ISG Construction Ltd

Blackley Fire Station

Surface Water Management Report

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Architects Consulting Engineers Quantity Surveyors

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Contents

1. Introduction 4
2. National Policy and Water Management Guidance 5
3. Site Setting and Description 6
4. Surface Water Management Principles 8
5. Surface Water Run-Off Destination 10
6. SuDS Feasibility 11
7. Development Greenfield Run-Off Rates 14
8. Pre-Development Surface Water Run-Off Rates 16
9. Climate Change 16
10. Below Ground Drainage Networks and Surface Water Management Calculations 17
11. Maintenance Requirements 20
12. Conclusion / Summary 21

Appendices

Appendix A - Topographical Survey
Appendix B - Proposed Site Plan
Appendix C - Ground Investigation Data
Appendix D - United Utilities Asset Plan
Appendix E - Greenfield SW Run-Off Rates and Volume Calculations
Appendix F - Pre-Development SW Run-Off Rates and Volume Calculations
Appendix G - Below Ground Drainage Layout and Details
Appendix H - Surface Water Management Calculations

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 $1.59x10^{-6}$ 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 draiange 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

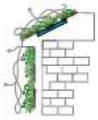
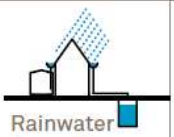
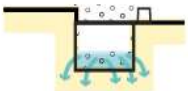
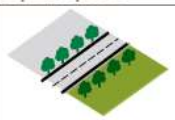
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

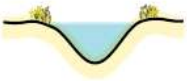
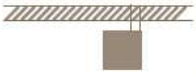
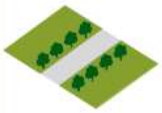
Run-Off Destination	Feasible	Description
Discharge to Ground	No	The infiltration tests carried out by Grange Geo in March 2024 show the ground to be inadequate for infiltration as a falling head test failed, and a test in an as-built chamber failed over 24-hours with the 1st reading being a 1.59 x 10^{-6} 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 maintenancce typically 2-3 metres wide.
Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Open space	Could be above or below ground and sized to storage need.
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open space	Dependant on runoff volumes and soils.
Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open space	Typically 5-15% of drainage area to provide good treatment.
 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	 Open space	Dependant on runoff volumes and soils.

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

SuDS Method	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 x 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):

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

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:

QBAR = 3.18 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:

$Q_{100\ (6\text{-Hour})}$ = 80.41m³ (402.04m³/ha)

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 l/s

Q_{30} = 51.1 l/s

Q_{100} = 69.1 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:

$Q_{100\ (6\text{-Hour})}$ = 92.17m³ (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:

$Q_{100\ (6\text{-hour})}$ - 5.0 l/s x (60 x 60 x 6) - 108,000 litres - 108.00m³

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}	-	80.41m³	-	108.00m³	-	34% Increase

Pre-Development Volume to Post Development Volume

Storm	-	Pre-v	-	Post Dev	-	Difference
Q_{100}	-	92.17m³	-	108.00m³	-	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 s 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	-	130.00m²
Attenuation Tank Depth	-	1.20m
Porosity	-	0.95
Attenuation Tank Volume	-	148.200m³
Overall Tank Volume	-	*156.00m³*

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 s 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

1219
Ward Bdy
ROCHDALE ROAD
covered area
jarmac
conc.
grass
path paving
line hidden
features could be hidden under parked cars
bush
403450N
403400N
403350N
403300N
403250N
403200N
403150N
403100N
403050N
403000N
402950N
402900N
402850N
402800N
402750N
402700N
402650N
402600N
402550N
402500N
402450N
402400N
402350N
402300N
402250N
402200N
402150N
402100N
402050N
402000N
401950N
401900N
401850N
401800N
401750N
401700N
401650N
401600N
401550N
401500N

KEY FOR UNDERGROUND SERVICES

Foul Water Drain
Foul Water 300M and above
Surface Water Drain
Surface Water Drain 300M and above
Combined Water Drain
Combined Water Drain 300M and above
End of trace — EOT
Electric cables
HV cables
Gas
Water
Telephone
Catv
CCTV
Comms
Fibre Optics
Pipe
Vents
Fuel
Offsets
Vapour Recovery
Gauge Lines
Unidentified GPR
Unidentified EML
Token From Records
Assumed Routes
Empty Ducts
Earth Rod
Rising Main
Overhead
Heating Pipes
Traffic Signals
Multi User
Trench Scar
Service Duct

Where chamber extents are significantly greater than the cover size, their approximate extents are shown thus;

ABBREVIATION KEY

AR	assumed route
BD	base bend
BD	backdrop
CL	cover level
CL	cover level
CR	cable riser
CR	cable riser
EOD	external back drop
EOT	end of trace
FH	fire hydrant
FH	fire hydrant
FL	flooded
FL	flooded
GV	gate valve
HOB	head of run
IC	inspection
IC	inspection chamber
IBD	internal back drop
IL	invert level
MH	manhole
PL	pit level
RE	rodding eye
RE	rodding eye
RWP	rainwater pipe
SL	silt level
SL	silt level
SV	stop valve
TF	trapped foul pipe
TF	trapped soil
TFR	taken from records
TP	trial pit
UDO	unable to determine outfall
UTF	unable to find
UTL	unable to trace
UTS	unable to survey
UTT	unable to trace
WL	water level
WL	water level
WO	wash over
WO	wash out valve

UTILITY SURVEY NOTES

ELECTROMAGNETIC AND/OR GROUND PENETRATING RADAR TECHNIQUES HAVE BEEN USED TO LOCATE AND MAP UNDERGROUND UTILITIES AND FEATURES ON THIS DRAWING. WHERE THESE TECHNIQUES ARE APPLIED, IT IS ASSUMED THAT THE INFORMATION CONTAINED WITHIN THIS DRAWING IS ACCURATE AND OF THE HIGHEST QUALITY. HOWEVER, THE RESULTS FROM THESE TYPES OF SURVEYS ARE NOT INFALLIBLE AND SHOULD THE LOCATION OR DEPTH OF SERVICES/FEATURES BE OF PARTICULAR IMPORTANCE TO A PROJECT, THEN IT IS STRONGLY ADVISED THAT TRIAL EXCAVATIONS SHOULD BE UNDERTAKEN TO CONFIRM SURVEY RESULTS.

ALL HAVE USED ALL RECORD DRAWINGS THAT WERE AVAILABLE TO US BY THE CLIENT AND ALL RELEVANT UTILITY COMPANIES. WHILST ALL THE RECORD DRAWING INFORMATION TAKEN FROM THESE DRAWINGS (IE PIPE SIZES, MATERIAL) IS NOT GUARANTEED, SERVICES LOCATED FROM RECORD DRAWINGS WILL BE SHOWN AND ANNOTATED AS TAKEN FROM RECORDS (TFR). HISTORIC RECORD INFORMATION IS OFTEN INCOMPLETE/INACCURATE AND CANNOT BE RELIED UPON.

A SINGLE LINE INDICATING A UTILITY MAY INDICATE THE PRESENCE OF MULTIPLE SERVICES WITHIN CLOSE PROXIMITY TO EACH OTHER. WHERE A SINGLE LINE TYPE IS SHOWN WE RECOMMEND HAND DIGGING WITHIN 0.5m, TO EXPOSE HIDDEN SERVICES.

WHERE QUOTED, DEPTH INFORMATION OF UNDERGROUND SERVICES/FEATURES IS STATED, DEPTHS ARE GENERALLY WITHIN +/- 10% ACCURATE, BUT CANNOT BE GUARANTEED. ANY DEPTHS SHOWN ARE USUALLY TO THE TOP OF THE SERVICE/FEATURE. DRAINTS SEWERS AND DRAINS ARE USUALLY TO INVERT (BASE OF DRAINAGE CHANNEL) UNLESS OTHERWISE STATED.

AT ALL WE USE SKILLED STAFF AND MODERN CALIBRATED EQUIPMENT TO PERFORM OUR SURVEYS. HOWEVER, THE COMPLETENESS OF ANY UNDERGROUND SURVEY DEPENDS ON THE CONDITIONS ENCOUNTERED ON SITE AND WE CANNOT ACCEPT ANY INACCURACIES BEYOND THOSE THAT COULD BE REASONABLY EXPECTED BY A COMPETENT COMPANY.

CONTRACTORS UTILISING OUR DRAWINGS FOR INTRUSIVE WORK SHOULD TAKE ALL REASONABLE MEASURES TO WORK SAFELY IN ACCORDANCE WITH HSG47 GUIDELINES "AVOIDING DANGER FROM UNDERGROUND SERVICES".

Disclaimer

Only manholes that were accessible on site during survey
other manholes may be present but covered
all invert levels taken where possible at main channel.
Man Entry to sewers has not been undertaken. Depths, Pipesizes etc
are measured from the ground. All sewers and inverts to be checked
prior to any works commencing on site. The CAD Room Ltd are
not responsible for manholes, services, information not surveyed which
may have an impact on site development.
Boundaries shown are physical and may not represent legally conveyed

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Bredbury Ind. Estate
Bredbury
SK6 2SU
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E: www.thecadroom.com

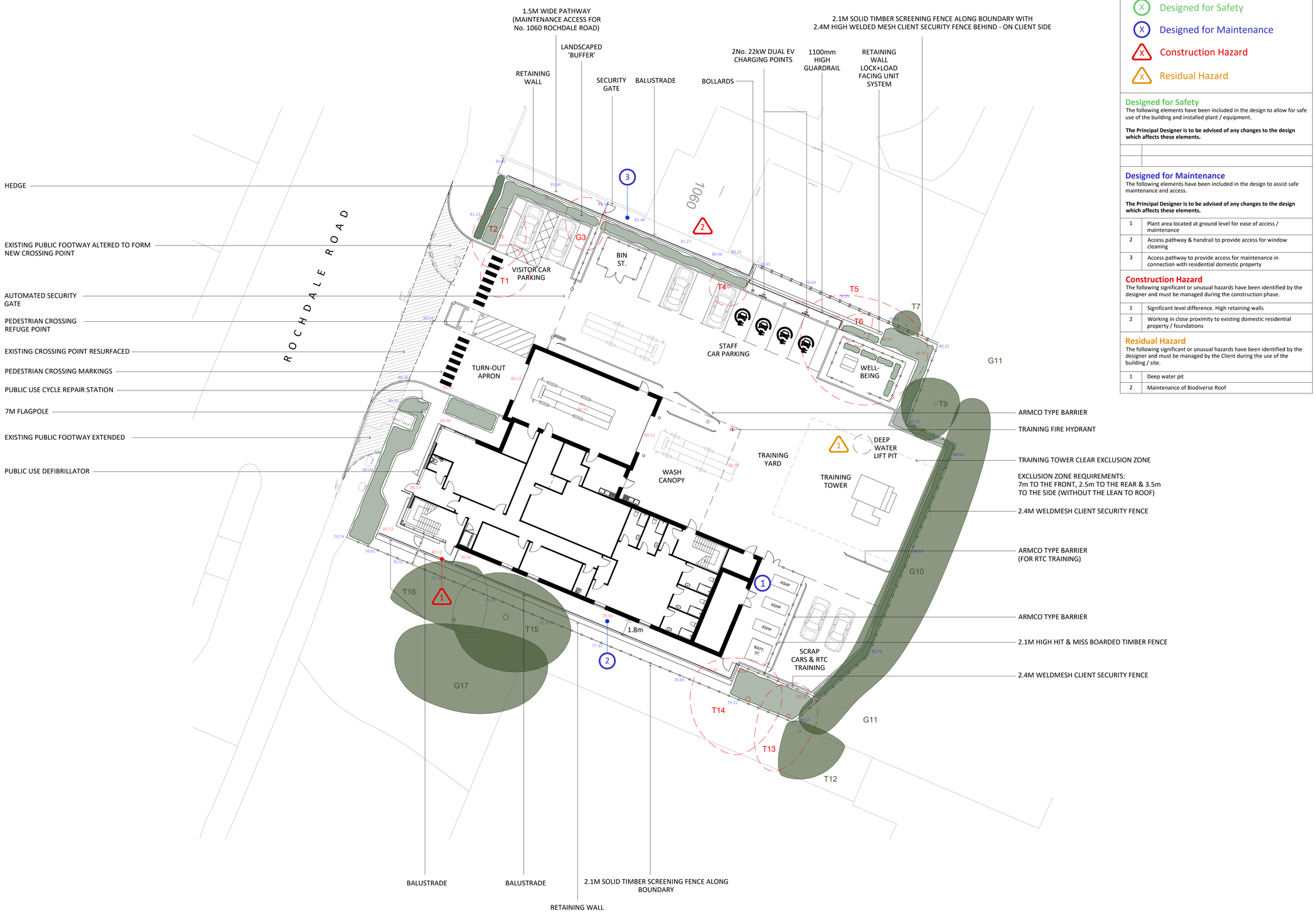
Client:
GMCA

Location:
Blackley Fire Station

Comments:

Drawing Number:	01-S-1072-GM Fire Stations		Revision: A
Date:	09.02.2022	Scale:	1:100 @ A0
Drawn By:	LK	Checked By:	CG

Appendix B - Proposed Site Plans



X Designed for Safety

X Designed for Maintenance

X Construction Hazard

X Residual Hazard

Designed for Safety

The following elements have been included in the design to allow for safe use of the building and installed plant / equipment.

The Principal Designer is to be advised of any changes to the design which affects these elements.

Designed for Maintenance

The following elements have been included in the design to assist safe maintenance and access.

The Principal Designer is to be advised of any changes to the design which affects these elements.

1	Plant area located at ground level for ease of access / maintenance
2	Access pathway & handrail to provide access for window cleaning
3	Access pathway to provide access for maintenance in connection with residential domestic property

Construction Hazard

The following significant or unusual hazards have been identified by the designer and must be managed during the construction phase.

1	Significant level difference. High retaining walls
2	Working in close proximity to existing domestic residential property / foundations

Residual Hazard

The following significant or unusual hazards have been identified by the designer and must be managed by the Client during the use of the building / site.

1	Deep water pit
2	Maintenance of Biodiverse Roof

status

CONSTRUCTION

This drawing is copyright Bradshaw Gass & Hope LLP and is not to be copied, reproduced or re-distributed either in whole or in part without the prior written permission of the originator.

The originator shall have no responsibility for any liability, loss, cost, damage or expense arising from or relating to any use of this document other than for its intended purpose on this project.

This drawing shall be read in conjunction with all other relevant drawings, specifications and associated documentation. Any discrepancies, errors or omissions are to be reported to the originator before proceeding with work.

All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

ref	hazard	date

N

TREE TO BE RETAINED

TREE TO BE REMOVED

NEW SOFT LANDSCAPING

00.00 EXISTING LEVEL

00.00 PROPOSED LEVEL

WORKS WITHIN THE PUBLIC HIGHWAY

ref	revision	by	date
C4	TIMBER GATE OMITTED FROM EXTERNAL PLANT	LC	25.01.24
C3	SHRUBS OMITTED FROM EV CHARGING AREA DUE TO LOCK+LOAD RETAINING WALL GROUND BUILD UP REQUIREMENTS	LC	30.11.23
C2	RETAINING WALL TO EV AREA UPDATED. EXTERNAL PLANT AREA UPDATED. TRAINING HYDRANT ADDED.	LC	23.11.23
C1	STAGE 5 CONSTRUCTION ISSUE	LC	15.11.23

Architects
Consulting Engineers
Quantity Surveyors

21 Silverwell Street
Bolton
BL1 1PR
t: 01204 525321
email@bghbolton.co.uk
www.bghbolton.co.uk

Bradshaw Gass & Hope LLP

client

ISG CONSTRUCTION LTD

project

BLACKLEY FIRE STATION

drawing

PROPOSED SITE PLAN

drawn by	ST	date	NOV 23
checked by		date	
scale	1:200		A1
dwg no	BFS-BGH-XX-XX-DR-A-0203	rev	C4

Appendix C - Ground Investigation Data

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Geotechnical & Environmental Specialists

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.

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Geotechnical & Environmental Specialists

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 E -06m/s at this location.

Yours sincerely,

for **Grange GeoConsulting Ltd**

Andrew Hare

Andrew Hare
Director
MSc DIC FGS

APPENDICES

Appendix A SITE LOCATION PLAN

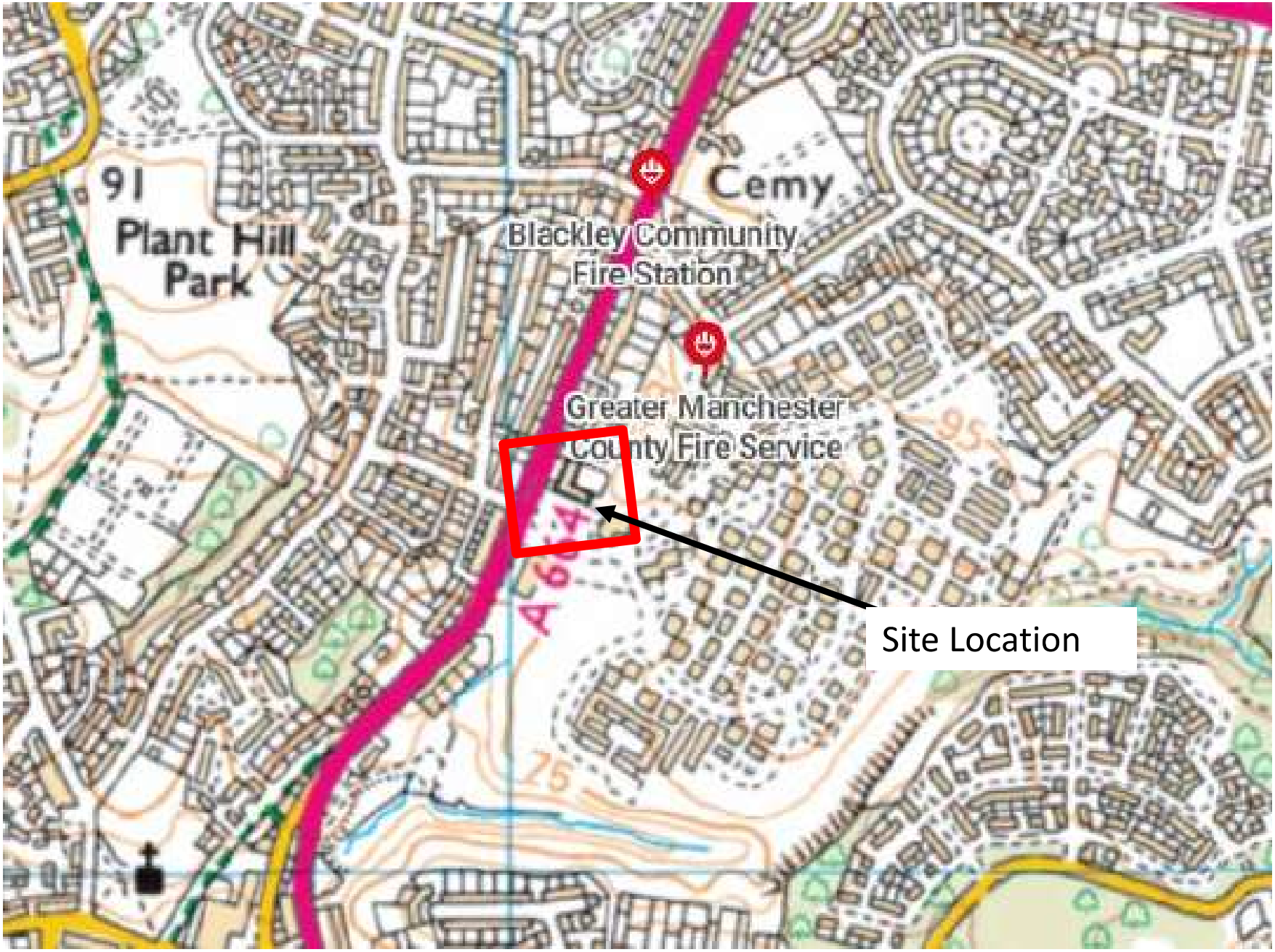
Appendix B TRIAL PIT PHOTOGRAPHS

Appendix C GROUND INVESTIGATION PLAN, EXPLORATORY HOLE LOGS

Appendix D SOAKAWAY TESTING RESULTS

Appendix A

SITE LOCATION PLAN



Grange Geo	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

TP No: TP1

Client: Cheltenham Green Civils
Project: Blackley Fire Station

Sheet: 1 of 1
Method: Excavation with 13t digger

Sample Depth (m)	Sample Type	S. Vane kN/m^2	Description	Depth mBGL	Legend
			Made Ground, concrete foundation.		
			Orange brown and grey mottled, sandy CLAY. (Glacial Till)		
0.50				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

Grange Geo Consulting Ltd, 43 Winchilsea Avenue, Newark, NG24 4AD
Tel: 07773529385

Appendix D

Soakaway Testing Results

BRE BR365 - Trial Pit Soakaway Data Sheet

Site: Blackley Fire Station

Client: Cheltenham Green Civils

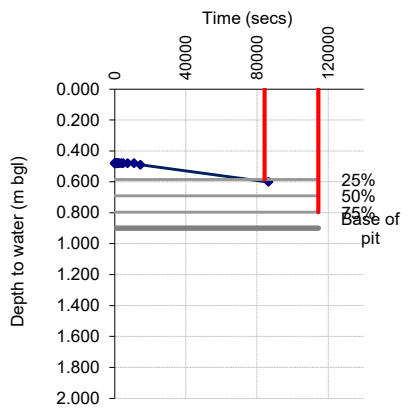
Test Location TP1 **Date of start of testing** 23/02/2024 **Date at end of testing** 24/02/2024

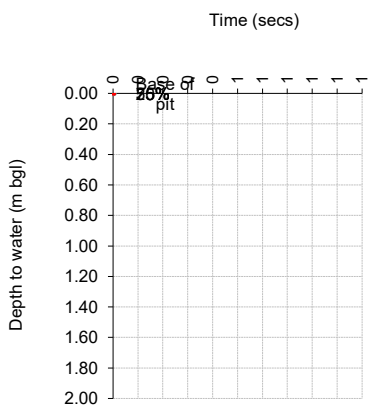
Test Run 1		Test Run 2		Test Run 3	
Pit Dimensions (m)		**Pit Dimensions (m)**		**Pit Dimensions (m)**	
Length	2.000m	Length		Length	
Width	2.000m	Width		Width	
Depth	0.900m	Depth		Depth	
Fill Depth	0.420m	Fill Depth	0.000m	Fill Depth	0.000m
Max Volume	1.680m³	Max Volume	0.000m³	Max Volume	0.000m³
Gravel used to backfill Test Pit	No	Gravel used to backfill Test Pit	No	Gravel used to backfill Test Pit	No

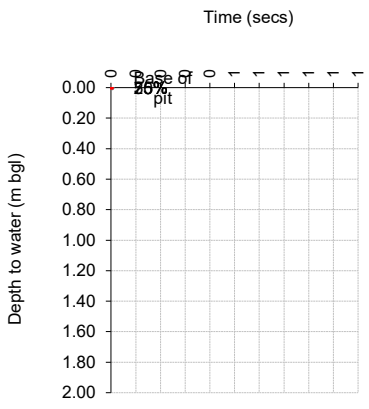
Time to soakaway

Test Run 1 Time (secs)	Test Run 1 Time (min)	Test Run 1 Depth to water (m bgl)	Test Run 2 Time (secs)	Test Run 2 Time (min)	Test Run 2 Depth to water (m bgl)	Test Run 3 Time (secs)	Test Run 3 Time (min)	Test Run 3 Depth to water (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)**	
$V_{p\ 75\text{-}25}$	0.8400m³	$V_{p\ 75\text{-}25}$	0.0000m³	$V_{p\ 75\text{-}25}$	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
$t_{p\ 75\text{-}25}$	30240.0	$t_{p\ 75\text{-}25}$		$t_{p\ 75\text{-}25}$	
Soil Infiltration Rate	**NA**	**Soil Infiltration Rate**		**Soil Infiltration Rate**	







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

BRE BR365 - Trial Pit Soakaway Data Sheet

Site: Blackley Fire Station

Client: Cheltenham Green Civils

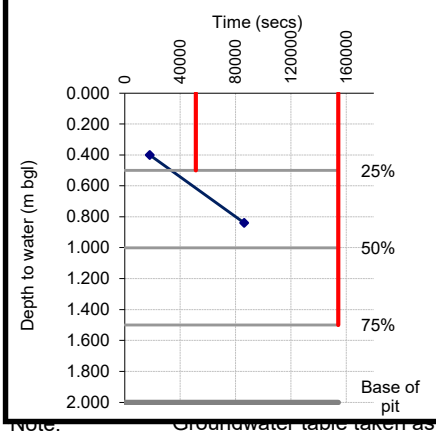
Test Location TP2 **Date of start of testing** 11/03/2024 **Date at end of testing** 12/03/2024

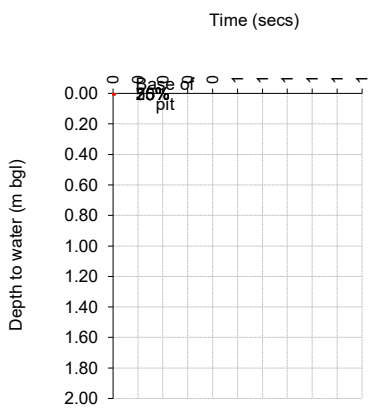
Test Run 1		Test Run 2		Test Run 3	
Pit Dimensions (m)		**Pit Dimensions (m)**		**Pit Dimensions (m)**	
Length	1.240m	Length		Length	
Width	1.240m	Width		Width	
Depth	2.000m	Depth		Depth	
Fill Depth	2.000m	Fill Depth	0.000m	Fill Depth	0.000m
Max Volume	3.075m³	Max Volume	0.000m³	Max Volume	0.000m³
Gravel used to backfill Test Pit	No	Gravel used to backfill Test Pit	No	Gravel used to backfill Test Pit	No

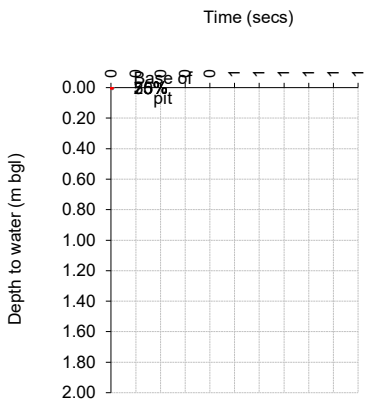
Time to soakaway

Time (secs)	Time (min)	Depth to water (m bgl)	Time (secs)	Time (min)	Depth to water (m bgl)	Time (secs)	Time (min)	Depth to water (m bgl)
	0	*0.000*		*0*		*0*	*0*	
18000	300	0.400						
86400	1440	0.840						

25% water depth	0.500m	**25% water depth**	0.000m	**25% water depth**	0.000m
50% water depth	1.000m	**50% water depth**	0.000m	**50% water depth**	0.000m
75% water depth	1.500m	**75% water depth**	0.000m	**75% water depth**	0.000m
25% time (seconds)	51429 sec	**25% time (seconds)**		**25% time (seconds)**	
75% time (seconds)	154286 sec	**75% time (seconds)**		**75% time (seconds)**	
$V_{p\ 75\text{-}25}$	1.5376m³	$V_{p\ 75\text{-}25}$	0.0000m³	$V_{p\ 75\text{-}25}$	0.0000m³
$a_{p\ 50}$ **(Actual area from test)**	9.3744m²	$a_{p\ 50}$ **(Actual area from test)**	0.0000m²	$a_{p\ 50}$ **(Actual area from test)**	0.0000m²
$t_{p\ 75\text{-}25}$	102857.1	$t_{p\ 75\text{-}25}$		$t_{p\ 75\text{-}25}$	
Soil Infiltration Rate	**1.59E-06m/s**	**Soil Infiltration Rate**		**Soil Infiltration Rate**	







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

Appendix D - Uited Utilities Asset Plan

Refno	Cover	Func	Invert	Size x	Size y	Shape	Mat	Length	Grad
1227	80.29	CO	76.08	225			VC	19.43609	1 in 97
0605		CO		100			VC	24.24364	
0602	93.82	CO	90.91	225			VC	33.21515	1 in 54
8613		FO		100			RPM	5.304619	
8785				100			VC	9.249864	
1107	83.19	CO	0	225			VC	27.44979	
1225	89.24	CO	87.74	150			VC	1.414415	1 in 62
1223				150			VC	9.409469	
9501	91.28	CO	87.56	300			VC	96.9706	1 in 69
2306				150			VC	6.92287	
8306				150			VC	9.403631	
0114	78.11	CO	76.94	525			CO	59.03635	1 in 204
1306	78.9	CO	76.91	300			VC	33.52511	
0119	78.31	CO	0	100			VC	10.63015	
3509				100			VC	6.309988	
1226	80.29	CO	78.8	300			VC	40.4475	1 in 21
1107	84.29	CO	80.98	450			VC	130.8198	1 in 13
7615				150			VC	19.6362	
7501	87.87	SW	86.45	225			VC	2.287819	1 in 3
1502	91.73	CO	88.2	450			VC	35.5449	
1505	95.22	SW	92.68	225			CO	9.209465	
9556		SW		100			UN	9.689465	
7618		FO		100			RPM	7.499288	
1301				375			CO	9.498833	
2506	96.21	CO	93.81	225			VC	13.41941	1 in 20
0204	78.21	CO	76.08	525			CO	29.41888	
9401	89.26	CO	85.35	225			VC	36.6973	1 in 30
3302				150			VC	11.77347	
8612	90.13	FO	88.3	150			VC	7.744482	1 in 4
8314				150			VC	17.17663	
3423	97.01		94.02	225			VC	38.05511	1 in 56
8326				100			VC	7.301999	
1109	78.62	CO	76.44	225			CO	59.43984	
9330				150			VC	11.75845	
8505				150			VC	6.202947	
2218	86.78	CO	85.16	225			VC	21.63331	1 in 28
1106				150			VC	17.26848	
1205	79.89	CO	77.44	225			VC	34.69618	1 in 40
1504				150			VC	14.70482	
3505	96.49	CO	94.5	150			VC	43.82519	1 in 23
0724				150			VC	10.12331	
2221	85.23	CO	83.39	150			CO		
0503	83.63	CO	80.76	225			VC	44.27669	1 in 89
2429	94.74		93.15	150			VC	14.70482	
0509				150			VC	44.75237	
9302	85.95	CO	81.09	225			VC	47.42342	1 in 31
1314	80.94	CO	77.34	225			VC	30.4705	1 in 19
8618				100			VC	13.23331	
1130	79.97	CO	78.3	300			VC	51.97469	
0201				150			VC	9.249786	
1204				150			VC	7.337457	
8002		CO	0	150			VC	140.9634	
3414	94.26	CO	93.35	225			VC	41.88876	1 in 13
7501	87.87	SW		150			VC	0.3765124	
2329	83.28	CO	81.84	225			VC	16.40122	1 in 78
2501	96.25	CO	94.48	225			VC	30	1 in 30
0502	86.29	CO	82.69	225			VC	47.23684	1 in 62
9301	81.18	CO	0	225			VC	23.25941	1 in 19
0203	77.88	CO	70.65	525			CO	59.48109	1 in 108
2439	86.96	CO	84.38	150			VC	6.204855	1 in 126
2117	83.82	CO	82.17	225			VC	12.20856	1 in 14
9402	80.83	CO	78.14	225			VC	80.03937	1 in 102
0303	78.3	CO	72.85	525			VC	105.2343	1 in 59
9634				150			VC	9.299381	
2310				150			VC	12.09426	
2303	88.62	CO	0	525			CO	186.7432	
1105				150			VC	11.27484	
2439	86.96	CO	0	225			VC	22.27187	
0504				150			VC	11.75158	
1503	96.16	CO	93.52	225			VC	17.23382	1 in 57
1221	78.84	CO	0	1500			CO	79.21997	
2309	86.53	CO	84.67	225			VC	27.20284	1 in 35
2438	88.43	CO	86.32	225			VC	19.31321	1 in 18
8602	99.36	CO	97.16	300			VC	9.3	
8333				150			VC	10.69738	
9205	74.25	CO	69.68	525			CO	18.34829	
3411	93.29	CO	91.02	300			VC	50	1 in 15
2311				150			VC	9.888755	
0506				100			VC	13.29348	
3318	88.19	CO	86.21	225			VC	9.435553	1 in 2.03886076
7602	89.26	SW	87.1	750			CO	11.5256	1 in 119
1102	83.26	CO		300			VC	20.87345	
0402				100			PP	14.95917	
1101				150			VC	7.97622	
2502	100.26	CO	98.71	225			VC	25	1 in 32
3516				150			VC	6.238936	
2433	96.26	CO		150			VC	7.789479	
2112	86.26	CO	84.32	150			VC	25.55387	1 in 18
8302	88.21	CO	84.94	225			VC	7.211102	
8613	89.83	FO	86.35	150			VC	28.71817	1 in 42
2305		CO		150			VC	13.46964	
9304	87.96	CO	86.6	225			VC	21.63331	1 in 1002
2103	87.79	CO	85.42	225			VC	25	1 in 47
0201	79.14	CO	76.69	225			CO	65.73431	1 in 28
9551		SW		100			UN	5.191955	
1508				150			VC	13.03184	
1503	95.85	CO	91.59	225			VC	31.28471	1 in 49
3413	94.91	CO	93.78	150			VC	3.162278	
2225	83.83	CO	81.23	225			VC	52.49762	1 in 97
9301	88.82	CO	84.94	300			VC	7.071068	1 in 354
3501	100.1	CO	95.23	450			VC	64.07027	1 in 88
2432	94.88	CO	93.45	225			VC	18.9295	1 in 22
8614		SW		150			UN	9.279388	
9310				150			VC	6.856872	
1116	79.77	CO	78.23	150			VC	5	1 in 1
2220	86.66	CO	84.49	375			CO	54.31812	1 in 20
3518				150			VC	10.78868	
9601	85.63	CO	0	100			VC	3.162278	
1221	81.45	CO	80.31	300			VC	14.89687	1 in 41
2601				150			VC	15.28866	
2102	86	CO	84.23	225			VC	39.44617	1 in 20
9614		CO		150			UN	12.07327	
2206	87.85	CO	86.03	225			VC	50.24938	1 in 17
1918				150			VC	14.19427	
1118	78.81	CO	76.26	450			CO	41.54612	
1124	80.68	CO	78.44	225			VC	20.24964	1 in 88
8305	88.22	CO	85.71	300			VC	125.7422	1 in 44
9602	95	CO	90.4	225			VC	46.21897	1 in 68
1501	88.33	CO	82.61	450			CO	94.54899	1 in 123
1114	81.55	CO	77.77	450			CO	35.79992	1 in 31
8758				100			VC	7.374828	
1201	79.43	CO	77.05	150			VC	9.262258	1 in 32
8787				100			VC	7.767881	
8306				100			VC	6.299879	
9316				150			VC	16.41626	
2113	84.89	CO	82.86	225			VC	22.56732	1 in 34
0108	79	CO		300			VC	7.211102	
2438	90.24	CO	88.12	225			VC	28.40016	1 in 15
9610	89.66	SW	86.95	1050			CO	33.99992	1 in 19
8303	85.17	CO	80.56	225			VC	54.31916	1 in 30
3208	87.85	CO	82.4	225			CO	30.41381	1 in 21
1306	83.53	CO	81.83	225			CO	49.27872	1 in 19
8322				150			VC	6.022725	
8786				100			VC	9.246104	
1504	84.3	CO	82.5	300			VC	23.70855	
1506	96.56	CO	0	150			VC	14.14214	
8784				100			VC	9.220872	
2424	94.63	CO	92.55	225			VC	38.08716	1 in 16
8110	79.25	CO	77.46	225			VC	17	1 in 35
9310				150			VC	10.4424	
2426	84.24	CO	81.24	225			VC	61.7414	1 in 16
8503	92.19	CO	89.05	300			VC	36.05709	1 in 69
2503	99.43	CO	94.48	450			CO	31.29445	1 in 91
2216	86.84	CO	85.29	225			VC	34.48188	1 in 192
8603	90.24	SW	88.58	225			VC	7.280992	1 in 21
9205	74.25	CO	69.8	450			VC	31.1127	1 in 120
2208				150			VC	11.56018	
8103	69.58	CO	66.89	300			VC	1.414214	1 in 1
8602	91.41	CO	87.87	300			VC	34.71211	1 in 120
2437	87.33	CO	84.72	225			VC	39.36348	1 in 15
1124	78.24	CO	76.94	150			CO	8.602325	
1109	82.1	CO	79.9	300			VC	55	1 in 24
9401	91.71	CO	76.39	225			VC	40.5216	1 in 156
2001	82.07	CO	78.75	450			CO	47.70744	1 in 70
8504	91.51	CO	88.85	225			VC	10.19894	
1103	81.51	CO	78.05	450			CO	6.403124	1 in 29
0119	78.11	CO	74.91	450			CO	12.23996	
1115	79.87	CO	76.58	450			CO	9.219844	1 in 31
1609				150			VC	19.21994	
2201	94.14	CO	91.65	375			CO	49.48828	
8601	96.45	CO	94.86	225			VC	102.2389	1 in 49
9402	89.93	CO	86.42	225			VC	36.97681	1 in 25
9501	93.84	CO	90.17	225			VC	39.62123	1 in 51
7603	89.11	FO	86.85	150			VC	13.27678	1 in 27
7301				100			VC	5.209941	
9603	92.19	CO	89.65	225			VC	58.9533	1 in 58
3301				150			VC	8.194229	
8202	79.13	CO	77.33	225			CO	17.89449	1 in 38
2101	92.26	CO	90.13	225			VC	21.26851	1 in 19
3503			0	150			VC	68.90035	
7602	87.85	CO	85.67	225			VC	45.33602	1 in 7
3305	89.56	CO	87.31	225			VC	55.03632	1 in 23
7302				100			VC	8.105305	
3322	90.11	CO	86.79	225			VC	62.36186	1 in 61
7202	88.12	CO	85.99	225			VC	50.31169	1 in 48
2607				150			VC	5.32704	
1302				150			VC	14.01878	
1504	93.51	CO	90.09	450			VC	18.25756	1 in 97
0725				150			VC	19.29751	
1512				150			VC	5.270956	
1104				150			VC	7.302428	
1921	90.83	CO	85.07	450			CO	24.16609	
8507	90.74	CO	86.57	225			VC	38.01316	1 in 112
0601	96.31	CO	92.27	225			VC	31.29445	1 in 62
8102	69.61	CO	64.7	450			VC	96.60328	1 in 67
0401	81.46	CO	76.29	525			CO	81.02469	1 in 71
9202		CO	0	1500			CO	229.4846	
2335	83.83	CO	81.51	225			VC	15.81139	1 in 99
8406	95.85	CO	92.65	225			VC	35.31386	1 in 24
7760				100			VC	16.49564	
9309	75.24	CO	72.08	300			VC	12.20856	
7505	96.26	CO	92.42	450			VC	32.44996	1 in 74
1001	80.33	CO	76.93	450			VC	17.49286	1 in 53
0604				150			VC	9.299381	
2412	89.26	CO	0	225			VC	10.77033	
9625				150			VC	7.280427	
3504	97.79	CO	96.37	225			VC	47.50785	1 in 41
9404		CO		150			UN	13.29427	
1418	89.99	CO	87.65	225			VC	18.35756	1 in 13
9625				150			VC	9.219844	
0115	78.13	CO	74.18	450			CO	20.20965	1 in 32

Refno	Cover	Func	Invert	Size x	Size y	Shape	Mat	Length	Grad
1407	94.8	CO	92.98	225			VC	24.16609	1 in 81
2227	85.23	CO	83.43	225			VC	42.43819	1 in 50
9315		CO		150			VC	13.0233	
3513		CO		100			VC	5.831386	
3444	90.34	CO	79.61	525			CO	36.31634	
9503		CO		150			UN	10.19114	
2332	87.09	CO	85.04	225			VC	59.09011	1 in 25
2330	82.92	CO	80.83	225			VC	42.17486	1 in 29
3434	95.34	CO	93.13	225			VC	13.83293	
2413	92.54	CO	90.94	225			VC	16.12452	1 in 7
2115	83.24	CO	81.25	225			VC	29.49852	
8409	98.16	CO	96.56	225			VC	22.31051	1 in 6
8501	70.01	CO	67.43	375			CO	15.93486	1 in 45
9606		CO		150			UN	13.85159	
1610		CO		150			VC	7.478546	
7401	91.17	CO	0				UN	6.388985	
8608	92.38	SW	90.83	225			VC	35.545	1 in 17
2301	89.43	CO	82.89	375			CO	25.63201	1 in 52
3325	89.35	CO	87.56	225			VC	34.1321	1 in 28
1108		CO	0	225			VC	35.44417	
2211		CO		150			VC	5.785221	
2411	92.95	CO	87.51	525			CO	30.4795	1 in 8
8607	94.21	SW	92.8	150			VC	35.79406	1 in 19
0302	77.91	CO	76.41	225			CO	50	
3304		CO		100			VC	5.656275	
3412	96.24	CO	94.54	225			VC	36.78754	1 in 33
3224	89.28	CO	87.07	225			VC	55.30275	1 in 40
9201	72.54	CO	68.02	525			CO	100.449	1 in 78
1728		CO		150			VC	16.7081	
2101	86.62	CO	84.35	225			VC	34.83949	1 in 28
1217		CO		150			VC	7.601641	
1305	80.2	CO	78.95	375			CO	36.67424	1 in 12
1419	93.14	CO	90.64	225			VC	33.51515	1 in 12
2302	87.36	CO	85.34	225			VC	53.7731	1 in 13
1307	81.76	CO	78.78	225			CO	19.23538	1 in 19
9638		CO		150			VC	8.246035	
2318	85.95	CO	83.82	300			CO	14.4222	1 in 34
2307	87.15	CO	85.15	225			VC	21.09502	1 in 49
8303				150			VC	13.89647	
3503		CO		150			VC	13.89647	
1304	82.57	CO	80.77	225			CO	16.74482	1 in 16
1210	83.31	CO	80.69	300			VC	56.21952	1 in 128
1502	91.91	CO	85.19	450			VC	20.86665	1 in 300
3948		CO		0			UN	5.191111	
0906		CO		100			VC	1.859584	
2312	87.44	CO	85.06	225			VC	22.83542	1 in 88
9354		SW		100			UN	9.805501	
8308		CO		150			VC	6.213365	
2518		CO		150			VC	11.77128	
6798		CO		0				7.239524	1 in
2323	85.13	CO	82.31	375			CO	13.60147	1 in 45
0501	84.99	CO	79.7	525			CO	86.45602	1 in 60
3519		CO		150			VC	7.723894	
8525		FO		100			PE	13.34866	
0102	78.02	CO		450			CO	24.21861	
0107	79.02	CO	76.75	300			VC	15.95796	1 in 28
2443	90.89	CO	87.7	300			CO	8.062258	1 in 1
1603		CO	0	450			VC	8.944272	
1202	78.49	CO	76.69	150			VC	7.28011	
3305		CO		150			VC	6.203648	
2302	86.7	CO	84.79	225			VC	72.20111	1 in 55
2334	83.3	CO	81.01	225			VC	12.16553	1 in 152
1325	79.66	CO	75.5	375			CO	26.40676	

LEGEND

Abandoned | Foul | Surface Water | Combined

- Public Sewer
- Private Sewer
- Section 104
- Rising Main
- Sludge Main
- Overflow
- Water Course
- Highway Drain

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

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

- FO Foul
- SW Surface Water
- CO Combined
- OV Overflow

SEWER SHAPE

- CI Circular
- EG Egg
- OV Oval
- FT Flat Top
- RE Rectangular
- SQ Square
- TR Trapezoidal
- AR Arch
- BA Barrel
- HO HorseShoe
- UN Unspecified

SEWER MATERIAL

- AC Asbestos Cement
- BR Brick
- PE Polyethylene
- RP Reinforced Plastic Matrix
- CO Concrete
- CSB Concrete Segment Bolted
- CSU Concrete Segment Unbolted
- CC Concrete Box Culverted
- PSC Plastic / Steel Composite
- GRC Glass Reinforced Plastic
- DI Ductile Iron
- PVC Polyvinyl Chloride
- CI Cast Iron
- SI Spun Iron
- ST Steel
- VC Vitrified Clay
- PP Polypropylene
- PF Pitch Fibre
- MAC Masonry, Coursed
- MAR Masonry, Random
- U Unspecified

Address or Site Reference:

GREATER MANCHESTER FIRE & RESCUE SERVICE
1058 FIRE STATION ROCHDALE ROAD,
MANCHESTER,
M9 7EQ

Scale: 1:1250 **Date:** 30/11/2022

Sheet: 1 of 1

Printed by: Properly Searches

SEWER RECORDS

United Utilities
Water for the North West

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

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

IH 124 Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	50.000	Urban	0.690
SAAR (mm)	1056	Region Number	Region 10

Results	**l/s**
QBAR Rural	355.4
QBAR Urban	794.2
Q2 years	805.9
Q1 year	691.0
Q2 years	805.9
Q5 years	971.4
Q10 years	1053.6
Q20 years	1128.9
Q25 years	1148.8
Q30 years	1163.3
Q50 years	1203.1
Q100 years	1273.7
Q200 years	1370.1
Q250 years	1399.3
Q1000 years	1583.9

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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 (m^3)	80.408

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

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	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 * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	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

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Synthetic Rainfall Details

Storm Duration (mins) 30

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of 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

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

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

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%	100/15 Summer				10.222
1.001	2	15 Winter	30	+0%	30/15 Summer				10.163

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.003	0.000	0.76			32.8	OK	
1.001	2	0.038	0.000	1.18			51.1	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+0%	100/15 Summer				10.392
1.001	2	15 Winter	100	+0%	30/15 Summer				10.285

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.167	0.000	1.03			44.6	SURCHARGED	
1.001	2	0.160	0.000	1.60			69.1	SURCHARGED	

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	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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Summary Wizard of 360 minute 100 year Winter I+0% for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+0%	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

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

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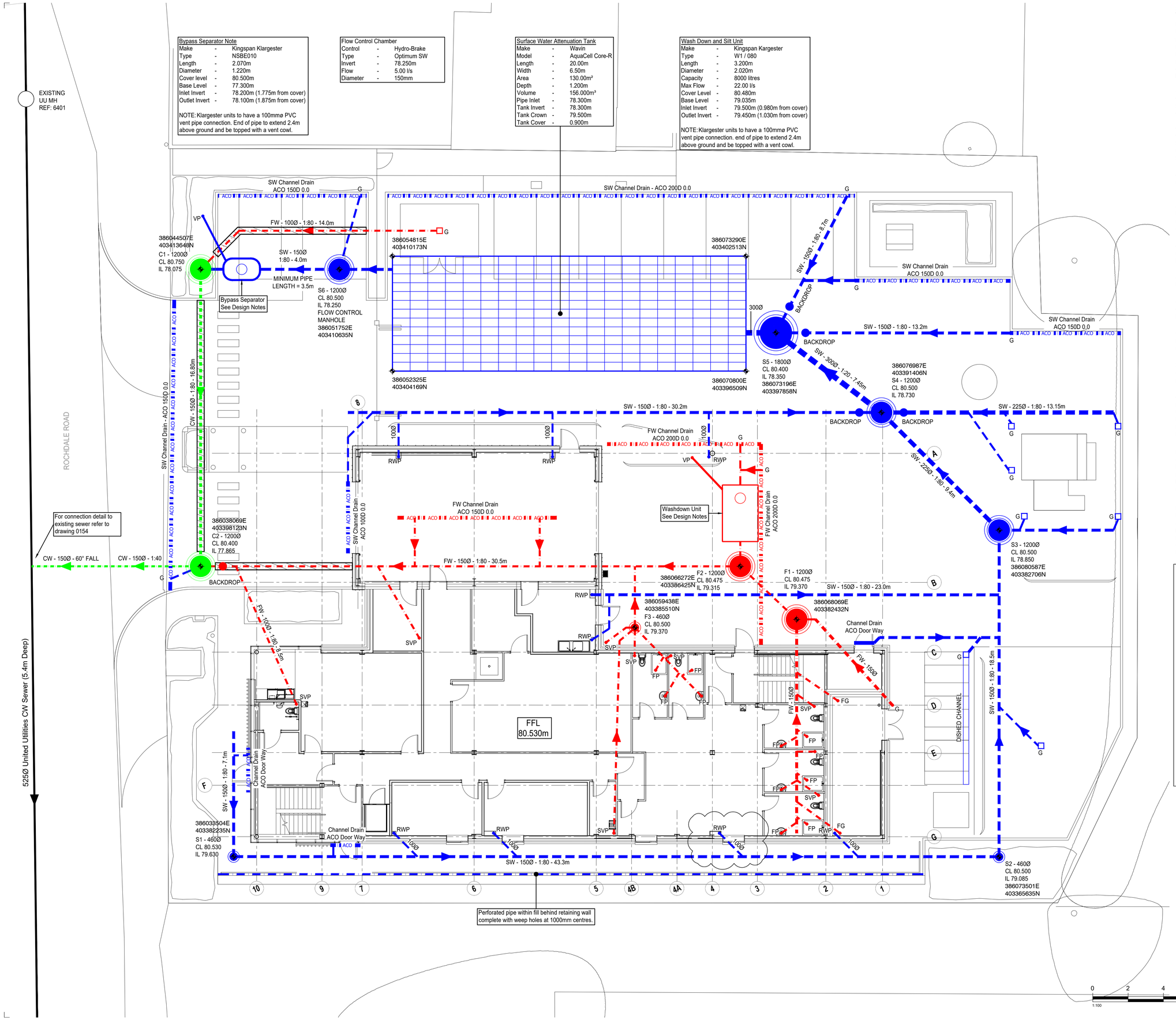
Appendix G - Below Ground Drainage Layout and Details



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 100mmø 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 100mmø PVC vent pipe connection. end of pipe to extend 2.4m above ground and be topped with a vent cowl.

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 existing drainage depths, size and conditions, to which the proposed drainage is to connect, are to be confirmed prior to the commencement of any drainage works.

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
- RWP — Rainwater Pipe
- VP — Surface Vent Pipe
- FP — Foul Down Pipe
- SVP — Soil Vent Pipe
- FG — Floor Gully
- Surface Water Channel Drain
- Foul Water Channel Drain
- External Surface Water Gully
- Concrete Encasement

status: **CONSTRUCTION**

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This drawing shall be read in conjunction with all other relevant drawings, specifications and associated documentation. Any discrepancies, errors or omissions are to be reported to the originator before proceeding with work.

All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

ref	hazard	date

Site Specific Drainage Notes:

Infiltration tests at base of soakaway manhole required to confirm rates. Soakaway size, depth and attenuation tank size / volume subject to change once known.

Rainwater pipe and foul down pipe locations to be confirmed by Architect prior to the commencement of drainage works. Design subject to change once known.

Final external levels to be confirmed. Manhole and inspection cover levels subject to change once final external levels are known.

Existing combined network (to which the foul water is connecting / discharging) location, size and depth to be confirmed prior to the commencement of any drainage works. Design subject to change once known.

All foul water pipes to be 100Ø unless shown otherwise.

All surface water pipes to be 150Ø unless shown otherwise.

Foul water down pipes to have rest bend invert of 450mm below finished floor level, unless stated otherwise.

Rainwater pipe to have rest bend invert of 600mm below finished floor level unless stated otherwise.

Surface and foul water discharge to sewer subject to Section 106 agreement with United Utilities. No drainage work to commence until approval has been received.

All existing drainage found on-site to remain live unless proven to be redundant. Survey of existing drainage to establish network to be carried out prior to the commencement of work on site.

Drainage Specifications

Foul water pipes to be Polypipe to BS EN 1401-1 or similar.

Surface water pipes to be Polypipe Ridgidrain or similar.

Manhole and soakaway manhole to be Precast Concrete by FP McCann or similar

Inspection chambers to be Polypipe or similar.

Channel and Threshold Drains by ACO or similar.

Attenuation tank to be WAVIN AquaCell Core-R or similar.

ref	revision	by	date
C5	RWP LOCATION AT 4G UPDATED	DMC	10.05.24
C4	PIPE SIZES UPDATED. SPRINKLER OVERFLOW PIPE REROUTED. GULLY LOCATION MOVED TO EXTERNAL	DMC	07.05.24
C3	UPDATED TO DTM COMMENTS	DMC	03.05.24
C2	SETTING OUT COORDINATES ADDED	DMC	09.02.24
C1	STAGE 5 CONSTRUCTION ISSUE	DMC	17.11.23

Architects
Consulting Engineers
Quantity Surveyors

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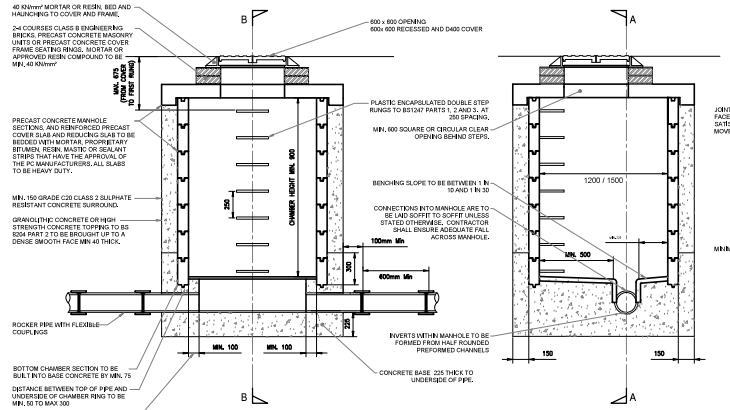
Bradshaw Gass & Hope LLP

client: ISG CONSTRUCTION

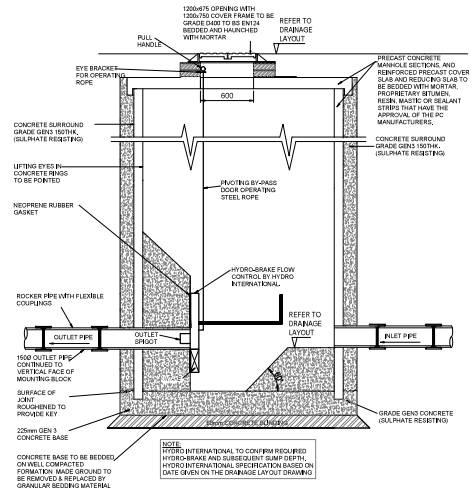
project: BLACKLEY FIRE STATION

drawing: PROPOSED DRAINAGE LAYOUT

drawn by	MDS	date	20.04.23
checked by		date	
scale	1:100		A1
dwg no.	BFS-BGH-XX-XX-DR-C-0151	rev	C5



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



FLOW CONTROL MANHOLE DETAIL

CONTROL MANHOLE NOTES

ALL DIMENSION ARE IN MILLIMETERS

PRECAST CONCRETE UNITS TO BE BS6911 PART 200 AND TO BE CONSTRUCTED WITH A MINIMUM CLASS 3 SULPHATE RESISTING CEMENT.

ALL INSITU CONCRETE TO BE CLASS STANDARD MIX ST4 (GRADE C20) IN ACCORDANCE WITH SECTION 4 OF BS8539 PART 2.

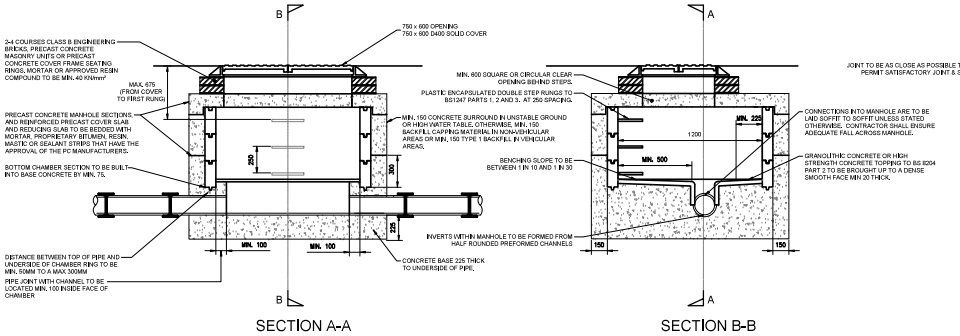
MATERIALS FOR JOINTING MANHOLE RINGS TO BE A RUBBER BITUMEN COMPOUND OF APPROVED MANUFACTURER 'TOKSTRIP' OR SIMILAR.

ALL BRICKWORK TO BE CLASS B ENGINEERING-2 COURSES MIN-4 COURSES MAX; 225mm THICK - BS5628 PART 3.

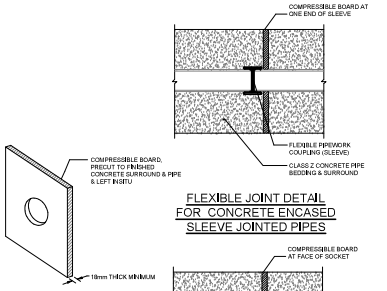
20mm THICK GRANOLITHIC CONCRETE BENCHING TO BE BROUGHT UP TO A DENSE SMOOTH FACE NEATLY SHAPED AND FINISHED TO ALL BRANCH CONNECTIONS, WHERE BENCHING IS LESS THAN 450mm WIDE, SLOPE TO BE 1:10; MORE THAN 450mm, 1:30

PIPES ENTERING MANHOLES TO HAVE A FLEXIBLE JOINT AS CLOSE AS FEASIBLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH THE PIPE IS BUILT IN ORDER TO FACILITATE MOVEMENT OF THE JOINT.

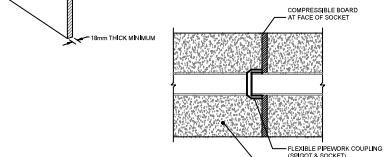
THE LENGTH OF THE NEXT PIPE (ROCKER PIPE) LINES, BEDDING, LAYING AND JOINTING OF PIPES AND BACKFILLING OF TRENCHES SHALL BE IN ACCORDANCE WITH THE WSA,SPDC 'SEWERS FOR ADOPTION - 7TH EDITION TOGETHER WITH ANY LOCAL AUTHORITY REQUIREMENTS.



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

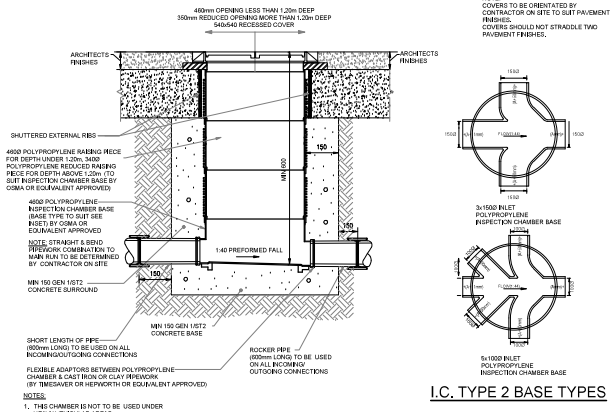


FLEXIBLE JOINT DETAIL
FOR CONCRETE ENCASED
SLEEVE JOINTED PIPES



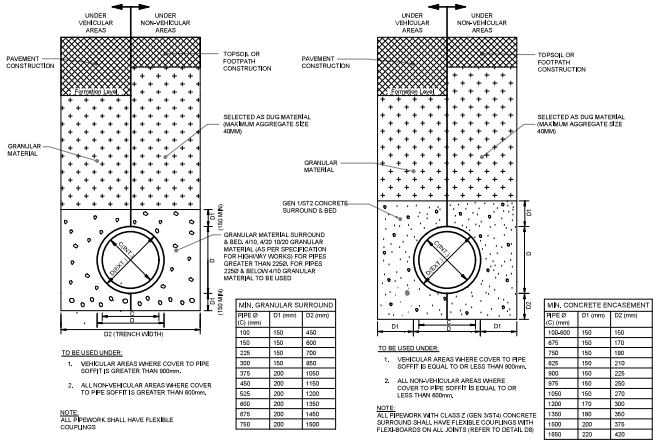
FLEXIBLE JOINT DETAIL FOR
CONCRETE ENCASED SPIGOT
& SOCKET JOINTED PIPES

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



I.C. TYPE 2 BASE TYPES

PPIC
POLYPROPYLENE INSPECTION CHAMBER

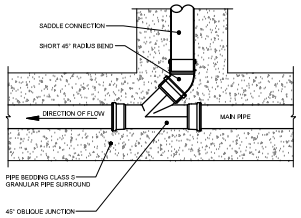


MIN. GRANULAR SURROUND		
PIPE Ø (O) (mm)	D1 (mm)	D2 (mm)
100	150	450
150	150	800
225	150	700
300	150	850
375	200	1050
450	200	1150
525	200	1200
600	200	1350
675	200	1450
750	200	1500

MIN. CONCRETE ENCASEMENT		
PIPE Ø (O) (mm)	D1 (mm)	D2 (mm)
100-400	150	150
675	150	170
750	150	180
825	150	210
900	150	225
975	150	250
1050	150	270
1200	170	300
1350	180	350
1500	200	375
1650	220	420

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

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



TYPICAL 45° PIPE JUNCTION
CONNECTION DETAIL

status: PRELIMINARY

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Hazard Identification

ref	hazard	date

ref	revision	by	date
P2	FLOW CONTROL AND TYPE B ADDED	MDS	11.04.24
P1	FIRST ISSUE	MDS	21.04.23

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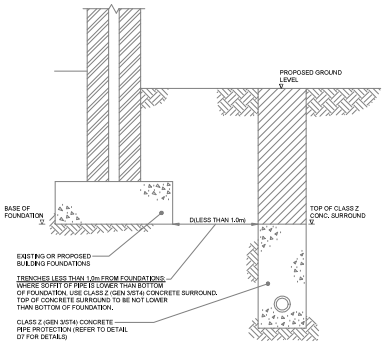
Bradshaw Gass & Hope LLP

client: GREATER MANCHESTER COMBINED AUTHORITY

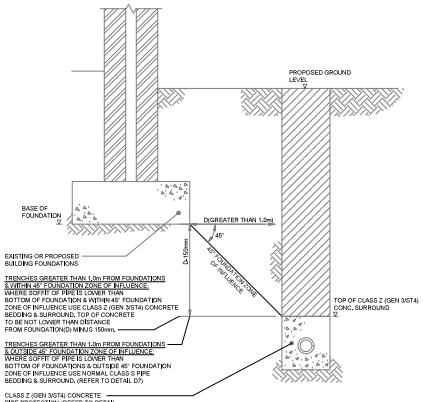
project: BLACKLEY FIRE STATION

drawing: DRAINAGE DETAILS SHEET 1

drawn by	MDS	date	20.04.23
checked by	BH	date	
scale	N.T.S		A1
dwg no	1978.35.402	rev	P2

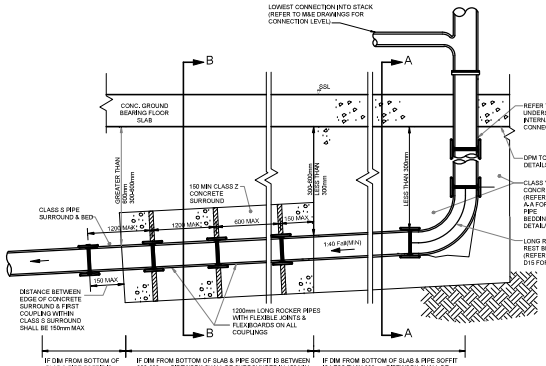


DRAINAGE TRENCH LESS THAN 1.0m
FROM EXISTING/PROPOSED FOUNDATIONS



DRAINAGE TRENCH GREATER THAN 1.0m
FROM EXISTING/PROPOSED FOUNDATIONS

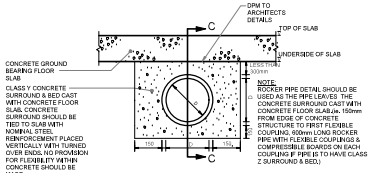
PIPE PROTECTION ADJACENT
TO EXISTING/PROPOSED
FOUNDATIONS



NOTES:
1. THIS DETAIL SHALL ONLY BE USED UNDER AREAS OF GROUND BEARING SLAB WHERE UNDER SLAB PIPEWORK CAN BE SUPPORTED BY UNDER SLAB FILL MATERIAL.
2. CONNECTION INTO INTERNAL MANHOLE OR MAIN UNDER SLAB RUN OR EXIT THROUGH FOUNDATION EDGE DETAIL AS PER DETAIL D (REFER TO DRAINAGE PLAN)

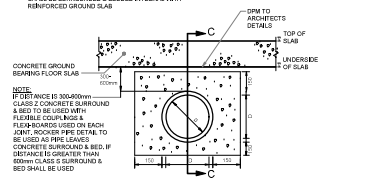
SECTION C-C

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



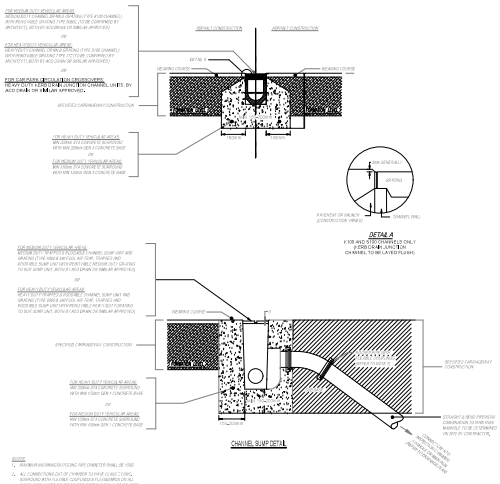
SECTION A-A
WHERE DISTANCE BETWEEN PIPE SOFFIT &
UNDERSIDE OF CONCRETE GROUND BEARING
FLOOR SLAB/GROUND BEAM IS LESS THAN 300mm

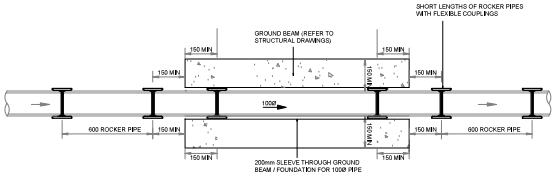
WHERE SOFFIT OF PIPE IS WITHIN 300mm OF UNDERSIDE OF CONCRETE FLOOR SLAB, THE PIPE SHALL BE SURROUNDED & BEDDED INTEGRAL WITH REINFORCED GROUND SLAB



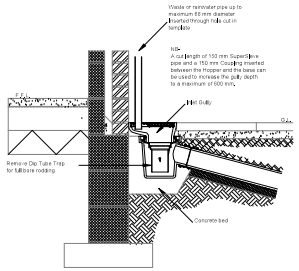
WHERE SOFFIT OF PIPE IS BETWEEN 300 & 600mm FROM UNDERSIDE OF CONCRETE FLOOR SLAB, THE PIPE SHALL BE SURROUNDED & BEDDED IN ST4 CONCRETE. WHERE THIS DISTANCE EXCEEDS 600mm THE PIPE SHALL BE SURROUNDED & BEDDED IN GRANULAR MATERIAL

SECTION B-B
WHERE DISTANCE BETWEEN PIPE SOFFIT & UNDERSIDE
OF CONCRETE GROUND BEARING FLOOR SLAB/GROUND
BEAM IS GREATER THAN 300mm

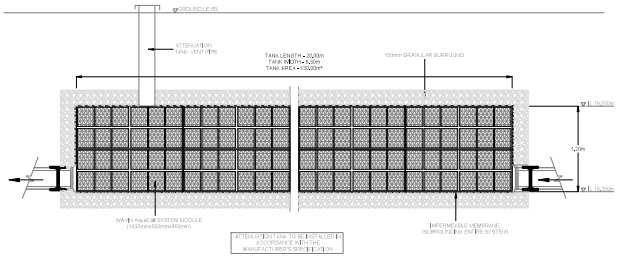




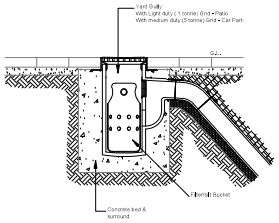
TYPICAL PIPE THROUGH GROUND BEAM /
FOUNDATION DETAIL



TYPICAL RAINWATER PIPE AND
BACK INLET GULLY DETAIL



TYPICAL CELLULAR UNIT / TANK DETAIL



EXTERNAL SW GULLY DETAIL

status
PRELIMINARY

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All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

ref	hazard	date

ref	revision	by	date
P2	FLOW CONTROL AND TYPE B ADDED	MDS	11.04.24
P1	FIRST ISSUE	MDS	21.04.23

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GREATER MANCHESTER COMBINED AUTHORITY

project
BLACKLEY FIRE STATION

drawing
DRAINAGE DETAILS
SHEET 2

drawn by	MDS	date	20.04.23
checked by	BH	date	
scale	N.T.S		A1
dwg no	1978.35.403	rev	P2

Appendix H - Surface Water Management Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	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)	0.200
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 Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.185	4-8	0.015

Total Area Contributing (ha) = 0.200

Total Pipe Volume (m³) = 2.699

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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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
1.000	43.300	0.545	79.4	0.022	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	18.500	0.235	78.7	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.400	0.120	78.3	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	7.450	0.380	19.6	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	2.000	0.050	40.0	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	4.000	0.050	80.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	4.000	0.175	22.9	0.023	0.00	0.0	0.600	o	300	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	50.00	5.64	79.630	0.022	0.0	0.0	1.3	1.13	19.9	4.3
1.001	50.00	5.91	79.085	0.032	0.0	0.0	1.9	1.13	20.0	6.3
1.002	50.00	6.02	78.850	0.060	0.0	0.0	3.7	1.48	58.8	11.8
1.003	50.00	6.05	78.730	0.105	0.0	0.0	6.4	3.57	252.1	20.6
1.004	50.00	6.07	78.350	0.177	0.0	0.0	10.8	2.49	176.2	34.8
1.005	50.00	6.10	78.300	0.177	0.0	0.0	10.8	1.76	124.4	34.8
1.006	50.00	6.12	78.250	0.200	0.0	0.0	12.2	3.30	233.5	39.3

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	80.530	0.900	Open Manhole	460	1.000	79.630	150				
S2	80.500	1.415	Open Manhole	460	1.001	79.085	150	1.000	79.085	150	
S3	80.500	1.650	Open Manhole	1200	1.002	78.850	225	1.001	78.850	150	
S4	80.500	1.770	Open Manhole	1200	1.003	78.730	300	1.002	78.730	225	
S5	80.400	2.050	Open Manhole	1200	1.004	78.350	300	1.003	78.350	300	
Tank	80.400	2.100	Open Manhole	1	1.005	78.300	300	1.004	78.300	300	
S6	80.500	2.250	Open Manhole	1200	1.006	78.250	300	1.005	78.250	300	
C1	80.750	2.675	Open Manhole	1200		OUTFALL		1.006	78.075	300	

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

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S1	80.530	79.630	0.750	Open Manhole	460
1.001	o	150	S2	80.500	79.085	1.265	Open Manhole	460
1.002	o	225	S3	80.500	78.850	1.425	Open Manhole	1200
1.003	o	300	S4	80.500	78.730	1.470	Open Manhole	1200
1.004	o	300	S5	80.400	78.350	1.750	Open Manhole	1200
1.005	o	300	Tank	80.400	78.300	1.800	Open Manhole	1
1.006	o	300	S6	80.500	78.250	1.950	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	43.300	79.4	S2	80.500	79.085	1.265	Open Manhole	460
1.001	18.500	78.7	S3	80.500	78.850	1.500	Open Manhole	1200
1.002	9.400	78.3	S4	80.500	78.730	1.545	Open Manhole	1200
1.003	7.450	19.6	S5	80.400	78.350	1.750	Open Manhole	1200
1.004	2.000	40.0	Tank	80.400	78.300	1.800	Open Manhole	1
1.005	4.000	80.0	S6	80.500	78.250	1.950	Open Manhole	1200
1.006	4.000	22.9	C1	80.750	78.075	2.375	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)
1.006	C1	80.750	78.075	0.000	1200	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	45.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

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Simulation Criteria for Storm

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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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: 1.006, Volume (m³): 2.8

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)	78.250
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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Storage Structures for Storm

Cellular Storage Manhole: Tank, DS/PN: 1.005

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 (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
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 (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1	0.150	0.765	0.000	0.915
1.001	S2	0.235	0.327	0.000	0.562
1.002	S3	1.866	0.374	0.000	2.240
1.003	S4	2.002	0.527	0.000	2.528
1.004	S5	2.318	0.142	0.000	2.460
1.005	Tank	0.000	0.283	156.433	156.716
1.006	S6	2.545	0.283	0.000	2.828
Total		9.116	2.700	156.433	168.250

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Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1	0.150	0.757	0.000	0.907
1.001	S2	0.235	0.313	0.000	0.548
1.002	S3	1.866	0.328	0.000	2.194
1.003	S4	2.002	0.446	0.000	2.448
1.004	S5	2.318	0.100	0.000	2.419
1.005	Tank	0.000	0.242	156.433	156.675
1.006	S6	2.545	0.200	0.000	2.744
Total		9.116	2.385	156.433	167.934

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	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	OFF
DVD Status	ON
Inertia Status	OFF

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	30 Summer	2	+0%	100/30 Summer				79.676
1.001	S2	30 Summer	2	+0%	100/30 Summer				79.141
1.002	S3	30 Summer	2	+0%	30/120 Winter				78.920
1.003	S4	30 Summer	2	+0%	30/120 Winter				78.797
1.004	S5	30 Summer	2	+0%	30/30 Summer				78.496
1.005	Tank	120 Winter	2	+0%	30/30 Summer				78.487
1.006	S6	120 Winter	2	+0%	30/30 Summer				78.491

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.104	0.000	0.21			4.0	OK	
1.001	S2	-0.094	0.000	0.30			5.6	OK	
1.002	S3	-0.155	0.000	0.21			10.1	OK	
1.003	S4	-0.233	0.000	0.11			17.3	OK	
1.004	S5	-0.154	0.000	0.47			28.7	OK	
1.005	Tank	-0.113	0.000	0.08		65	4.8	OK	
1.006	S6	-0.059	0.000	0.05			4.7	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	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	OFF
DVD Status	ON
Inertia Status	OFF

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	30 Summer	30	+40%	100/30 Summer				79.720
1.001	S2	30 Summer	30	+40%	100/30 Summer				79.229
1.002	S3	240 Winter	30	+40%	30/120 Winter				79.113
1.003	S4	240 Winter	30	+40%	30/120 Winter				79.112
1.004	S5	240 Winter	30	+40%	30/30 Summer				79.111
1.005	Tank	240 Winter	30	+40%	30/30 Summer				79.110
1.006	S6	240 Winter	30	+40%	30/30 Summer				79.127

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.060	0.000	0.66			12.8	OK	
1.001	S2	-0.006	0.000	0.99			18.5	OK	
1.002	S3	0.038	0.000	0.17			8.3	SURCHARGED	
1.003	S4	0.082	0.000	0.09			14.4	SURCHARGED	
1.004	S5	0.461	0.000	0.39			23.8	SURCHARGED	
1.005	Tank	0.510	0.000	0.09		204	5.5	SURCHARGED	
1.006	S6	0.577	0.000	0.05			5.0	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	OFF
DVD Status	ON
Inertia Status	OFF

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	30 Summer	100	+45%	100/30 Summer				80.121
1.001	S2	30 Summer	100	+45%	100/30 Summer				79.715
1.002	S3	240 Winter	100	+45%	30/120 Winter				79.607
1.003	S4	240 Winter	100	+45%	30/120 Winter				79.605
1.004	S5	240 Winter	100	+45%	30/30 Summer				79.604
1.005	Tank	240 Winter	100	+45%	30/30 Summer				79.604
1.006	S6	240 Winter	100	+45%	30/30 Summer				79.613

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.341	0.000	0.85			16.5	SURCHARGED	
1.001	S2	0.480	0.000	1.23			23.1	SURCHARGED	
1.002	S3	0.532	0.000	0.23			11.2	SURCHARGED	
1.003	S4	0.575	0.000	0.13			19.7	SURCHARGED	
1.004	S5	0.954	0.000	0.55			33.5	SURCHARGED	
1.005	Tank	1.004	0.000	0.09		324	5.5	SURCHARGED	
1.006	S6	1.063	0.000	0.05			5.0	SURCHARGED	

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