based on the presence of cohesive boulder clay and potential contamination from previous commercial site uses, infiltration is not a viable option and should be discounted.

7.3. Hydrology

- 7.3.1. There is an existing watercourse to the east of the site – the current private drainage system for the Business Park discharges into this watercourse.

7.4. Existing Drainage

- 7.4.1. There are no surface water sewers in close proximity to the site.
- 7.4.2. There is an existing private drainage system on the site which connects to the wider Birch Business Park drainage system and ultimately outfalls into the watercourse to the east.

7.5. Sustainable Drainage Systems

7.5.1. SuDS Objectives

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

7.5.2. SuDS's Design Themes

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individual's plot structure, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area of land.

7.5.3. The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

7.5.4. SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- Land Use Characteristics: The size and type of the development plot allows a range of source control and site control SuDS devices to be considered both above and below ground.
- Site Characteristics: Cohesive underlying clays and contamination mean infiltration is not a viable SuDS technique.
- Catchment Characteristics: The site is currently classed as brownfield.

- Environmental and Amenity Performance: The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. Safety to all future occupiers is paramount and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

7.5.5. SuDS Methods

Tables 5 and 6, below, provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the development.

Table 5: Surface SuDS Methods

Method	Comment	Suitability for Development
Green Roofs	• Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater Promotes evaporation and local biodiversity.	<u>Not suitable:</u> • Architectural proposals for the development and maintenance issues deem this unsuitable.
Water Butts	• Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Not suitable:</u> • Cannot be used with siphonic drainage.
Rainwater Harvesting	• Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	<u>Not Suitable:</u> • Additional costs of installation would have severe effect on viability of development. • Running and maintenance costs would not be acceptable to client and future occupiers.
Infiltration Options	• Reduces total run off volume from the development.	<u>Not Suitable:</u> • Cohesive underlying clays and presence of contamination means infiltration is not viable.
Permeable Surfacing (Infiltration)	• Reduces total run off volume from the development. • Can be used to enhance water quality.	<u>Not Suitable:</u> • Cohesive underlying clays and presence of contamination means infiltration is not viable.
Permeable Surfacing (Standard)	• Can be used to enhance quality of runoff water. • Sub-base provides 'source' storage and reduces the volume of storage downstream.	<u>Suitable:</u> • Private parking bays have the potential to attenuate and filter surface water flows through the use of permeable

	- The storage can be created with selection of the stone fill or use of plastic box stems. - Impermeable membrane at base of construction to prevent impact on pavement stability.	surfacing (subject to confirmation from architect on surface finishes).
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also improve water quality through filtration.	<i>Not Suitable:</i> The type of development and requirement for significant amounts of outdoor parking means the incorporation of swales, basins or ponds will impact viability of development.

Table 6: Sub-Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<i>Suitable:</i> The use of geocellular attenuation may be possible to retain excess storm water.
Large Diameter Pipes, Culverts or Tanks	- Suitable for sites with insufficient space for basins etc. - Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. - Generally suitable for adoption by the statutory water company.	<i>Suitable:</i> The use of oversized pipes may be possible to retain excess storm water.

7.5.6. SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 5 and 6, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

Table 7: SuDS Hierarchal Approach

Method	Suitability	Suitability for Development
Infiltration to Ground	No	Cohesive underlying clay and presence of contamination means infiltration is not viable.
Connection to Watercourse	Yes	There is an existing watercourse to the east of the site. All existing drainage from Birch Business Park connects into this.
Connection to Surface Water Sewer	No	There are other suitable options that would take precedence.
Connection to a Combined Sewer	No	There are other suitable options that would take precedence.

7.5.7. SuDS Design Philosophy

The SuDS assessment and hierarchal approach discussed in Tables 5, 6 and 7 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of Prevention, Source Control and Site Control techniques with discharge rates to be restricted to 50% existing brownfield run off rates, to reduce the risk of both site and downstream flooding.

The following design philosophy is proposed:

- Cohesive underlying clays and contamination mean infiltration is not a viable option.
- The site will discharge into the existing private surface water network prior to outfalling into the watercourse to the east.
- Surface Water discharge rates will be reduced by 50% from the pre development brownfield rates, to reduce the risk of both on site and downstream flooding.
- Site control in the form of geo-cellular storage.
- Aim to limit where possible the impermeable fraction of development.

7.6. Surface Water Drainage Strategy

- 7.6.1. The outline strategy is to collect runoff from the roofs and other site areas and direct it to new below-ground surface water drainage pipework. This pipework will discharge into the existing private surface water network prior to outfalling into the watercourse to the east.
- 7.6.2. The discharge rate will be restricted to the 50% existing brownfield run off rates. In turn this will generate surface water attenuation volumes which will be contained within geocellular storage prior to outfall.
- 7.6.3. The proposed drainage layout for the new development site will be designed in accordance with Design & Construction Guidance (DCG), BS EN 752: 2008 and Building Regulations Part H guidance, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100 year return period including a 40% increase to account for climate change to confirm that there is no flood risk to the building.

- 7.6.4. Flooding can occur on a local scale beyond the 30-year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. Design & Construction Guidance states that developments should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.
- 7.6.5. In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by Design & Construction Guidance. Using storage within the external areas would be achievable and would direct flood water away from the proposed building, with flows directed back into the surface water drainage network as water levels in the drainage network receded. The exceedance flows and volumes can be calculated for the new development drainage layout. In the case of this development and due to the fall across the site, consideration will be given to make sure all water is controlled so that it does not impact on any adjoining properties.
- 7.6.6. Table 8 below defines the outline post-development attenuation volumes. The volumes identified below are preliminary for this outline assessment and are likely to alter at detailed design stage.
- 7.6.7. Any future drainage calculations carried out as part of a site-wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate Change allowances.

Table 8: Outline Attenuation Volumes

Birch Business Park – Unit B	Existing Flow Rate (l/s)	Existing Flows less 50% (l/s)	Proposed Discharge Rate (l/s)	Flow Reduction (%)	Attenuation Requirement (m³)
30 year	172	86	73	57.5	233
100 year	221	110.5	73	67	546

7.7. Pollution Control

- 7.7.1. Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, French drains with silt traps or by the use of Sustainable Drainage techniques. If appropriate, oil separators in line with Pollution Prevention Guidance 3 (PPG 3) criteria will be provided (it is acknowledged that PPG 3 has been withdrawn, however as no replacement has been released it is still best practice guidance).

7.8. Foul Water Strategy

- 7.8.1. The outline foul water drainage strategy is to connect to the existing foul drainage network of the Business Park. This then passes through an onsite sewage treatment plan and ultimately into the watercourse to the east. There would be very limited increase in the foul water discharge rates generated by the new development.

8. MANAGEMENT MEASURES, OFF SITE IMPACTS AND RESIDUAL RISK

8.1. Flood Risk Management Measures

- 8.1.1. The report has found the site to be at low risk of flooding from all sources.
- 8.1.2. The surface water drainage strategy will restrict runoff to 50% of existing brownfield flow rates, prior to discharge into the existing drainage on site. Attenuation has been proposed in the form of geo-cellular storage. The new surface water networks will be designed in line with current British Standard and Design & Construction Guidance up to the 100-year storm return period including an allowance for climate change.
- 8.1.3. The use of SuDS in the form of Source Control and Site Control measures, with controlled (restricted) outflow, will help to minimise the flood risk impact to the surrounding sewer network.
- 8.1.4. There will be a site management health and safety document prepared in respect of the final development. This will include the required maintenance regime for the on-site drains and drainage facilities such as the channels, gullies, pipes, manholes and all SuDS facilities.
- 8.1.5. The Management Company, Yeagate Limited, and site occupiers will be responsible for site cleanliness, gully emptying and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.
- 8.1.6. Should any flooding occur from the new sewers and drains it will be directed away from the buildings to the external areas.

8.2. Off Site Impacts

- 8.2.1. Up to and including the 100-year plus increase in rainfall allowance due to climate change (CC) event, the report has justified that there is no risk of flooding.
- 8.2.2. Surface water runoff does not increase from the pre-development regime and utilises SuDS solutions to satisfy the site constraints, the proposed development will therefore not increase flood risk onto its locality.

8.3. Residual Risk

- 8.3.1. With careful design of the drainage elements as described above there will be no residual flood-related risks that will remain after the development has been completed.

5. APPENDICES

- Appendix A – Architectural Site Layout
- Appendix B – Site Topographical Survey
- Appendix C – Ridge Design Drawings
- Appendix D – Outline Surface Water Attenuation Calculations

APPENDIX A – ARCHITECTURAL SITE LAYOUT

All site dimensions shall be verified by the Contractor on site prior to commencing any works.

Do not scale from this drawing.

Only work to written dimensions.

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— Business Park Boundary

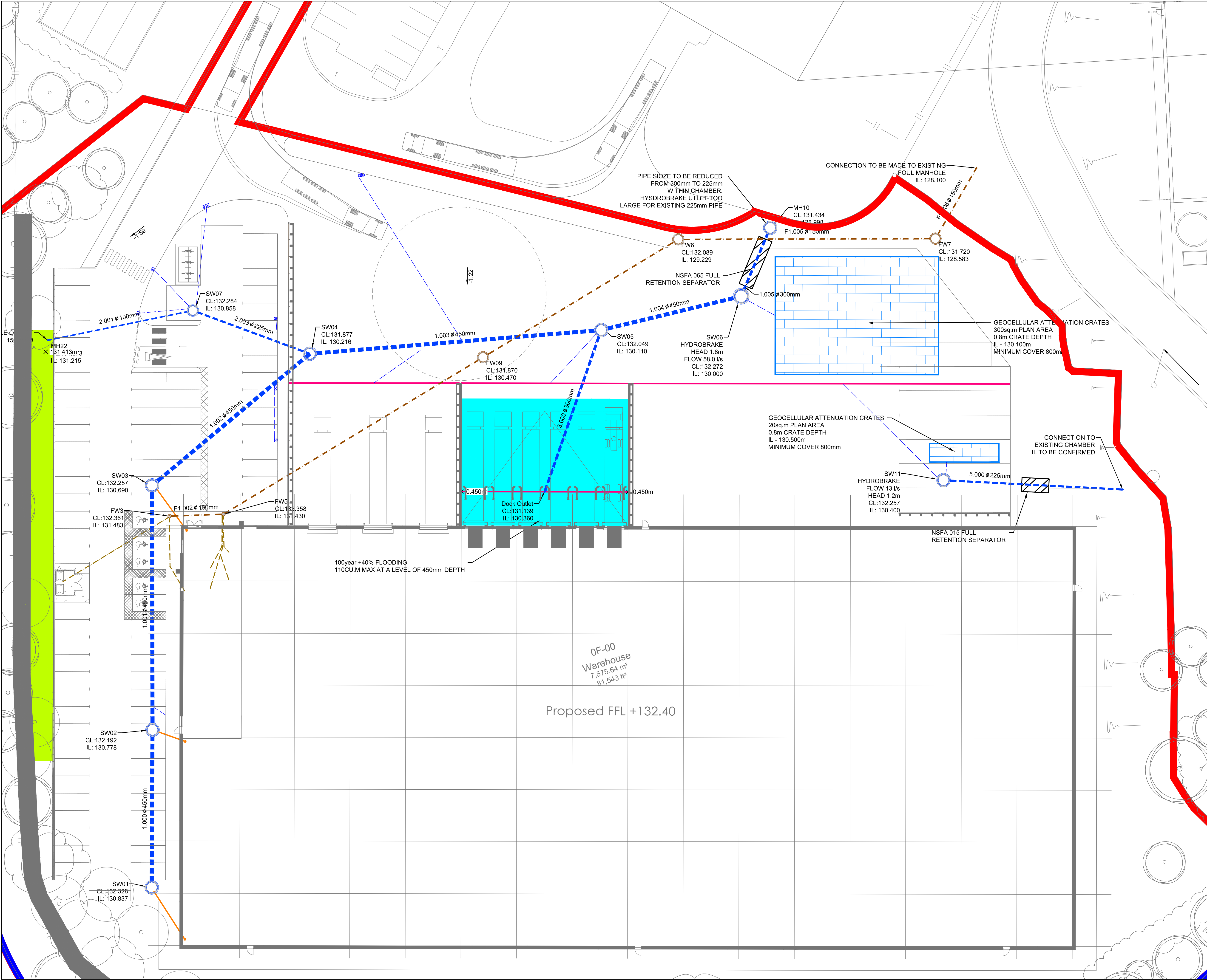
DRAFT



APPENDIX B – SITE TOPOGRAPHICAL SURVEY



APPENDIX C – RIDGE DESIGN DRAWINGS



GENERAL NOTES

- 1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
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- 4. INFORMATION CONTAINED ON THIS DRAWING IS TENDER DESIGN ONLY. FURTHER DETAILED DESIGN AND CO-ORDINATION WITH THE CONTRACTOR, DESIGN TEAM AND APPROPRIATE SUB-CONTRACTORS WILL BE REQUIRED TO FULLY DEVELOP AND DETAIL THE FINAL CONSTRUCTION DETAILS. CONTRACTOR TO USE THEIR EXPERIENCE AND JUDGEMENT TO MAKE SUFFICIENT ALLOWANCES FOR DETAILED DESIGN DEVELOPMENT.

DRAINAGE KEY

- PROPOSED FW SEWER
- PROPOSED FW MANHOLE
- PROPOSED LATERAL FW DRAIN
- PROPOSED LATERAL FW PPIC
- PROPOSED FW RISING MAIN
- PROPOSED SW SEWER
- PROPOSED SW MANHOLE
- PROPOSED LATERAL SW DRAIN
- PROPOSED LATERAL SW PPIC
- PROPOSED DRAINAGE CHANNEL
- PROPOSED GEOCELLULAR ATTENUATION
- PROPOSED SWALE

P5	12.05.22	AP	PB	LAYOUT UPDATE
P4	10.05.22	AP	PB	TENDER ISSUE
P3	11.04.22	AP	PB	ATTENUATION REVIEW
P2	03.03.22	AP	PB	BOUNDARY UPDATE
P1	21.02.22	AP	PB	TENDER ISSUE
No	DATE	DRAWN	REV'D ENG.	AMENDMENT

STATUS	PURPOSE OF ISSUE
D2	TENDER

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RIDGE

CLIENT
YEARGATE LIMITED

PROJECT
UNIT B
BIRCH BUSINESS PARK

DRAFTER
AP

ENGINEER
PB

TITLE
UNIT B
PROPOSED
DRAINAGE GA

PROJECT REFERENCE:

SCALE
1:500

SHEET
A1

DRAWING No
BUB-RDG-00-ZZ-DR-C-0501

REV
P5



GENERAL NOTES

1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING, WORK TO DIMENSIONS OR CO-ORDINATES PROVIDED. ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS, SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY.
4. INFORMATION CONTAINED ON THIS DRAWING IS SCHEME DESIGN ONLY AND REQUIRES FURTHER DETAILED DESIGN AND CO-ORDINATION WITH THE CONTRACTOR, DESIGN TEAM AND APPROPRIATE SUB-CONTRACTORS.

Parcel Table		
Parcel #	Area	Pipe Ref.
1	2714.400	1.001
2	1390.965	1.003
3	2714.400	1.002
4	2750.950	1.000
5	516.626	3.000
6	2403.749	5.000
7	586.173	1.004
8	991.350	1.001
9	217.453	2.000
10	838.369	1.003
11	518.909	1.002

P1	14.09.21	JF	PB	PRELIMINARY ISSUE
No	DATE	DRAWN	REV'D ENG.	AMENDMENT

STATUS	PURPOSE OF ISSUE
S2	FOR INFORMATION

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RIDGE

CLIENT
YEARGATE LIMITED

PROJECT
**UNIT B
BIRCH BUSINESS PARK**

DRAFTER
PB

ENGINEER
PB

TITLE
**UNIT B -
PROPOSED
DRAINAGE AREAS**

PROJECT REFERENCE:

SCALE
1:250

SHEET
A1

DRAWING No
BUB-RDG-00-ZZ-DR-C-0103

REV
P1

APPENDIX D – OUTLINE SURFACE WATER ATTENUATION CALCULATIONS

Scott Hughes Design Ltd		Page 0
The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)	
Date 14/09/2021 File SW Drainage Network.mdx	Designed by P Barrett Checked by	
Micro Drainage Network 2018.1		

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW Proposed

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	28.492	0.273	104.4	0.275	10.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	32.583	0.135	241.4	0.370	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	31.185	0.416	75.0	0.323	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.000	23.339	0.784	29.8	0.021	10.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	42.802	0.107	400.0	0.223	0.00	0.0	0.600	o	450	Pipe/Conduit	
3.000	23.404	0.078	300.1	0.052	10.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	24.324	0.061	400.0	0.059	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	23.000	0.058	396.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	32.77	10.31	130.346	0.275	0.0	0.0	0.0	1.54	108.8	27.3
1.001	32.10	10.72	129.923	0.645	0.0	0.0	0.0	1.30	207.4	62.8
1.002	31.76	10.95	129.788	0.968	0.0	0.0	0.0	2.35	373.8	93.3
2.000	33.01	10.16	130.456	0.021	0.0	0.0	0.0	2.41	95.7	2.1
1.003	30.74	11.65	129.372	1.212	0.0	0.0	0.0	1.01	160.7	113.0
3.000	32.57	10.43	129.319	0.052	0.0	0.0	0.0	0.90	63.8	5.1
1.004	30.19	12.05	129.091	1.323	0.0	0.0	0.0	1.01	160.7	121.1
1.005	29.71	12.43	129.030	1.323	0.0	0.0	0.0	1.01	161.4	121.1

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Manhole Schedules for SW Proposed

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Back
SW01	131.546	1.200	Open Manhole	1200	1.000	130.346	300				
SW02	131.273	1.350	Open Manhole	1200	1.001	129.923	450	1.000	130.073	300	
SW03	131.271	1.483	Open Manhole	1200	1.002	129.788	450	1.001	129.788	450	
SW07	131.506	1.050	Open Manhole	1200	2.000	130.456	225				
SW04	130.722	1.350	Open Manhole	1200	1.003	129.372	450	1.002	129.372	450	
								2.000	129.672	225	
Dock Outlet	130.119	0.800	Open Manhole	1200	3.000	129.319	300				
SW05	130.915	1.824	Open Manhole	1200	1.004	129.091	450	1.003	129.265	450	
								3.000	129.241	300	
SW06	131.385	2.355	Open Manhole	1200	1.005	129.030	450	1.004	129.030	450	
SW06	131.385	2.413	Open Manhole	1500		OUTFALL		1.005	128.972	450	

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PIPELINE SCHEDULES for SW Proposed

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	o	300	SW01	131.546	130.346	0.900	Open Manhole	1200
1.001	o	450	SW02	131.273	129.923	0.900	Open Manhole	1200
1.002	o	450	SW03	131.271	129.788	1.033	Open Manhole	1200
2.000	o	225	SW07	131.506	130.456	0.825	Open Manhole	1200
1.003	o	450	SW04	130.722	129.372	0.900	Open Manhole	1200
3.000	o	300	Dock Outlet	130.119	129.319	0.500	Open Manhole	1200
1.004	o	450	SW05	130.915	129.091	1.374	Open Manhole	1200
1.005	o	450	SW06	131.385	129.030	1.905	Open Manhole	1200

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
1.000	28.492	104.4	SW02	131.273	130.073	0.900	Open Manhole	1200
1.001	32.583	241.4	SW03	131.271	129.788	1.033	Open Manhole	1200
1.002	31.185	75.0	SW04	130.722	129.372	0.900	Open Manhole	1200
2.000	23.339	29.8	SW04	130.722	129.672	0.825	Open Manhole	1200
1.003	42.802	400.0	SW05	130.915	129.265	1.200	Open Manhole	1200
3.000	23.404	300.1	SW05	130.915	129.241	1.374	Open Manhole	1200
1.004	24.324	400.0	SW06	131.385	129.030	1.905	Open Manhole	1200
1.005	23.000	396.6	SW06	131.385	128.972	1.963	Open Manhole	1500

Free Flowing Outfall Details for SW Proposed

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level (m)	(mm)	(mm)
1.005	SW06	131.385	128.972	0.000	1500	0

Scott Hughes Design Ltd		Page 3																				
The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)																					
Date 14/09/2021 File SW Drainage Network.mdx	Designed by P Barrett Checked by																					
Micro Drainage Network 2018.1																						
<u>Simulation Criteria for SW Proposed</u> Volumetric Runoff Coeff 0.840 Additional Flow - % of Total Flow 0.000 Areal Reduction Factor 1.000 MADD Factor * 10m³/ha Storage 2.000 Hot Start (mins) 0 Inlet Coefficient 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 <u>Synthetic Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Summer</td> </tr> <tr> <td>Return Period (years)</td> <td>1</td> <td>Cv (Summer)</td> <td>0.840</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.308</td> <td></td> <td></td> </tr> </table>			Rainfall Model	FSR	Profile Type	Summer	Return Period (years)	1	Cv (Summer)	0.840	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	19.000	Storm Duration (mins)	30	Ratio R	0.308		
Rainfall Model	FSR	Profile Type	Summer																			
Return Period (years)	1	Cv (Summer)	0.840																			
Region	England and Wales	Cv (Winter)	0.840																			
M5-60 (mm)	19.000	Storm Duration (mins)	30																			
Ratio R	0.308																					
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Micro Drainage	Network 2018.1	

Online Controls for SW Proposed

Hydro-Brake® Optimum Manhole: SW06, DS/PN: 1.005, Volume (m³): 6.3

Unit Reference	MD-SHE-0304-5800-1800-5800
Design Head (m)	1.800
Design Flow (l/s)	58.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	304
Invert Level (m)	129.030
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	58.0
Flush-Flo™	0.571	58.0
Kick-Flo®	1.241	48.5
Mean Flow over Head Range	-	49.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.3	1.200	50.3	3.000	74.3	7.000	112.1
0.200	31.2	1.400	51.4	3.500	80.0	7.500	116.0
0.300	53.3	1.600	54.8	4.000	85.4	8.000	119.7
0.400	56.8	1.800	58.0	4.500	90.4	8.500	123.3
0.500	57.8	2.000	61.0	5.000	95.2	9.000	126.8
0.600	58.0	2.200	63.9	5.500	99.7	9.500	130.2
0.800	57.0	2.400	66.7	6.000	104.0		
1.000	55.0	2.600	69.3	6.500	108.2		

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Storage Structures for SW Proposed

Cellular Storage Manhole: SW06, DS/PN: 1.005

Invert Level (m) 129.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	400.0	0.0	0.801	0.0	0.0
0.800	400.0	0.0			

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)	
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SW Proposed

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 Coefficient 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 FSR Ratio R 0.308
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SW01	15 Winter	1	+0%	100/15 Summer	100/15 Winter		
1.001	SW02	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
1.002	SW03	15 Winter	1	+0%	30/15 Summer			
2.000	SW07	15 Winter	1	+0%	100/15 Summer			
1.003	SW04	15 Winter	1	+0%	30/15 Summer	100/15 Summer		
3.000	Dock Outlet	15 Winter	1	+0%	30/15 Summer	100/15 Winter		
1.004	SW05	15 Winter	1	+0%	30/15 Summer	100/30 Winter		
1.005	SW06	30 Winter	1	+0%	30/15 Winter	100/60 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Pipe Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW01	130.443	-0.203	0.000	0.23	22.8	OK	3
1.001	SW02	130.101	-0.272	0.000	0.32	58.2	OK	4
1.002	SW03	129.950	-0.288	0.000	0.28	89.9	OK	
2.000	SW07	130.477	-0.204	0.000	0.02	1.7	OK	
1.003	SW04	129.676	-0.146	0.000	0.77	110.8	OK	9

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)	
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SW Proposed

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
3.000	Dock Outlet	129.424	-0.195	0.000	0.08	4.6	OK	8
1.004	SW05	129.419	-0.122	0.000	0.87	117.3	OK	5
1.005	SW06	129.309	-0.171	0.000	0.37	49.3	OK	1

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)	
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Micro Drainage Network 2018.1		

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

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 Coefficient 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 FSR Ratio R 0.308
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SW01	15 Winter	30	+0%	100/15 Summer	100/15 Winter		
1.001	SW02	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
1.002	SW03	15 Winter	30	+0%	30/15 Summer			
2.000	SW07	30 Winter	30	+0%	100/15 Summer			
1.003	SW04	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
3.000	Dock Outlet	15 Winter	30	+0%	30/15 Summer	100/15 Winter		
1.004	SW05	15 Winter	30	+0%	30/15 Summer	100/30 Winter		
1.005	SW06	60 Winter	30	+0%	30/15 Winter	100/60 Winter		

PN	US/MH Name	Water Level	Surcharged Depth	Flooded Volume	Pipe Flow / Overflow		Status	Level Exceeded
		(m)	(m)	(m ³)	Cap.	(l/s)		
1.000	SW01	130.541	-0.105	0.000	0.60	59.4	OK	3
1.001	SW02	130.465	0.092	0.000	0.78	140.3	SURCHARGED	4
1.002	SW03	130.367	0.129	0.000	0.69	224.0	SURCHARGED	
2.000	SW07	130.488	-0.193	0.000	0.05	4.3	OK	
1.003	SW04	130.169	0.347	0.000	1.92	276.0	SURCHARGED	9

Birch Business Park
Unit B
SW Drainage (Main)

Designed by P Barrett
Checked by



Network 2018.1

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

PN	US/MH Name	Water	Surcharged	Flooded	Pipe		Status	Level Exceeded	
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)			Flow (l/s)
3.000	Dock Outlet	129.767	0.148	0.000	0.22		12.3	SURCHARGED	8
1.004	SW05	129.756	0.215	0.000	2.19		293.4	SURCHARGED	5
1.005	SW06	129.624	0.143	0.000	0.43		57.9	SURCHARGED	1

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The Flint Glass Works 64 Jersey Street Manchester M4 6JW	Birch Business Park Unit B SW Drainage (Main)	
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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW Proposed

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 Coefficient 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 FSR Ratio R 0.308
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow
1.000	SW01	15 Winter	100	+40%	100/15 Summer	100/15 Winter	
1.001	SW02	15 Winter	100	+40%	30/15 Summer	100/15 Summer	
1.002	SW03	15 Summer	100	+40%	30/15 Summer		
2.000	SW07	30 Summer	100	+40%	100/15 Summer		
1.003	SW04	120 Winter	100	+40%	30/15 Summer	100/15 Summer	
3.000	Dock Outlet	120 Winter	100	+40%	30/15 Summer	100/15 Winter	
1.004	SW05	60 Winter	100	+40%	30/15 Summer	100/30 Winter	
1.005	SW06	60 Winter	100	+40%	30/15 Winter	100/60 Winter	

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Pipe Flow / Cap. (l/s)	Pipe Flow (l/s)	Status
1.000	SW01		131.547	0.901	0.898	1.09	107.2	FLOOD
1.001	SW02		131.287	0.914	14.423	1.26	227.8	FLOOD
1.002	SW03		131.200	0.962	0.000	1.00	322.4	FLOOD RISK
2.000	SW07		130.767	0.086	0.000	0.13	11.5	SURCHARGED
1.003	SW04		130.736	0.914	13.943	1.49	214.8	FLOOD

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Micro Drainage		Network 2018.1

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

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Pipe Flow (l/s)	Status
3.000	Dock Outlet		130.202	0.583	84.405	0.64	36.2	FLOOD
1.004	SW05		130.921	1.380	7.805	2.56	343.4	FLOOD
1.005	SW06		131.385	1.905	0.361	0.43	58.0	FLOOD

PN	US/MH Name	Level Exceeded
1.000	SW01	3
1.001	SW02	4
1.002	SW03	
2.000	SW07	
1.003	SW04	9
3.000	Dock Outlet	8
1.004	SW05	5
1.005	SW06	1

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW Proposed

Pipe Sizes Pipe Manhole Sizes Manhole

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.308	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	80	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.840	Min Slope for Optimisation (1:X)	300

Designed with Level Soffits

Network Design Table for SW Proposed

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	24.685#	0.200	123.4	0.240	10.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	24.685	0.176	140.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	32.80	10.29	129.400	0.240	0.0	0.0	0.0	1.41	99.9	23.9
1.001	32.48	10.49	129.200	0.000	10.0	0.0	0.0	0.85	15.0	10.0

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PIPELINE SCHEDULES for SW Proposed

Upstream Manhole

- Indicates pipe length does not match coordinates

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	300	Channel Outlet	131.239	129.400	1.539	Open Manhole	1200
1.001	o	150	SW11	131.070	129.200	1.720	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	24.685#	123.4	SW11	131.070	129.200	1.570	Open Manhole	1200
1.001	24.685	140.3	SW06	131.385	129.024	2.211	Open Manhole	1500

Free Flowing Outfall Details for SW Proposed

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.001	SW06	131.385	129.024	0.000	1500	0
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Simulation Criteria for SW Proposed

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.840
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.308		

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Online Controls for SW Proposed

Hydro-Brake® Optimum Manhole: SW11, DS/PN: 1.001, Volume (m³): 3.8

Unit Reference	MD-SHE-0149-1300-2000-1300
Design Head (m)	2.000
Design Flow (l/s)	13.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	129.200
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	13.0
Flush-Flo™	0.585	13.0
Kick-Flo®	1.213	10.3
Mean Flow over Head Range	-	11.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.4	1.200	10.5	3.000	15.8	7.000	23.6
0.200	10.9	1.400	11.0	3.500	17.0	7.500	24.4
0.300	12.1	1.600	11.7	4.000	18.1	8.000	25.2
0.400	12.7	1.800	12.4	4.500	19.1	8.500	26.0
0.500	12.9	2.000	13.0	5.000	20.1	9.000	26.7
0.600	13.0	2.200	13.6	5.500	21.1	9.500	27.4
0.800	12.8	2.400	14.2	6.000	22.0		
1.000	12.1	2.600	14.7	6.500	22.8		

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Storage Structures for SW Proposed

Cellular Storage Manhole: SW11, DS/PN: 1.001

Invert Level (m) 129.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	90.0	0.0	0.801	0.0	0.0
0.800	90.0	0.0			

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

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 Coefficient 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 FSR Ratio R 0.308
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 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) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	Channel Outlet	120 Winter	100	+40%	100/15 Summer			
1.001	SW11	120 Winter	100	+40%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	Channel Outlet	130.766	1.066	0.000	0.51	45.2	SURCHARGED	
1.001	SW11	130.761	1.411	0.000	0.91	13.0	SURCHARGED	



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