

ISG Construction Ltd

Blackley Fire Station

Surface Water Management Report

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Preliminary Note

This report has been produced by Mark Symonds who has over 20 years' experience in infrastructure engineering (in particular surface water management design) and has qualifications including: BSc (Hons) Civil Engineering (2003); HND Civil Engineering Studies (2002); and OND Construction Studies (2000).

1. Introduction

Bradshaw Gass & Hope LLP have prepared this surface water management report to support a detailed drainage design for the redevelopment of Blackley Fire Station, which is in Manchester City Council area.

The report describes and demonstrates how the surface water run-off rate and volume from the post development site will be managed to adhere to National and local planning policy, 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 (2010) Planning for SuDS;
- CIRIA SuDS Manual C753 (2015);
- Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015);

And local policies including:

- 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).

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; will ensure that the drainage is managed and maintained for its lifetime to prevent flooding; and will ensure that the development will not increase the risk of flooding to neighbouring land and property.

2. National Policy and Water Management 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.

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

Blackley Fire Station is in a residential area of Blackley, is approximately 10km north of Manchester city centre, and is bound by residential dwellings to the north, undeveloped land and a community building leading to White Moss Road to the south, and Rochdale Road to the west.

The address of the site is Blackley Fire Station, Rochdale Road, Manchester, M9 7EQ, with co-ordinates for the centre of the site being E: 386060; N: 403390.

3.2. Existing Site and Topography

As detailed on the topographical survey plan in Appendix A, the site consists of an existing fire station building to the south, parking and yard areas to the north, access to the west, and undeveloped grassed areas along the northern and southern boundaries.

The site has a general fall from north to south, with the High point along the northern boundary being approximately 81.64m AOD, and the low-point along the southern boundary being approximately 76.33m AOD.

3.3. Proposed Development

The proposed site plan is shown in Appendix B, with a full description of the works being stated by the Architect. However, in brief, and in relation to this report, the proposal is to demolish the existing fire station building, and to build a new building in its place. The parking and yard areas will be reconfigured, with a new training tower to the east, and soft-landscaping around the perimeter.

3.4. Ground Conditions

Soakaway testing at the site was carried out by Grange Geo with the findings published on the 15th March 2024. The Grange Geo report, as shown in Appendix C, states the following:

'Water levels failed to fall from 25% to 75% full, within a 24-hour period. As such the infiltration rate was too low to calculate and soakaways are unlikely to be feasible at this location.'

A second soakaway was conducted in the as built soakaway Chamber on the 11th and 12th of March 2024. This test failed to drain the chamber for 25% to 75% full within a 24-hour period. We have calculated an infiltration rate of 1.59×10^{-6} m/s at this location'.

Therefore, based on the test results, the use of soakaway / discharge of surface water to ground is not feasible.

3.5. Waterbody / Rivers / Canals / Reservoirs

There are no known water bodies near the site, with the nearest being Boggart Hole Brook approximately 1 km to the south.

3.6. Existing Drainage Networks

The nearest public sewer to the site is a 525mm diameter combined water sewer in Rochdale Road (west of site – See Appendix D), with the assumption that surface water run-off from the existing site discharges to this sewer.

3.7. Development Areas

The overall development boundary area is approximately 2,260m² / **0.226 ha**.

The existing fire station site consists of the building, yard, parking and access areas, which equate to approximately 1,560m² / 0.156 ha, with the remaining undeveloped grassed areas equating to approximately 700m² / 0.070 ha.

The surface water run-off from the developed areas discharges to the existing drainage network, with the surface water run-off from the undeveloped grassed areas discharging off the site at a natural / greenfield rate.

Therefore, in terms of the pre-development surface water run-off calculations, the area of **0.156 ha** is to be used, and in terms of greenfield run-off calculations, the site has an urban factor of **0.69** (0.156 ha / 0.226 ha).

The proposed developed area of the site consists of the new fire station building, parking and yard areas, which equates to approximately 2,000m² / 0.200 ha, and soft-landscaping areas equating to approximately 260m² / 0.026 ha.

The surface water run-off from the developed areas of the site is discharged to a below ground drainage network, with the surface water run-off from the permeable (soft-landscaping) areas discharging off the site at a natural / greenfield rate. Therefore, the surface water management area is based on an area of **0.200 ha**.

4. Surface Water Management Principles

The surface water for the development areas of the 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

DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems states:

'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'.

United Utilities have stated that the peak surface water flow from the development site is to be 5.0 l/s, if discharged to their 525mm diameter combined water sewer in Rochdale Road.

As the site is previously developed, the aim will be to reduce the run-off rates to the equivalent greenfield rates, or to a peak flow rate of 5.0 l/s for all storm events.

4.5. Volume Control

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

'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 S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.

4.6. Flood Risk

DEFRA 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'.

5. Surface Water Run-Off Destination

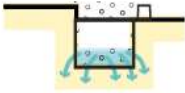
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

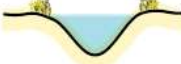
Run-Off Destination	Feasible	Description
Discharge to Ground	No	The infiltration tests carried out by Grange Geo in March 2024 show the ground to be inadequate for infiltration as a falling head test failed, and a test in an as-built chamber failed over 24-hours with the 1 st reading being a 1.59×10^{-6} m/s. Therefore, based on the test result, discharge of surface water to ground is not feasible.
Discharge to Surface Water Body	No	There are no known waterbodies near the development site. Therefore, discharge to a surface waterbody is not feasible.
Discharge to Surface Water Sewer	No	There are no known surface water sewers near to the development site. Therefore, discharge to a surface water sewer is not feasible.
Discharge to Highway Drain or Other	No	There are no known highway or other drains near to the development site. Therefore, discharge to a highway or other drain is not feasible.
Discharge to Combined Water Sewer	Yes	As the ground is not suitable for soakaways, and there are no known waterbodies, surface water sewer, or highway drains near the site, the only alternative is to discharge to the 525mm combined water sewer in Rochdale Road.

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 maintenance 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	Potential Use	Description
Green Roofs	Yes	There is potential to have biodiverse roofs over parts of the new fire station building. Full details to be confirmed, but the biodiverse roof will reduce surface water run-off rates, act as a pollutant control, and add biodiversity to the development.
Rainwater Harvesting	Yes	Rainwater harvesting tanks could be installed for use with firefighting practices. Full details of the harvesting method / size / volume to be confirmed.
Soakaway	No	The infiltration tests carried out by Grange Geo in March 2024 show the ground to be inadequate for infiltration as a falling head test failed, and a test in an as-built chamber failed over 24-hours with the 1st reading being a 1.59×10^{-6} m/s. Therefore, based on the test result, the use of a soakaway is not feasible.

Filter Strips	No	There are limited areas within the site for filter drains, and therefore this is not a suitable SuDS method.
Permeable Paving	No	External parking and yard areas are used by heavy loads vehicles, where permeable paving will not have the structural integrity to withstand the loads. Therefore, it is deemed that this is not a suitable SuDS method.
Swale	No	There are limited areas within the site for swales, and therefore this is not a suitable SuDS method.
Pond / Basin	No	There are limited areas within the site for ponds/ basins, and therefore this is not a suitable SuDS method.
Underground Storage	Yes	The surface water run-off from the Site will be restricted. Therefore, there will be a requirement to have underground storage for storm events up to 1 in 30-year; and to suitably sized so that the volume of water during the 1 in 100-year storm event is kept a minimum at surface level, where it can be contained on the Site.

7. Development Greenfield Run-Off Rates

To minimise the surface water run-off from the new fire station site, it is preferred that the post development surface water run-off be restricted to the equivalent greenfield run-off rates and volume.

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 of 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):

$$\text{QBAR} = 0.00108 \times \text{AREA}^{0.89} \times \text{SAAR}^{1.17} \times \text{SOIL}^{2.17}$$

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 = 1056

Soil = 0.450

Urban Factor = 0.69

Region Number = 10

The calculations in Appendix E show the rate for 50.00ha is 794.2 l/s, but is to be reduced to reflect the surface water catchment area (0.200 ha) of the development site. Therefore, the QBAR (greenfield run-off) for development area has been calculated to be:

$$\text{QBAR} = 3.18 \text{ l/s (15.88 l/s/ha)}$$

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	3.18 l/s	0.93	3.0 l/s
Q ₃₀	3.18 l/s	1.70	5.4 l/s
Q ₁₀₀	3.18 l/s	2.08	6.6 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 FEH 2013, with the results shown in Appendix E.

The FEH 2013 data and variables used to calculate the greenfield run-off volume at the Site location area as follows:

Site Location	=	GB 386063 03387 SD 86063 03387
Area	=	0.200 ha
SAAR	=	982
CWI	=	123.325
SPR Host	=	47.000
URBTEXT	=	0.50 (actual 0.69, but 0.50 highest for calculation)

Based on these calculation results (Appendix E), the greenfield run-off volume for the surface water management area of the Site is:

Q ₁₀₀ (6-Hour)	=	80.41m ³ (402.04m ³ /ha)
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8. Pre-Development Surface Water Run-Off Rates

The pre-development surface water run-off rates from the existing developed areas of the site are to be calculated, so that the post development rates are at least a betterment.

The calculations to determine the pre-development surface water run-off rates and volume are based on the pre-development surface water run-off area of 0.156 ha, the rainfall data given by the FEH 2013, and simulation / calculations in the MicroDrainage computer software (see Appendix F).

Based on the FEH 2013 data and computer software results, the pre-development surface water run-off rates are as follows:

$$Q_2 = 21.7 \text{ l/s}$$

$$Q_{30} = 51.1 \text{ l/s}$$

$$Q_{100} = 69.1 \text{ l/s}$$

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

$$Q_{100} \text{ (6-Hour)} = 92.17 \text{ m}^3 \text{ (360-minute storm duration)}$$

9. 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 summarised in Figure 1 below.

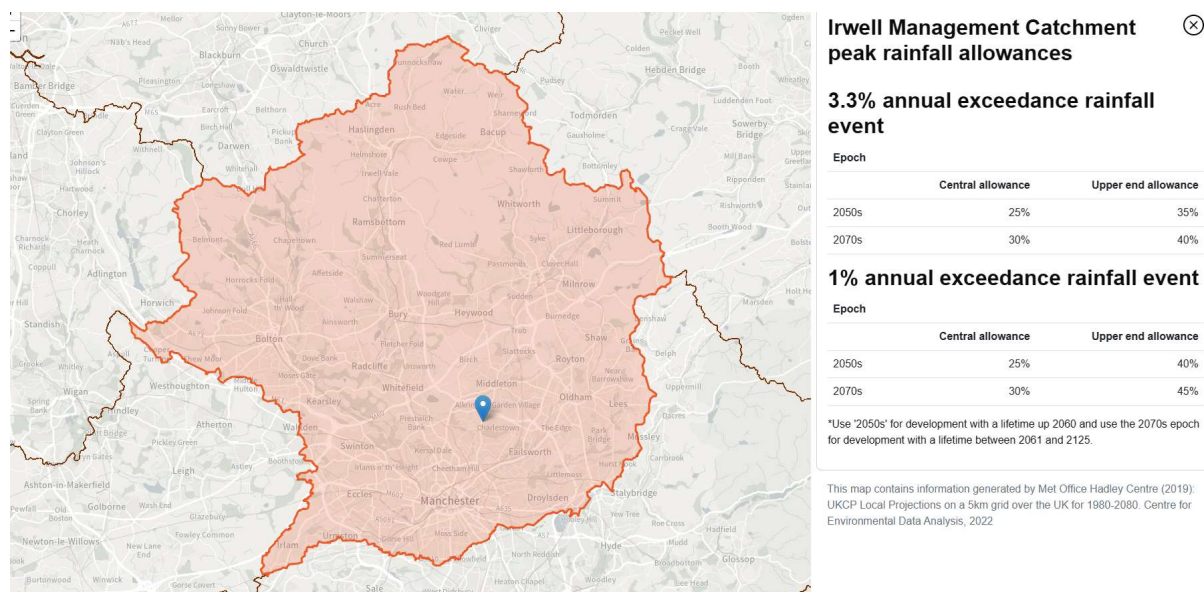


Figure 1 - Department for Environment Food & Rural Affairs – Climate Change Allowances

The lifetime of the Site is likely to be beyond 2061, and therefore the Epoch 2070's is to be used with Upper End Allowance (likelihood of increase rainfall). Therefore, the climate change allowance for the post development Site surface water run-off will be 40% and 45% for the 30-year and 100-year event, respectively.

10. Below Ground Drainage Networks and Surface Water Management Calculations

10.1. Surface Water Network Calculations

The calculations to determine the post development surface water run-off rates and required infiltration structure volume, are based on the post development surface water run-off area of 0.200 ha, and the rainfall data given by the FEH 2013.

10.2. Surface Water Drainage Network

As shown on the below ground drainage layout drawing in Appendix G, the proposed surface water network will consist of 150mm to 300mm diameter pipes; 460mm diameter inspection chambers, 1200mm diameter manholes; a petrol interceptor; a flow control chamber containing a hydro-brake; a below ground attenuation tank in the form of cellular units.

The surface water network will flow to the west of the site, where it will pass through the flow control chamber and petrol interceptor, prior to discharge to the 525mm diameter combined water sewer in Rochdale Road.

The restricted water will back flow and fill the network and attenuation tank (in the form of cellular units), where the water will be stored during the storm event to prevent flooding.

10.3. Surface Water Run-Off Rate

For the surface water run-off from the entire development site to be at the greenfield run-off rate, the surface water run-off rate for post development site is to be restricted to 3.0 l/s for the 1 in 2-year storm event; 5.4 l/s for the 1 in 30-year storm event including 40% climate change, and 6.6 l/s for the 1 in 100-year storm event including 45% climate change.

For the surface water run-off from the development site to be a reduction of the pre-development run-off rates, the surface water run-off rate for post development site is to be restricted to at less 21.7 l/s for the 1 in 2-year storm event; 51.1 l/s for the 1 in 30-year storm event including 40% climate change, and 69.1 l/s for the 1 in 100-year storm event including 45% climate change.

However, United Utilities have stated that the peak surface water run-off rate for each of the storm events (up to and including the 100-year + 45% climate change event) is to be 5.0 l/s.

Therefore, as shown in the output calculation from the MicroDrainage computer software in Appendix H, if the hydro-brake opening is set at 100mm, with a design head of 1.390 m, and a design flow of 5.0 l/s, the maximum surface water run-off rates for each storm event will be as follows:

Storm	-	Rate	-	Critical Storm Event
Q ₂	-	4.8 l/s	-	120-minute winter storm duration
Q _{30 + cc}	-	4.8 l/s	-	240-minute winter storm duration
Q _{100 + cc}	-	5.0 l/s	-	240-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

Storm	-	Greenfield	-	Post Dev	-	Difference
Q ₂	-	3.0 l/s	-	4.8 l/s	-	60% Increase
Q _{30+ 40%}	-	5.4 l/s	-	4.8 l/s	-	11% Reduction
Q _{100 + 45%}	-	6.0 l/s	-	5.0 l/s	-	17% Reduction

Pre-Development Rate to Post Development Rate

Storm	-	Pre-Dev	-	Post Dev	-	Difference
Q ₂	-	21.7 l/s	-	4.8 l/s	-	78% Reduction
Q _{30 + 40%}	-	51.1 l/s	-	4.8 l/s	-	91% Reduction
Q _{100 + 45%}	-	69.1 l/s	-	5.0 l/s	-	93% Reduction

The surface water run-off rates exceed the 2-year greenfield rate, but are an 11% and 17% reduction of the 30-year and 100-year greenfield rates, respectively, and are between an 78% to 93% reduction of the pre-development rates.

Therefore, the rates are deemed to be acceptable, as they meet the requirements of the Non-Statutory Technical Standards for Sustainable Drainage Systems S3 (see Section 3.4) and United Utilities.

10.4. Surface Water Run-Off Volume

The surface water run-off volumes for the post development site can be calculated for 1 in 100-Year the 6-hour duration (Inc. 45% CC), based on the peak discharge rate of 5.0 l/s, where:

$$Q_{100 (6\text{-hour})} \quad - \quad 5.0 \text{ l/s} \times (60 \times 60 \times 6) \quad - \quad 108,000 \text{ litres} \quad - \quad 108.00\text{m}^3$$

A summary of the post development surface water run-off volume compared to the greenfield volumes are as follows:

Greenfield Volume to Post Development Volume

Storm	-	Greenfield	-	Post Dev	-	Difference
Q ₁₀₀	-	80.41m ³	-	108.00m ³	-	34% Increase

Pre-Development Volume to Post Development Volume

Storm	-	Pre-v	-	Post Dev	-	Difference
Q ₁₀₀	-	92.17m ³	-	108.00m ³	-	17% Increase

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield and pre-development run-off volume.

However, the post development discharge volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (S6), which states: *'where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5, the runoff volume must be discharged at a rate that does not adversely affect flood risk'*.

As the rate at which the volume of water is discharged off the Site is 17% reduction of the greenfield rate, and 93% reduction of the pre-development rate for the 100-year storm event, it is deemed that the volume will not adversely affect flood risk.

10.5. 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)'*.

Attenuation will be within the drainage network and below ground attenuation tank in the form of cellular units.

As detailed in the MicroDrainage calculations (Appendix H) and below ground drainage layout (Appendix G) the attenuation volumes and details for the SuDS method are as follows:

Attenuation Tank Length	-	20.00m
Attenuation Tank Width	-	6.50m
Attenuation Tank Area	-	130.00m ²
Attenuation Tank Depth	-	1.20m
Porosity	-	0.95
Attenuation Tank Volume	-	148.200m ³
Overall Tank Volume	-	156.00m ³

The calculations show that no flooding occurs from the network for all storms up to and including the 100-year + 45% climate change event. All restricted surface water will therefore be contained on site, and is deemed acceptable.

11. Maintenance Requirements

The extent of the drainage network and SuDS features for the development site are shown on the below ground drainage layout drawings in Appendix F.

The management and maintenance of the surface water drainage networks and SuDS features will be by contractors appointed by Blackley Fire Station, which will form part of the overall site management and maintenance schedule. Details of which are as follows:

11.1. Surface Water Drainage Network, Cellular Units 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

11.2. 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 fire station.

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.

12. Conclusion / Summary

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

12.1. Peak Flow Control

The surface water run-off rates exceed the 2-year greenfield rate, but are an 11% and 17% reduction of the 30-year and 100-year greenfield rates, respectively, and are between an 78% to 93% reduction of the pre-development rates.

Therefore, the rates are deemed to be acceptable, as they meet the requirements of the Non-Statutory Technical Standards for Sustainable Drainage Systems S3 (see Section 3.4) and United Utilities.

12.2. Volume Control

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield and pre-development run-off volume.

However, the post development discharge volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (S6), which states: 'where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.

As the rate at which the volume of water is discharged off the Site is 17% reduction of the greenfield rate, and 93% reduction of the pre-development rate for the 100-year storm event, it is deemed that the volume will not adversely affect flood risk.

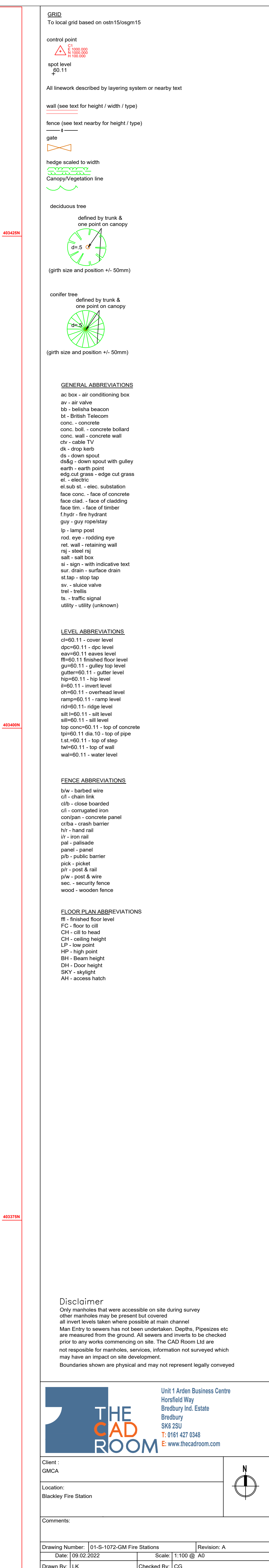
12.3. Flood Risk within the Development

The below ground cellular unit structure will be suitably sized so that no flooding occurs from the network for all storms up to and including the 100-year + 45% climate change event. All restricted surface water will therefore be contained on site, and is deemed acceptable.

12.4. Maintenance

The management and maintenance of the surface water drainage networks and SuDS features will be by contractors appointed by Blackley Fire Station, which will form part of the overall site management and maintenance schedule.

Appendix A - Topographical Survey





Appendix B - Proposed Site Plans



Appendix C

Ground Investigation Data

Grange Geo Consulting Ltd

43 Winchilsea Avenue Newark Notts NG24 4AD UK

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Andrew.hare@grangegeo.co.uk

www.grangegeo.co.uk



15th of March 2024

For the attention of **Andy Beswick**

Dear **Andy**,

Re: soakaway testing at Blackley Fire Station, Rochdale Road, Manchester

The following investigation was carried out at the above location in accordance with our quotation dated 17th of January and emailed instruction from Andy Beswick from Cheltenham Green Civils Ltd to proceed. Initial background information for the site indicated the site to be directly underlain superficial deposits of Glacial Till, which is in turn underlain by the Chester Formation Sandstone.

Site Works

The purpose of the investigation was to supply soakaway test data in general accordance with BRE document 365 (Soakaway Design) at one positions as part of the redevelopment of Blackley Fire Station, Manchester.

The appended drawing (R24011-DWG2) illustrates the position of the test pits, which were excavated on 23/02/2024 to a depth of 0.9m below the base of the existing basement footings. The trial pit was found to comprise sandy CLAY likely of Glacial origin.

Water was added to the trial pit and Falling water level readings were undertaken using a dip meter. A single test was conducted within trial pit TP1.

Grange Geo Consulting Ltd

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**Results**

Water levels failed to fall from 25% to 75% full, within a 24 hour period. As such the infiltration rate was too low to calculate and soakaways are unlikely to be feasible at this location.

A second soakaway was conducted in the as built soakaway Chamber on the 11th and 12th of March 2024. This test failed to drain the chamber for 25% to 75% full within a 24 hour period. We have calculated an infiltration rate of $1.59 \text{ E } -06 \text{ m/s}$ at this location.

Yours sincerely,

for **Grange GeoConsulting Ltd**

Andrew Hare

Andrew Hare

Director

MSc DIC FGS

APPENDICES

Appendix A SITE LOCATION PLAN

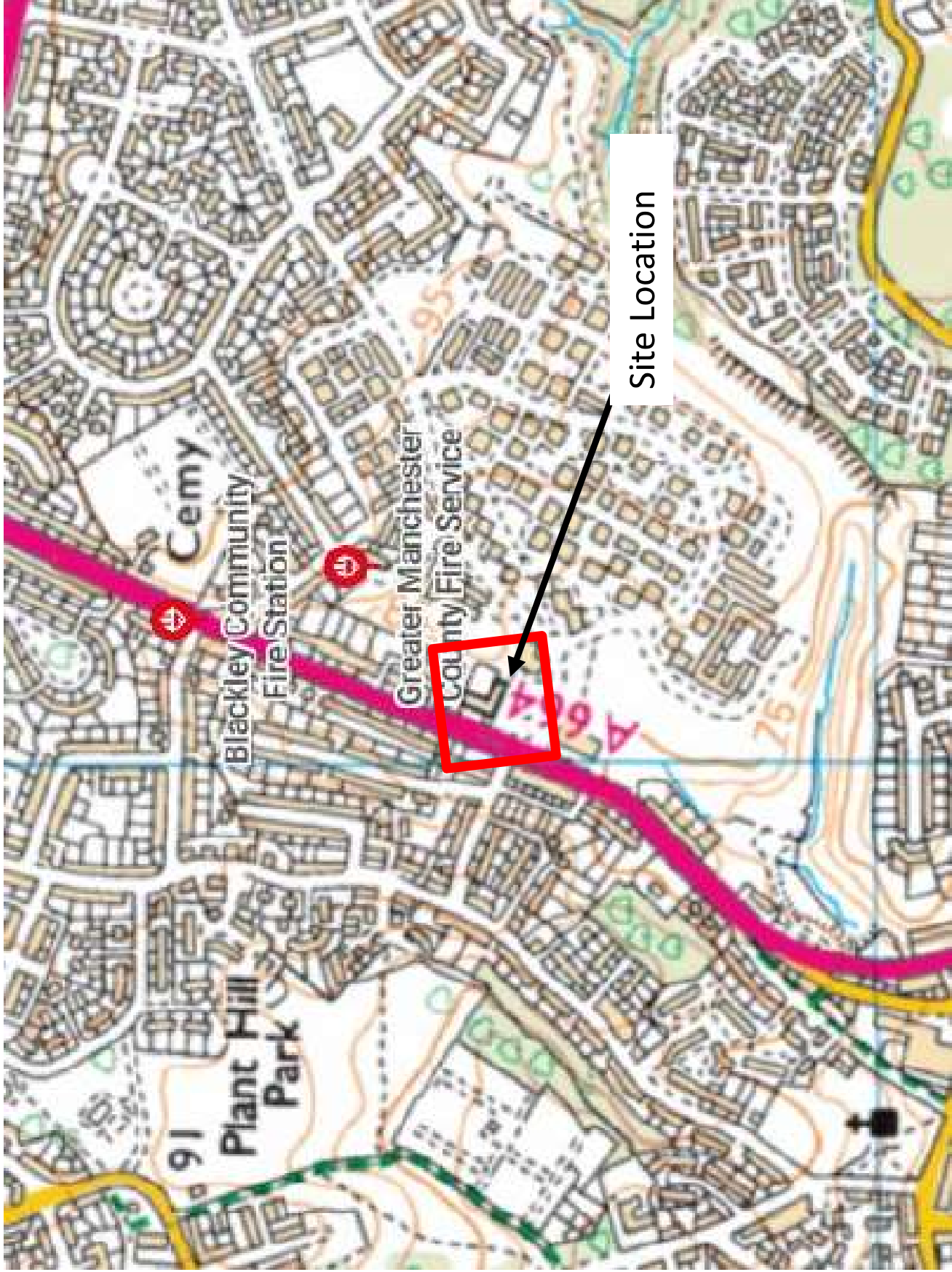
Appendix B TRIAL PIT PHOTOGRAPHS

Appendix C GROUND INVESTIGATION PLAN, EXPLORATORY HOLE LOGS

Appendix D SOAKAWAY TESTING RESULTS

Appendix A

SITE LOCATION PLAN



Site Location,
Blackley Fire Station

Client- Cheltenham Green Civils
Date- Feb 2024

North


Drawing- R24011-1



**Grange
Geo**

Test Location,
Blackley Fire Station

Client- Cheltenham Green Civils
Date- Feb 2024

North


Drawing- R24011-2

Appendix B

TRIAL PIT PHOTOGRAPHS



TP1 prior to testing.

Appendix C

GROUND INVESTIGATION PLAN, EXPLORATORY HOLE LOGS

Trial Pit Log

Client: Cheltenham Green Civils
Project: Blackley Fire Station

TP No: TP1
Sheet: 1 of 1
Method: Excavation with 13t digger



Sample		S. Vane kN/m ²	Description	Depth mBGL	Legend
Depth (m)	Type				
			Made Ground, concrete foundation.		
0.50			Orange brown and grey mottled, sandy CLAY. (Glacial Till)	0.50	- - - - - - - - - - - - - - - - - - - -
1.00			End of trial pit.	1.00	
1.50				1.50	
2.00				2.00	
2.50				2.50	
3.00				3.00	

General Comments: 1. Trial pit excavted at base of former basement foundation level. 2. 3.	Date: 23/02/2024 Logged by: AH Checked: AH Job No: R23102
---	--

Appendix D

Soakaway Testing Results

BRE BR365 - Trial Pit Soakaway Data Sheet

Site:Blackley Fire Station

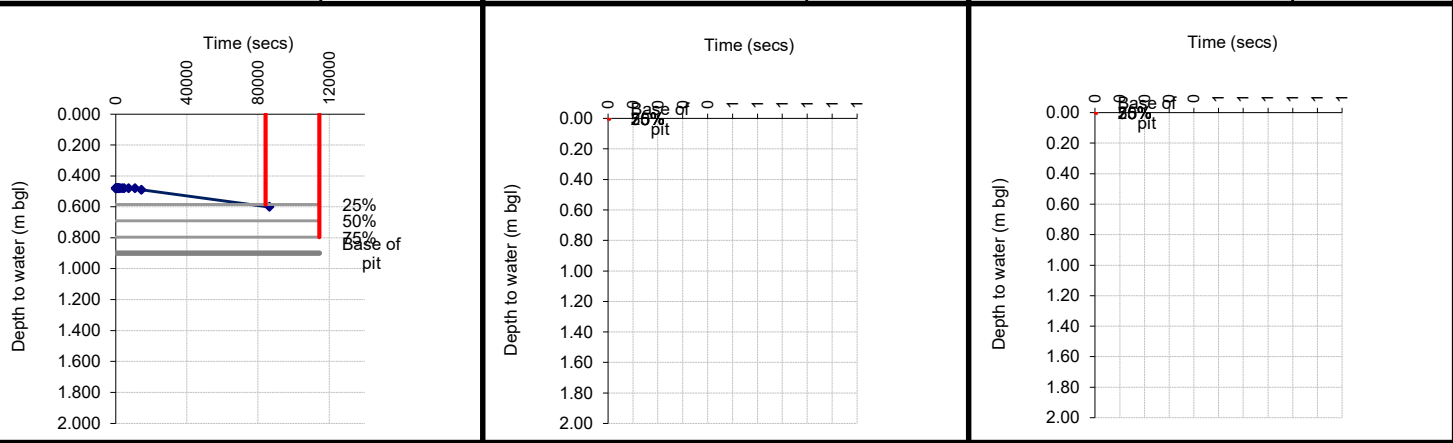
Client:Cheltenham Green Civils

Test Location:TP1

Date of start of testing:23/02/2024

Date at end of testing:24/02/2024

Test Run 1			Test Run 2			Test Run 3		
Pit Dimensions (m)			Pit Dimensions (m)			Pit Dimensions (m)		
Length	2.000m		Length			Length		
Width	2.000m		Width			Width		
Depth	0.900m		Depth			Depth		
Fill Depth	0.420m		Fill Depth	0.000m		Fill Depth	0.000m	
Max Volume	1.680m³		Max Volume	0.000m³		Max Volume	0.000m³	
Gravel used to backfill Test Pit	No		Gravel used to backfill Test Pit	No		Gravel used to backfill Test Pit	No	
Time to soakaway			Time to soakaway			Time to soakaway		
Time		Depth to water	Time		Depth to water	Time		Depth to water
(secs)	(min)	(m bgl)	(secs)	(min)	(m bgl)	(secs)	(min)	(m bgl)
	0	0.480		0		0	0	
60	1	0.480						
120	2	0.480						
180	3	0.480						
240	4	0.480						
300	5	0.480						
360	6	0.480						
420	7	0.480						
480	8	0.480						
540	9	0.480						
600	10	0.480						
900	15	0.480						
1200	20	0.480						
1500	25	0.480						
1800	30	0.480						
2400	40	0.480						
3600	60	0.480						
4800	80	0.480						
7200	120	0.480						
10800	180	0.480						
14400	240	0.490						
86400	1440	0.600						
25% water depth	0.585m		25% water depth	0.000m		25% water depth	0.000m	
50% water depth	0.690m		50% water depth	0.000m		50% water depth	0.000m	
75% water depth	0.795m		75% water depth	0.000m		75% water depth	0.000m	
25% time (seconds)	84240 sec		25% time (seconds)			25% time (seconds)		
75% time (seconds)	114480 sec		75% time (seconds)			75% time (seconds)		
V _{p 75-25}	0.8400m³		V _{p 75-25}	0.0000m³		V _{p 75-25}	0.0000m³	
a _{p 50} (Actual area from test)	6.8800m²		a _{p 50} (Actual area from test)	0.0000m²		a _{p 50} (Actual area from test)	0.0000m²	
t _{p 75 - 25}	30240.0		t _{p 75 - 25}			t _{p 75 - 25}		
Soil Infiltration Rate	NA		Soil Infiltration Rate			Soil Infiltration Rate		



Note: Groundwater table taken as base of pit for infiltration rate calculation.

Site:	Blackley Fire Station	
Client:	Cheltenham Green Civils	
Test Location	TP2	Date of sta

Site:	Blackley Fire Station				
Client:	Cheltenham Green Civils				
Test Location	TP2	Date of start of testing	11/03/2024	Date at end of testing	12/03/2024

The figure consists of three side-by-side graphs, each representing a different pit depth: 25%, 50%, and 75%. All graphs share the same axes: the vertical axis is 'Depth to water (m bgl)' ranging from 0.000 to 2.000 in increments of 0.200, and the horizontal axis is 'Time (secs)' ranging from 0 to 160,000 in increments of 40,000. A horizontal line at 2.000 m bgl is labeled 'Base of pit'. In each graph, a blue line with diamond markers shows the water level rising from the base of the pit towards the surface. The 25% pit graph shows the water level reaching approximately 0.400 m bgl at 160,000 seconds. The 50% and 75% pit graphs show the water level reaching the surface (0.000 m bgl) at approximately 40,000 and 80,000 seconds, respectively. A red vertical line is drawn at the time when the water level reaches the surface in each graph.

Note: Groundwater table taken as base of pit for infiltration rate calculation.



Appendix D

Uited Utilities Asset Plan

Appendix E - Greenfield SW Run-Off Rates and Volume Calculations

Flo Consult UK Ltd		Page 1
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley FS Greenfiled Run-Off Rate Calculations	
Date 11/04/2024 File	Designed by MDS Checked by MDS	
Innovyze	Source Control 2020.1.3	
IH 124 Mean Annual Flood Input Return Period (years)2Soil0.450 Area (ha) 50.000Urban0.690 SAAR (mm)1056Region NumberRegion 10 Results1/s QBAR Rural355.4 QBAR Urban794.2 Q2 years805.9 Q1 year691.0 Q2 years805.9 Q5 years971.4 Q10 years1053.6 Q20 years1128.9 Q25 years1148.8 Q30 years1163.3 Q50 years1203.1 Q100 years1273.7 Q200 years1370.1 Q250 years1399.3 Q1000 years1583.9		
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Flo Consult UK Ltd		Page 1
4 Market Square	Blackley FS	
Old Amersham	Greenfield Run-Off	
Buckinghamshire, HP7 0DQ	Volume Calculations	
Date 11/04/2024	Designed by MDS	
File	Checked by MDS	
Innovyze	Source Control 2020.1.3	

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
Areal Reduction Factor	1.00
Area (ha)	0.200
SAAR (mm)	982
CWI	123.325
SPR Host	47.000
URBEXT (USER)	0.5000

Results

Percentage Runoff (%)	57.18
Greenfield Runoff Volume (m³)	80.408

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Appendix F - Pre-Development SW Run-Off Rates and Volume Calculations

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley FS Pre-Development SW Run-off Calculations	
Date 11/04/2024 File	Designed by MDS Checked by MDS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
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 * 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 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)		2
FEH Rainfall Version		2013
Site Location	GB 386063 403387 SD 86063	03387
Data Type		Point
Summer Storms		Yes
Winter Storms		Yes
Cv (Summer)		0.750
Cv (Winter)		0.840

Flo Consult UK Ltd		Page 2
4 Market Square	Blackley FS	
Old Amersham	Pre-Development	
Buckinghamshire, HP7 0DQ	SW Run-off Calculations	
Date 11/04/2024	Designed by MDS	
File	Checked by MDS	
Innovyze	Network 2020.1.3	
<u>Synthetic Rainfall Details</u> Storm Duration (mins) 30		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley FS Pre-Development SW Run-off Calculations	
Date 11/04/2024 File	Designed by MDS Checked by MDS	
Innovyze	Network 2020.1.3	

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

Simulation Criteria

Synthetic Rainfall Details

Profile(s)

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	1	15 Winter	2	+0%	100/15 Summer				10.091
1.001	2	15 Winter	2	+0%	30/15 Summer				10.014

PN	US/MH Name	Surcharged	Flooded			Half Drain	Pipe		
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
1.000	1	-0.134	0.000	0.34			14.7	OK	
1.001	2	-0.111	0.000	0.50			21.7	OK	

Flo Consult UK Ltd			Page 4	
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ		Blackley FS Pre-Development SW Run-off Calculations		
Date 11/04/2024		Designed by MDS		
File		Checked by MDS		
Innovyze		Network 2020.1.3		
<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>				
<u>Simulation Criteria</u>				
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				
<u>Synthetic Rainfall Details</u>				
Rainfall Model FEH				
FEH Rainfall Version 2013				
Site Location GB 386063 403387 SD 86063 03387				
Data Type Point				
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) 2, 30, 100				
Climate Change (%) 0, 0, 0				

Flo Consult UK Ltd			Page 5						
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ		Blackley FS Pre-Development SW Run-off Calculations							
Date 11/04/2024		Designed by MDS							
File		Checked by MDS							
Innovyze			Network 2020.1.3						
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>									
<u>Simulation Criteria</u>									
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 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									
<u>Synthetic Rainfall Details</u>									
Rainfall Model FEH									
FEH Rainfall Version 2013									
Site Location GB 386063 403387 SD 86063 03387									
Data Type Point									
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) 2, 30, 100									
Climate Change (%) 0, 0, 0									
									Water
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	1	15 Winter	100	+0%	100/15 Summer				10.392
1.001	2	15 Winter	100	+0%	30/15 Summer				10.285
<u>Surcharged Flooded</u>									
PN	US/MH	Depth	Volume	Flow /	Half Drain	Pipe			Level
	Name	(m)	(m³)	Cap.	Time	Flow			Exceeded
				Overflow	(mins)	(l/s)	Status		
				(l/s)					
1.000	1	0.167	0.000	1.03		44.6	SURCHARGED		
1.001	2	0.160	0.000	1.60		69.1	SURCHARGED		
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley FS Pre-Development SW Run-off Calculations	
Date 11/04/2024 File	Designed by MDS Checked by MDS	
Innovyze		Network 2020.1.3

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	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 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)	2
FEH Rainfall Version	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Flo Consult UK Ltd		Page 2
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley FS Pre-Development SW Run-off Calculations	
Date 11/04/2024 File	Designed by MDS Checked by MDS	
Innovyze	Network 2020.1.3	

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 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 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 2013
 Site Location GB 386063 403387 SD 86063 03387
 Data Type Point
 Cv (Summer) 0.750
 Cv (Winter) 0.840

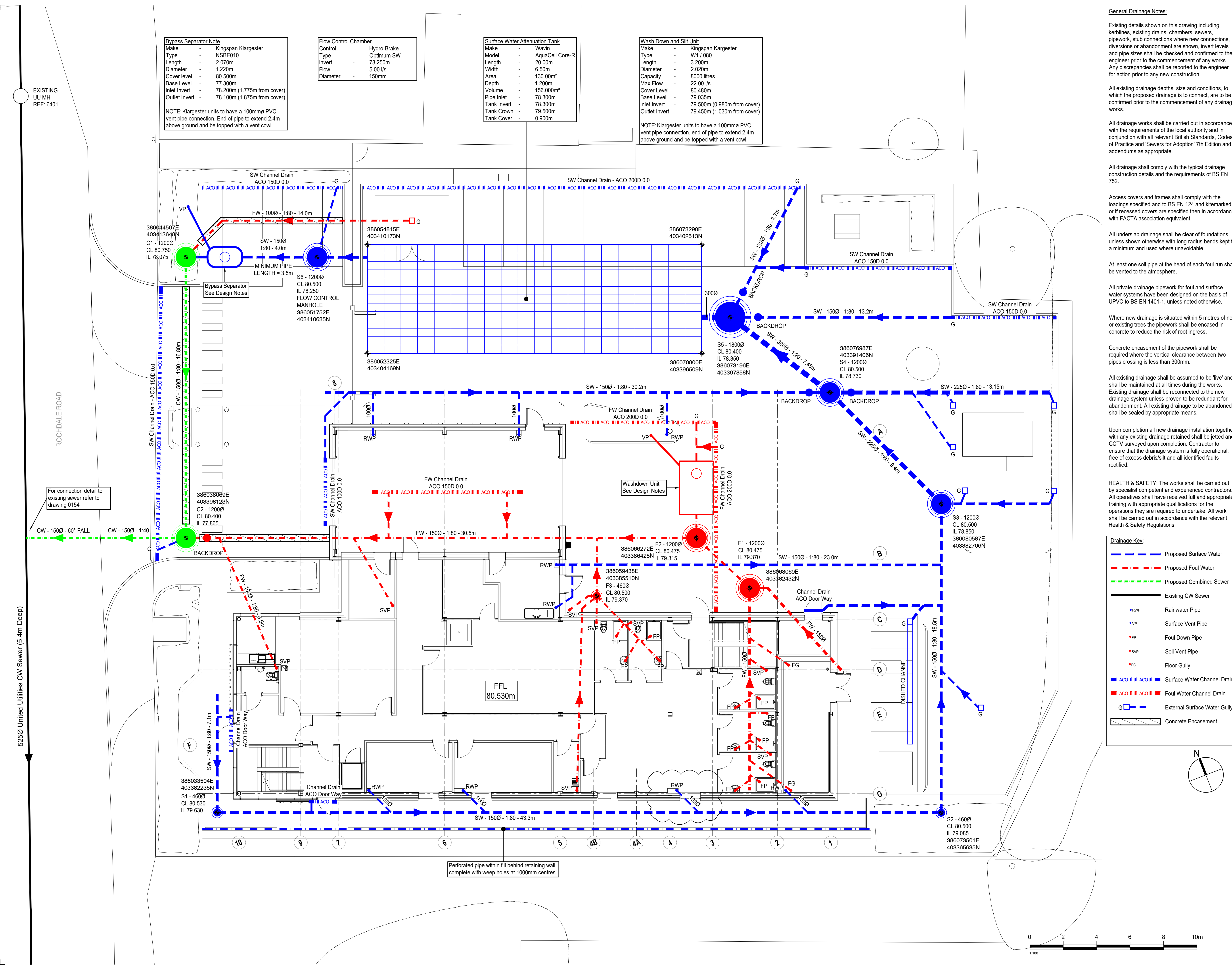
Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

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

			Water Surcharged Flooded				
PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+0%	12.000	10.060	-0.165	0.000	0.16
1.001	2	360 minute 100 year Winter I+0%	12.000	9.976	-0.149	0.000	0.25

			Half Drain Pipe			
PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Time (mins)	Flow (l/s)	Status
1.000	1		59.062		6.9	OK
1.001	2		92.167		10.7	OK

Appendix G - Below Ground Drainage Layout and Details



Bypass Separator Note	
Make	- Kingspan Klargester
Type	- NSBE010
Length	- 2.070m
Diameter	- 1.220m
Cover level	- 80.500m
Base Level	- 77.300m
Inlet Invert	- 78.200m (1.775m from cover)
Outlet Invert	- 78.100m (1.875m from cover)
NOTE: Klargester units to have a 100mm PVC vent pipe connection. End of pipe to extend 2.4m above ground and be topped with a vent cowl.	

Flow Control Chamber	
Control	- Hydro-Brake
Type	- Optimum SW
Invert	- 78.250m
Flow	- 5.00 l/s
Diameter	- 150mm

Surface Water Attenuation Tank	
Make	- Wavin
Model	- AquaCell Core-R
Length	- 20.00m
Width	- 6.50m
Area	- 130.00m²
Depth	- 1.200m
Volume	- 156.000m³
Pipe Inlet	- 78.300m
Tank Invert	- 78.300m
Tank Crown	- 79.500m
Tank Cover	- 0.900m

Wash Down and Silt Unit	
Make	- Kingspan Kargester
Type	- W1 / 080
Length	- 3.200m
Diameter	- 2.020m
Capacity	- 8000 litres
Max Flow	- 22.00 l/s
Cover Level	- 80.480m
Base Level	- 79.035m
Inlet Invert	- 79.500m (0.980m from cover)
Outlet Invert	- 79.450m (1.030m from cover)
NOTE: Klargester units to have a 100mm PVC vent pipe connection. End of pipe to extend 2.4m above ground and be topped with a vent cowl.	

EXISTING
UU MH
REF: 6401

General Drainage Notes:

Existing details shown on this drawing including kerblines, existing drains, chambers, sewers, pipework, stub connections where new connections, diversions or abandonment are shown, invert levels and pipe sizes shall be checked and confirmed to the engineer prior to the commencement of any works. Any discrepancies shall be reported to the engineer for action prior to any new construction.

All drainage works shall be carried out in accordance with the requirements of the local authority and in conjunction with all relevant British Standards, Codes of Practice and 'Sewers for Adoption' 7th Edition and addendums as appropriate.

All drainage shall comply with the typical drainage construction details and the requirements of BS EN 752.

Access covers and frames shall comply with the loadings specified and to BS EN 124 and kitemarked or if recessed covers are specified then in accordance with FACTA association equivalent.

All underslab drainage shall be clear of foundations unless shown otherwise with long radius bends kept to a minimum and used where unavoidable.

At least one soil pipe at the head of each foul run shall be vented to the atmosphere.

All private drainage pipework for foul and surface water systems have been designed on the basis of UPVC to BS EN 1401-1, unless noted otherwise.

Where new drainage is situated within 5 metres of new or existing trees the pipework shall be encased in concrete to reduce the risk of root ingress.

Concrete encasement of the pipework shall be required where the vertical clearance between two pipes crossing is less than 300mm.

All existing drainage shall be assumed to be 'live' and shall be maintained at all times during the works. Existing drainage shall be reconnected to the new drainage system unless proven to be redundant for abandonment. All existing drainage to be abandoned shall be sealed by appropriate means.

Upon completion all new drainage installation together with any existing drainage retained shall be jetted and CCTV surveyed upon completion. Contractor to ensure that the drainage system is fully operational, free of excess debris/silt and all identified faults rectified.

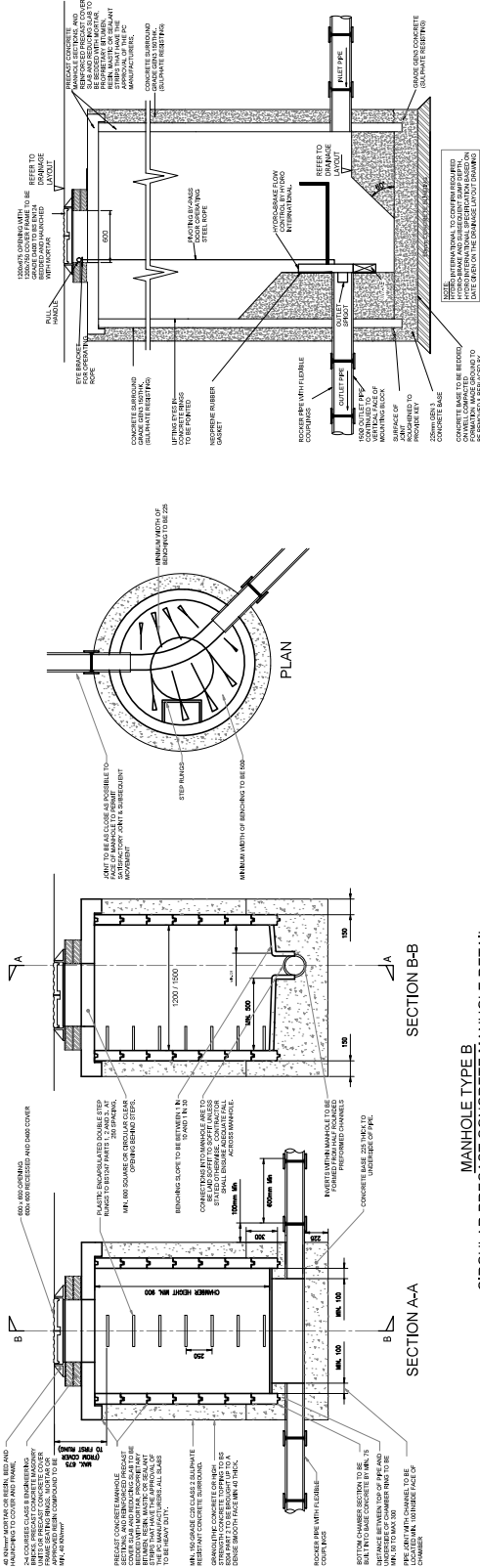
HEALTH & SAFETY: The works shall be carried out by specialist competent and experienced contractors. All operatives shall have received full and appropriate training with appropriate qualifications for the operations they are required to undertake. All work shall be carried out in accordance with the relevant Health & Safety Regulations.

Drainage Key:	
	Proposed Surface Water
	Proposed Foul Water
	Proposed Combined Sewer
	Existing CW Sewer
	Rainwater Pipe
	Surface Vent Pipe
	Foul Down Pipe
	Soil Vent Pipe
	Floor Gully
	Surface Water Channel Drain
	Foul Water Channel Drain
	External Surface Water Gully
	Concrete Encasement

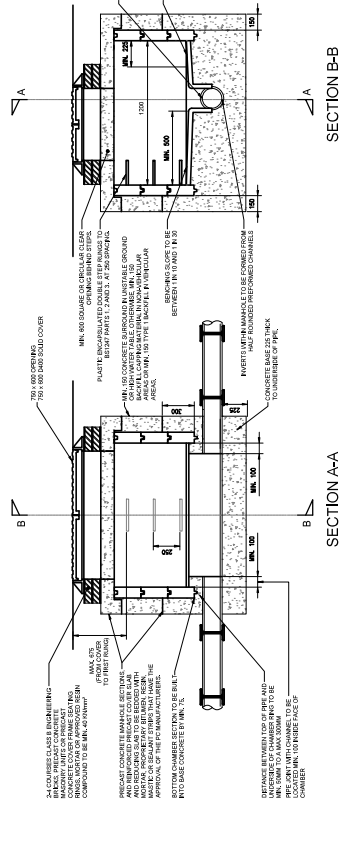
signature will have no responsibility for any false, false, or otherwise inaccurate or misleading information or any use of this document that is not intended or authorized by the originator.

Hazard Identification 	
ref	hazard

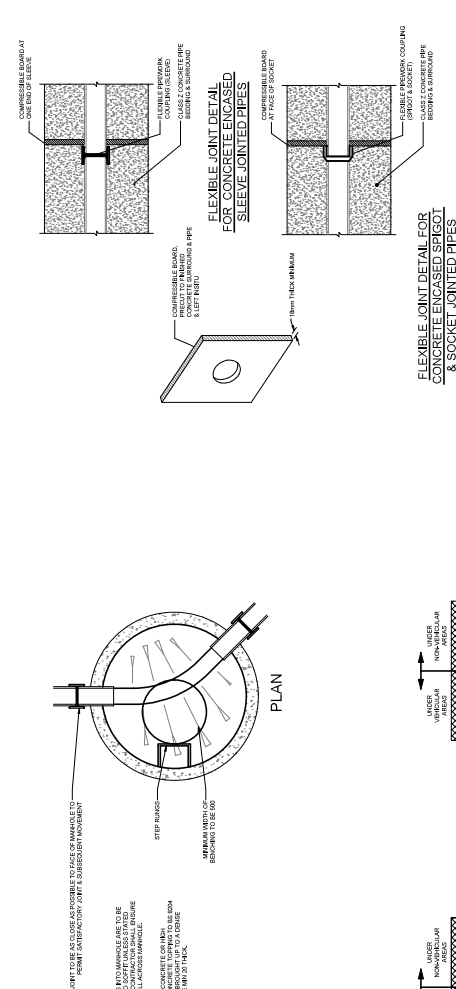
CONTROL MANHOLE NOTES

[illegible]

MANHOLE TYPE B
CIRCULAR PRECAST CONCRETE MANHOLE DETAIL
(DEPTH MORE THAN 1.50m TO TOP OF PIPE)



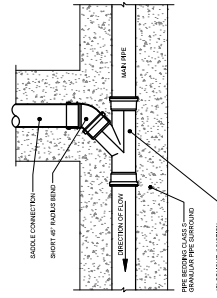
MANHOLE TYPE E
CIRCULAR PRECAST CONCRETE MANHOLE DETAIL
(DEPTH LESS THAN 1.50m TO TOP OF PIPE)



FLEXIBLE JOINT DETAIL FOR
CONCRETE ENCASED PIPES
(TO B.S. 1142)



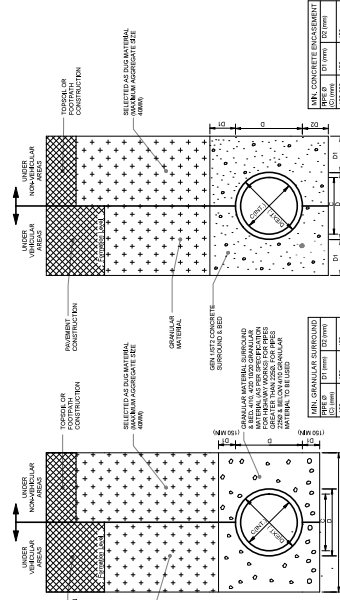
**FLEXIBLE JOINT DETAIL FOR
CONCRETE ENCASED SPIGO
& SOCKET JOINTED PIPES**



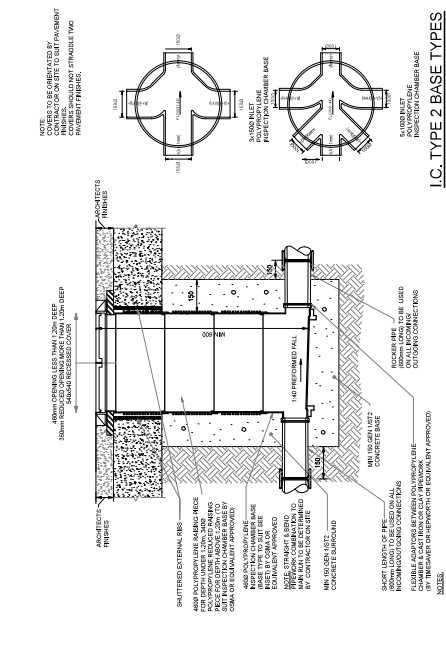
**TYPICAL 45° PIPE JUNCTION
CONNECTION DETAIL**

MIN. CONCRETE ENCASUREMENT			
HPF Ø (G) (mm)	D1 (mm)	D2 (mm)	
100-200	150	150	
Ø75	150	170	
750	150	160	
825	160	210	
800	160	225	
Ø75	160	260	
1050	150	270	
1200	170	300	
1350	180	360	
1100	200	375	
1650	220	420	

MIN. GRANULAR SURROUND			
PIPE Ø (C ₂) (mm)	D1 (mm)	D2 (mm)	D3 (mm)
102	150	450	
150	150	600	
225	150	750	
300	150	850	
375	200	1050	
450	200	1150	
525	200	1250	
600	200	1350	
675	200	1450	
750	200	1650	



CLASS Z PIPE BEDDING & SURROUND
TO BE USED FOR PLASTIC, VITRIFIED
CLAY & CONCRETE PIPEWORK)

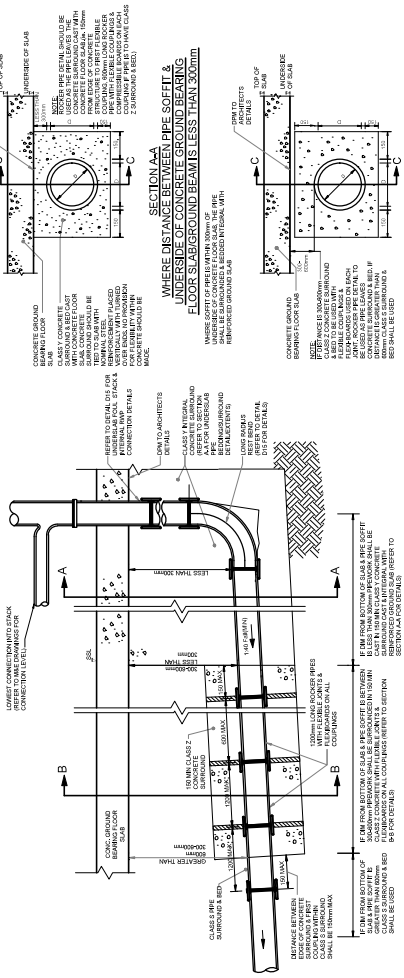


PPIC
POLYPROPYLENE INSPECTION CHAMBER

2. MAXIMUM INCOMING OUTGOING PIPE DIAMETER SHALL BE 100 OR 1500.

This drawing is a preliminary drawing and is not to be used for construction purposes. It is for information only and is subject to change without notice. The client acknowledges that the design is preliminary and that the contractor is responsible for obtaining all necessary permits and approvals. The client also acknowledges that the design is preliminary and that the contractor is responsible for obtaining all necessary permits and approvals. The client also acknowledges that the design is preliminary and that the contractor is responsible for obtaining all necessary permits and approvals.

Hazard Identification	
ref	hazard



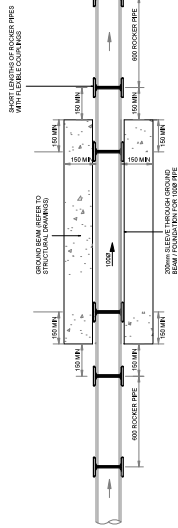
SECTION A-A
WHERE DISTANCE BETWEEN PIPE SOFFIT & UNDERSIDE OF CONCRETE GROUND BEARING IS LESS THAN 300MM

SECTION B-B
WHERE DISTANCE BETWEEN PIPE SOFFIT & UNDERSIDE OF CONCRETE GROUND BEARING IS GREATER THAN 300MM

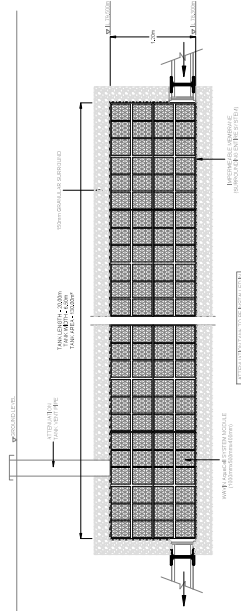
TYPICAL UNDERSLAB PIPE BEDDING DETAILS FOR PIPEWORK UNDER GROUND BEARING SLAB (FOR ALL UNDER SLAB PIPE DEPTHS)

SECTION C-C

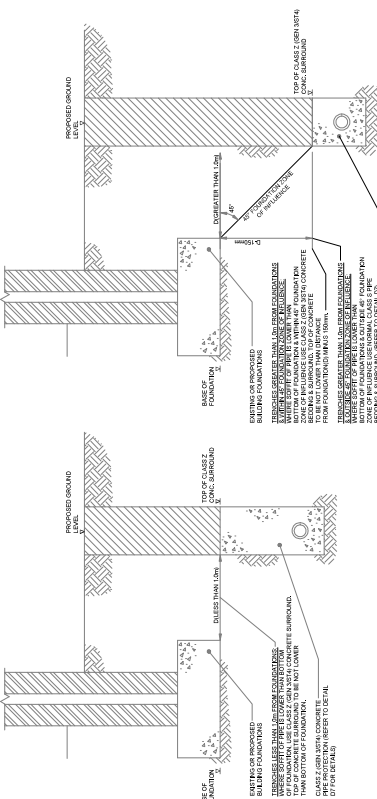
1. THE DETAIL SHALL ONLY BE USED UNDER AREAS OF GROUND BEARING SLAB WHERE THE PIPEWORK CAN BE SUPPORTED BY UNDER SLAB LATERAL WALL.
2. CONNECTION INTO INTERNAL MANHOLE OF MAN UNDER GROUND BEARING SLAB SHALL BE REFERRED TO DETAIL OF PIPE DETAIL (REFER TO DAMAGE PLAN).



TYPICAL PIPE THROUGH GROUND BEAM / FOUNDATION DETAIL

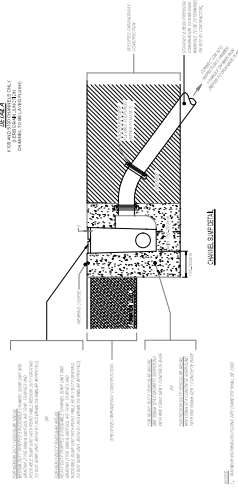
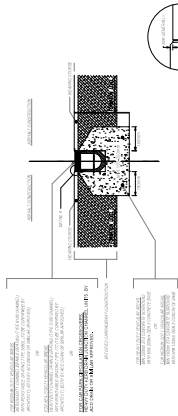


TYPICAL CELLULAR UNIT / TANK DETAIL



PIPE PROTECTION ADJACENT TO EXISTING PROPOSED FOUNDATIONS

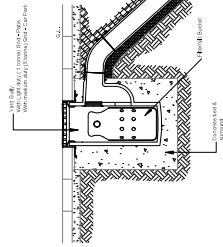
PIPE PROTECTION ADJACENT TO EXISTING PROPOSED FOUNDATIONS



PIPE PROTECTION ADJACENT TO EXISTING PROPOSED FOUNDATIONS

PIPE PROTECTION ADJACENT TO EXISTING PROPOSED FOUNDATIONS

TYPICAL RAINWATER PIPE AND BACK INLET GULLY DETAIL



EXTERNAL SW GULLY DETAIL

ref	hazard

21, St. Andrew Street
Bristol, BS1 1TP
Architects
Consulting Engineers
Quantity Surveyors
www.bradshawgass.co.uk
0117 925 1111

Bradshaw Gass & Hope LLP

Client
GREATER MANCHESTER
COMBINED AUTHORITY

Project
BLACKLEY FIRE STATION

Drawing
DRAINAGE DETAILS
SHEET 2

Drawn by	MCS	Scale	20/04/23
Checked by	BN	Scale	
Scale	N.T.S	Scale	A1
Project No	1978.35.403	Scale	P2

Appendix H - Surface Water Management Calculations

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
Date 11/04/2024 File SW Network Calculations ...	Designed by MDS Checked by MDS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location GB 386063 403387 SD 86063 03387	
Data Type	Point
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	0.172	4-8	0.028

Total Area Contributing (ha) = 0.200

Total Pipe Volume (m³) = 3.462

Network Design Table for Storm

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
----	---------------	-------------	----------------	----------------	----------------	--------------------	-----------	-------------	-------------	--------------	----------------

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)
----	-----------------	----------------	--------------	------------------	----------------------	---------------	-------------------	--------------	--------------	---------------

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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Network Design Table for Storm

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ					Blackley Fire Station Surface Water Network / Management Calculations							
Date 11/04/2024 File SW Network Calculations ...					Designed by MDS Checked by MDS							
Innovyze								Network 2020.1.3				
Manhole Schedules for Storm												
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)	Backdrop (mm)	
S1	80.500	1.335	Open Manhole	1200	1.000	79.165	225					
S2	80.500	1.375	Open Manhole	1200	2.000	79.125	225					
S3	80.500	1.625	Open Manhole	1200	1.001	78.875	225	1.000	78.875	225		
								2.000	78.875	225		
Tank	80.500	2.200	Open Manhole	1	1.002	78.300	300	1.001	78.375	225		
S4	80.560	2.340	Open Manhole	1200	1.003	78.220	300	1.002	78.220	300		
S5	80.530	0.820	Open Manhole	460	3.000	79.710	150					
S6	80.530	1.000	Open Manhole	460	3.001	79.530	150	3.000	79.530	150		
S7	80.560	2.415	Open Manhole	1200	1.004	78.145	300	1.003	78.145	300		
								3.001	79.475	150	1180	
C1	80.450	2.780	Open Manhole	1200		OUTFALL		1.004	77.670	300		
No coordinates have been specified, layout information cannot be produced.												
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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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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	225	S1	80.500	79.165	1.110	Open Manhole	1200
2.000	o	225	S2	80.500	79.125	1.150	Open Manhole	1200
1.001	o	225	S3	80.500	78.875	1.400	Open Manhole	1200
1.002	o	300	Tank	80.500	78.300	1.900	Open Manhole	1
1.003	o	300	S4	80.560	78.220	2.040	Open Manhole	1200
3.000	o	150	S5	80.530	79.710	0.670	Open Manhole	460
3.001	o	150	S6	80.530	79.530	0.850	Open Manhole	460
1.004	o	300	S7	80.560	78.145	2.115	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	23.350	80.5	S3	80.500	78.875	1.400	Open Manhole	1200
2.000	10.000	40.0	S3	80.500	78.875	1.400	Open Manhole	1200
1.001	10.000	20.0	Tank	80.500	78.375	1.900	Open Manhole	1
1.002	7.650	95.6	S4	80.560	78.220	2.040	Open Manhole	1200
1.003	7.600	101.3	S7	80.560	78.145	2.115	Open Manhole	1200
3.000	14.350	79.7	S6	80.530	79.530	0.850	Open Manhole	460
3.001	4.000	72.7	S7	80.560	79.475	0.935	Open Manhole	1200
1.004	4.750	10.0	C1	80.450	77.670	2.480	Open Manhole	1200

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)
1.004	C1	80.450	77.670	77.670	1200	0

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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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 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 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	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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Innovyze	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: 1.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0100-5000-1390-5000
Design Head (m)	1.390
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	78.145
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.390	5.0	Kick-Flo®	0.855	4.0
Flush-Flo™	0.418	5.0	Mean Flow over Head Range	-	4.4

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	3.3	1.200	4.7	3.000	7.2	7.000	10.7
0.200	4.6	1.400	5.0	3.500	7.7	7.500	11.0
0.300	4.9	1.600	5.3	4.000	8.2	8.000	11.4
0.400	5.0	1.800	5.6	4.500	8.7	8.500	11.7
0.500	5.0	2.000	5.9	5.000	9.1	9.000	12.1
0.600	4.9	2.200	6.2	5.500	9.5	9.500	12.4
0.800	4.3	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.7	6.500	10.3		

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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Storage Structures for Storm

Cellular Storage Manhole: Tank, DS/PN: 1.002

Invert Level (m) 78.300 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	130.0	0.0	2.600	0.0	0.0
0.200	130.0	0.0	2.800	0.0	0.0
0.400	130.0	0.0	3.000	0.0	0.0
0.600	130.0	0.0	3.200	0.0	0.0
0.800	130.0	0.0	3.400	0.0	0.0
1.000	130.0	0.0	3.600	0.0	0.0
1.200	130.0	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

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	S1	1.510	0.928	0.000	2.438
2.000	S2	1.555	0.398	0.000	1.953
1.001	S3	1.838	0.398	0.000	2.235
1.002	Tank	0.000	0.541	156.433	156.974
1.003	S4	2.646	0.537	0.000	3.184
3.000	S5	0.136	0.254	0.000	0.390
3.001	S6	0.166	0.071	0.000	0.237
1.004	S7	2.731	0.336	0.000	3.067
Total		10.583	3.462	156.433	170.478

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
Date 11/04/2024	Designed by MDS	
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Volume Summary (Static)

Length Calculations based on True Length

Pipe	USMH	Manhole	Pipe	Storage	Total
Number	Name	Volume (m³)	Volume (m³)	Structure Volume (m³)	Volume (m³)
1.000	S1	1.510	0.881	0.000	2.391
2.000	S2	1.555	0.350	0.000	1.905
1.001	S3	1.838	0.374	0.000	2.212
1.002	Tank	0.000	0.498	156.433	156.932
1.003	S4	2.646	0.452	0.000	3.099
3.000	S5	0.136	0.245	0.000	0.382
3.001	S6	0.166	0.056	0.000	0.222
1.004	S7	2.731	0.251	0.000	2.982
Total		10.583	3.107	156.433	170.124

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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Innovyze	Network 2020.1.3	

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

Simulation Criteria

Synthetic Rainfall Details

Profile(s)

Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 40, 45

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
Date 11/04/2024 File SW Network Calculations ...	Designed by MDS Checked by MDS	
Innovyze	Network 2020.1.3	

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.000	S1	-0.169	0.000	0.14			7.4	OK	
2.000	S2	-0.183	0.000	0.08			5.3	OK	
1.001	S3	-0.143	0.000	0.28			27.5	OK	
1.002	Tank	-0.130	0.000	0.07		60	4.9	OK	
1.003	S4	-0.044	0.000	0.07			4.9	OK	
3.000	S5	-0.101	0.000	0.23			4.3	OK	
3.001	S6	-0.085	0.000	0.39			5.7	OK	
1.004	S7	0.030	0.000	0.03			4.8	SURCHARGED	

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4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Blackley Fire Station Surface Water Network / Management Calculations	
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Innovyze	Network 2020.1.3	

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 (1/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	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 40, 45

									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period		Change	Surcharge	Flood	Overflow	Act.
1.000	S1	15	Winter	30	+40%	100/15	Summer		79.270
2.000	S2	15	Winter	30	+40%	100/15	Summer		79.201
1.001	S3	240	Winter	30	+40%	30/240	Winter		79.104
1.002	Tank	240	Winter	30	+40%	30/15	Summer		79.102
1.003	S4	240	Winter	30	+40%	30/15	Summer		79.137
3.000	S5	15	Winter	30	+40%	100/15	Summer		79.812
3.001	S6	15	Winter	30	+40%	30/15	Summer		79.713
1.004	S7	240	Winter	30	+40%	2/30	Winter		79.149

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)						
1.000	S1	-0.120	0.000	0.44			23.3	OK	
2.000	S2	-0.149	0.000	0.24			16.8	OK	
1.001	S3	0.004	0.000	0.20			19.7	SURCHARGED	
1.002	Tank	0.502	0.000	0.08		206	5.4	SURCHARGED	
1.003	S4	0.617	0.000	0.07			5.0	SURCHARGED	
3.000	S5	-0.048	0.000	0.73			13.4	OK	
3.001	S6	0.033	0.000	1.29			18.9	SURCHARGED	
1.004	S7	0.704	0.000	0.03			4.8	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	2013
Site Location	GB 386063 403387 SD 86063 03387
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 40, 45

									Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)
1.000	S1	15	Winter	100	+45%	100/15	Summer		79.603
2.000	S2	240	Winter	100	+45%	100/15	Summer		79.565
1.001	S3	240	Winter	100	+45%	30/240	Winter		79.564
1.002	Tank	240	Winter	100	+45%	30/15	Summer		79.560
1.003	S4	240	Winter	100	+45%	30/15	Summer		79.582
3.000	S5	15	Winter	100	+45%	100/15	Summer		79.995
3.001	S6	15	Winter	100	+45%	30/15	Summer		79.802
1.004	S7	240	Winter	100	+45%	2/30	Winter		79.593

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

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)						
1.000	S1	0.213	0.000	0.59			31.3	SURCHARGED	
2.000	S2	0.215	0.000	0.07			4.9	SURCHARGED	
1.001	S3	0.464	0.000	0.28			27.6	SURCHARGED	
1.002	Tank	0.960	0.000	0.08		319	5.8	SURCHARGED	
1.003	S4	1.062	0.000	0.08			5.3	SURCHARGED	
3.000	S5	0.135	0.000	1.02			18.6	SURCHARGED	
3.001	S6	0.122	0.000	1.78			26.1	SURCHARGED	
1.004	S7	1.148	0.000	0.03			5.0	SURCHARGED	