

Strabag UK Limited

Haweswater Aqueduct Resilience Programme

Woodgate Hill Construction Phase Surface Water Drainage Strategy

Reference: 80061155-ARP-HASWH-ZZ-RP-C-00001

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Contents

1.	Introduction	1
2.	Design Guidance	2
3.	Design Principles	3
4.	General Arrangement	4
4.1	Haul Road and parking areas	5
4.2	Welfare area	6
4.3	Platform	6
4.4	Ditches/Swales	6
4.5	Culverts	6
4.6	Detention basins	6
4.7	Outfalls	7
5.	Allowable runoff rate	8
6.	Hydrogeological Assessment	9
7.	Treatment	10
8.	Hydraulic Modelling	12
8.1	Rainfall Data	12
8.2	Catchments	12
8.3	Drainage Network Design	13
8.4	Hydraulic Model Results.	18
9.	Discharge of planning condition 11	19
10.	References	21

Table 1 – Q30+25% climate change hydraulic model storage results	18
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Table 2 – Q100+25% climate change hydraulic model storage results	18
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Figures

Figure 1 – General Arrangement of Hydraulic Model	4
Figure 2 - General Arrangement of East Side of Hydraulic Model	5
Figure 3 - General Arrangement of West Side of Hydraulic Model	5
Figure 4 – Storm durations selected for hydraulic model simulations	12
Figure 5 – Distribution of runoff from several catchments	13
Figure 6 – CIRIA SuDS Manual Guidance on Roughness Coefficients	14
Figure 7 – Plan view of west drainage network and detention basin in the hydraulic model	15
Figure 8 – 3D view of west drainage network and detention basin in the hydraulic model	15
Figure 9 – Plan view of east drainage network and detention basin in the hydraulic model	16
Figure 10 – 3D view of east drainage network and detention basin in the hydraulic model	16
Figure 11 – Detention basins typical design parameters in the hydraulic model	17

Appendices

Appendix A	A-1
Hydraulic Model Inputs	A-1
A.1 HR Wallingford greenfield runoff rate estimation tool	A-2
A.2 FEH 2022 Catchment Descriptors	A-3
Appendix B	B-1
Hydraulic Model Results	B-1
B.1 1 in 30 year + 25% critical duration results	B-2
B.2 1 in 100 year + 25% critical duration results	B-3

1. Introduction

On behalf of United Utilities (UU), Strabag UK Limited (SUK) is currently preparing to undertake the design of temporary works associated with the haul roads and compound areas for the Woodgate Hill construction site in Bury, UK. The design of the temporary works is being undertaken by Zentrale Technik (ZT). To facilitate the development of the design by ZT and application for regulatory approval by SUK, support is required to assist in the development of the drainage strategy with hydraulic analysis.

The purpose of this report is to set out the concepts and plans for the proposed surface water drainage designs to discharge planning condition 11.

The surface water drainage design has been developed in parallel with the Woodgate Hill construction stage site plans as shown in drawing 80061155-ZTK-HASWH-NA-DR-C-00001.

This report provides evidence to discharge the surface water planning condition 11 of the Bury Metropolitan Borough Council Planning Permission application number 66947.

2. Design Guidance

The standards used in the surface water drainage design include:

- National Planning Policy Framework (NPPF)
- Planning Practice Guidance (PPG)
- National standards for sustainable drainage systems 30th July 2025
- C753 The SuDS Manual (CIRIA)
- Rainfall Runoff Management for Developments (Environment Agency)
- UK SuDS greenfield runoff rate estimation (HR Wallingford)
- North West SuDS Pro-Forma, Version 1, April 2020, (Bury Metropolitan Borough County Council)

3. Design Principles

The surface water drainage design will follow the principles of SuDS, as laid out in the SuDS Manual executive summary:

SuDS design should, as much as possible, be based around the following:

- using surface water runoff as a resource
- managing rainwater close to where it falls
- managing runoff on the surface
- allowing rainwater to soak into the ground
- promoting evapotranspiration
- slowing and storing runoff to mimic natural runoff characteristics
- reducing contamination of runoff through pollution prevention and controlling the runoff at source
- treating runoff to reduce the risk of urban contaminants causing environmental pollution.

The surface water drainage network will be one of the first features to be constructed on site ensuring appropriate control of runoff and pollution mitigation is maintained from the start of the construction.

The drainage design uses SuDS features, such as grassed swales/ditches, permeable paving and detention basins to collect and attenuate runoff from hard surfaces, slow the flow and provide treatment. The aim is to minimise using pipework to convey the flows as far as practicable.

Although some of the SuDS features will provide a degree of infiltration/evapotranspiration, to be conservative, this will not be taken into account when modelling the storage volumes required for attenuation.

Detention basins will restrict the rate of runoff downstream and provide treatment and settlement. Opportunities for water reuse from the basins will be explored during detailed design. To be conservative, the attenuation volumes for the basins assumes a worst case scenario of no water reuse.

The drainage features will be kept shallow to reduce the risk of ground water from entering the network. Where this is not possible liners will be installed to mitigate this risk. Only surface water runoff is to be directed to the network during the construction period. Other sources of water, from other processes, have not been designed to discharge to the network and will be treated separately.

Earthworks will be seeded as soon as practicable and managed to reduce silty runoff and help to infiltrate at source. The methodology and measures outlined in the Construction Code of Practice (CCoP) will be used to manage and reduce the potential impact of the works. Specifics will be outlined in the Surface Water and Flood Risk Management Plan (SWFRMP).

Runoff from outside the construction site will be intercepted and directed to the nearest watercourse, using grassed ditches and checkdams. This runoff will not be attenuated as it is greenfield runoff.

4. General Arrangement

The surface water drainage network has been designed to drain the haul road, the construction compound, the platform and to intercept runoff that would have flowed towards the construction site. Refer to drawing 80061155-ZTK-HASWH-NA-DR-C-00001 for the general arrangement drawing for the location of the primary surface water drainage features.

Figure 1 – General Arrangement of Hydraulic Model

Figure 1 below presents a general arrangement of the hydraulic model showing the location of the three detention basins and their associated drainage networks. Figure 2 and Figure 3 below present the east and west sides of the hydraulic model respectively.

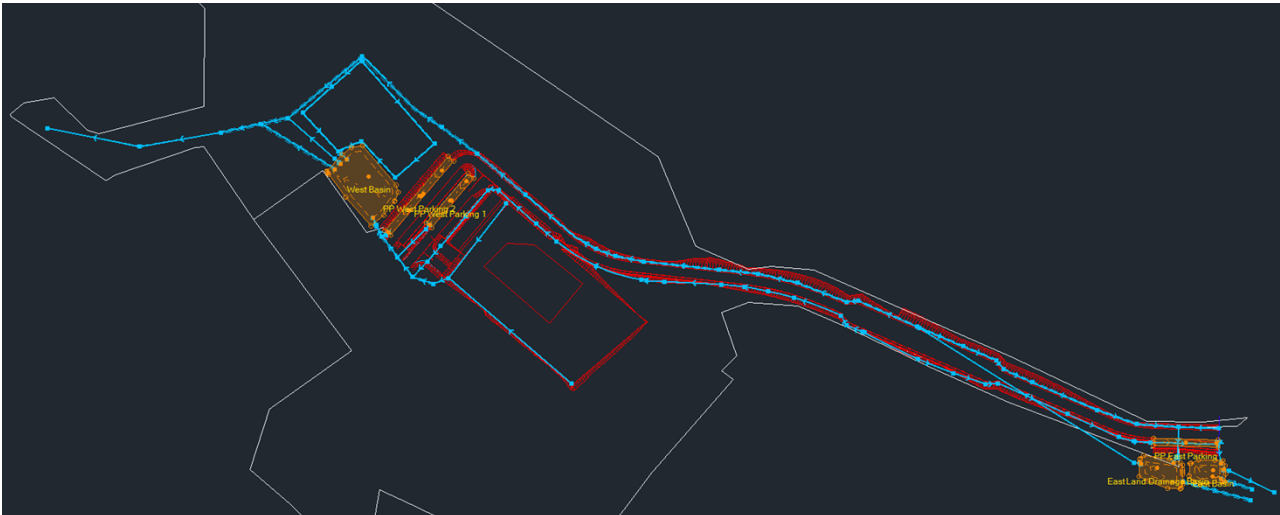


Figure 1 – General Arrangement of Hydraulic Model

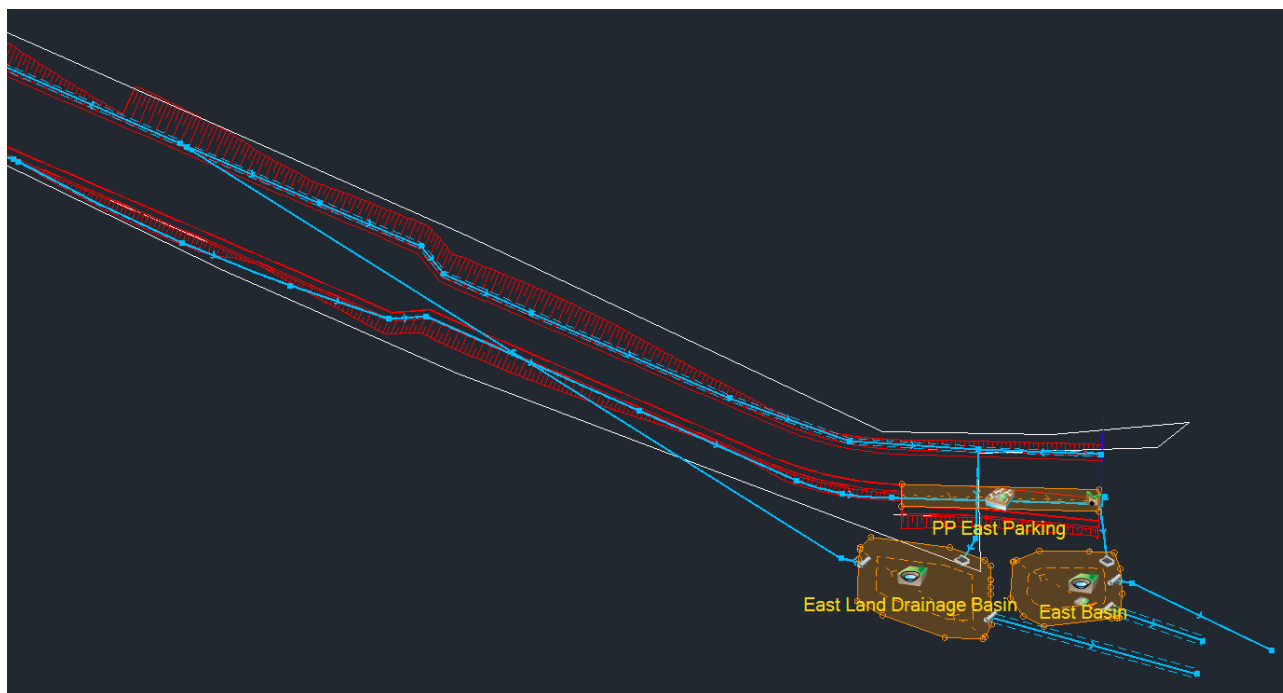


Figure 2 - General Arrangement of East Side of Hydraulic Model

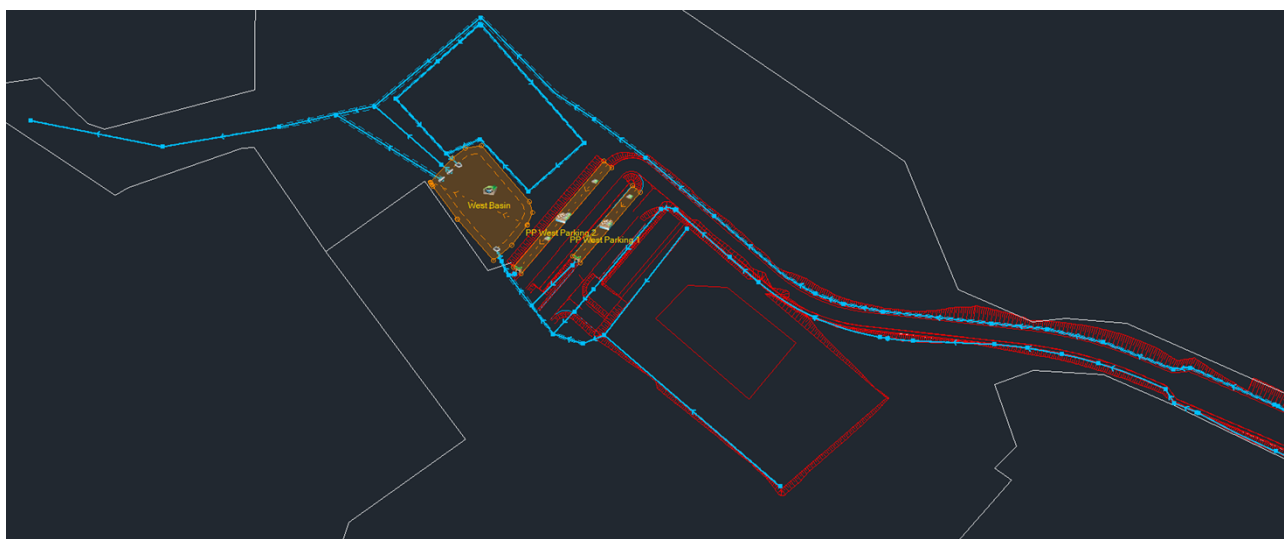


Figure 3 - General Arrangement of West Side of Hydraulic Model

4.1 Haul Road and parking areas

The haul road and pedestrian walkways are assumed to be 100% impermeable as they will have a paved finish. Whilst open conveyance features such as swales are generally preferred within the SuDS hierarchy due to the additional water quality, biodiversity and amenity benefits they can provide, their use is not considered appropriate for the majority of the haul road due to space constraints, health and safety risks associated with an open conveyance feature in close proximity to the pedestrian walkway, the location and sensitivity of the United Utilities (UU) drinking water reservoir and the risk of potential contaminated surface water filtering through into the reservoir. Therefore, this section of the haul road and walkway will crossfall to the haul road kerb and will be picked up in a channel drain (or similar) and a piped network.

The parking bays and the sections of haul road next to the parking bays will be drained via permeable paving. Due to the sensitivity of the UU drinking water reservoir, this permeable paving will be lined to prevent infiltration. The parking bays are assumed to be 100% impermeable as they will have a paved finish.

4.2 Welfare area

The welfare area is assumed to be 100% impermeable and drain to a swale and then a detention basin where water will be attenuated at ground level.

4.3 Platform

The platform area is assumed to be 100% impermeable as it is expected to have a bound surface pavement. It will drain to the South and West edges, and the runoff will be picked up in channel drains to ensure a relatively flat surface is provided for safety of workers. Surface water runoff will be conveyed from the channel drains to a swale and then a detention basin where water will be attenuated at ground level.

4.4 Ditches/Swales

The ditches/swales will convey runoff from the topsoil storage bund, platform, welfare area, and the majority of haul road and car parking areas. The runoff will gravitate to a basin which will attenuate the flow to the allowable rate of discharge (see Section 5 below).

Interception ditches will collect runoff from undisturbed greenfield areas outside of the haul road and construction areas. These interception ditches will direct any overland flows to the nearest watercourse without attenuation.

The ditches and swales will be grass seeded using coir netting as soon as practicable after construction to reduce the risk of silt pollution downstream, to slow the flow and to provide treatment of the runoff. The swales and ditch side slope angles are dictated by the available space on site, however, the aim is to provide 1 in 3 side slopes for swales and 1 in 1.5 side slopes for ditches, where practicable. This follows Sustainable Drainage principals that the slacker the side slope, the better treatment is provided.

Where velocities in the ditches/swales are higher than 1.0m/s, checkdams will be constructed to slow the flow further (refer to section 17.4 of the SuDS manual).

4.5 Culverts

Where a vehicular access point is required across a ditch or swale, pipe culverts will be constructed with headwalls either side. The pipes will be sized to ensure no flooding occurs for the design storm.

4.6 Detention basins

Two attenuation basins will be used to attenuate surface water runoff from all hard standing and impermeable areas of the site. There will also be a separate third basin to enable pumping of runoff that is intercepted at the North Eastern extent of the construction site. The basins will be used to store water during flood events minimising the risk of overland flooding.

Due to the site layout, constraints and discharge conditions, each of the basins are designed slightly differently. The general concept is to design the drainage so that there is no flooding in a 1 in 30 year plus 25% climate change event, with 300mm freeboard to the crest of the basin for this event.

The West Basin attenuates runoff from the construction compound, platform, part of the haul road and the topsoil storage area. This basin will drain by gravity to the nearest watercourse, Gipsy Brook. It will be designed to store water up to the 1 in 30 year plus 25% climate change rainfall event, limiting the discharge to the Qbar rate for storms up to the 1 in 30 year plus 25% climate change rainfall event. It will have a freeboard of 300mm to crest level above the design water level and a dedicated overflow to safely manage flows during exceedance events.

The East Basin attenuates runoff from part of the haul road. This basin will drain by gravity to the United Utilities (UU) Combined Sewer on Castle Hill Road. The hierarchy of discharge has been followed, as infiltration potential is poor (see Section 6) and would have an added risk to the UU drinking water reservoir, discharge to a nearby watercourse is not possible without pumping, and no suitable surface water sewer has been identified. This basin will be designed to store water up to 1 in 30 year plus 25% climate change rainfall event with a freeboard of 300mm to crest level above this design water level. As there is no watercourse nearby and due to the sensitivity of the UU reservoir, this basin will also be designed to store the 1 in 100 year plus 25% climate change event water below a dedicated exceedance overflow. The discharge from the basin to the UU combined sewer will not exceed 5l/s.

The East Land Drainage Basin holds runoff from the greenfield areas to the north of the Eastern section of the haul road. Unlike the East Basin, this runoff will not be discharged to the UU sewer. Instead, this will be pumped up to the high point of the Western land drainage catchment and gravitate to Gipsy Brook via this network. As this runoff is already classed as greenfield, it will not be restricted to a particular runoff rate. The pump and East Land Drainage Basin will be designed to store water up to 1 in 30 year plus 25% climate change rainfall event with a freeboard of 300mm to crest level above this design water level. As there is no watercourse nearby and due to the sensitivity of the UU reservoir, this basin will also be designed to store the 1 in 100 year plus 25% climate change event water below a dedicated exceedance overflow.

The basins proposed, and their available storage volumes before the freeboard level, are shown on the site layout drawing 80061155-ZTK-HASWH-NA-DR-C-00001. The runoff from existing undisturbed greenfield areas will not pass through the attenuation basins serving the hard standing areas, so far as is reasonably practicable.

The basins will have internal and external side slopes of 1 in 3 or slacker. They will be constructed with their crest level at existing ground level so far as reasonably practicable. Where the basins are constructed on a slope, or where there are space constraints, bunding may be needed to generate the storage volumes necessary in the basin. Where the basin bunds are above ground level, the basin will be lined to minimise the risk of seepage through the bund slope.

If basins have a risk of ground water entering, the basins will be lined appropriately to prevent seepage.

Where practicable, the basins will have a forebay constructed where the flow enters to help capture and settle sediment and to minimise the risk of flows short circuiting the basin from inlet to outlet. This will be designed in accordance with the principles set out in the SuDS manual.

For the East Basin and West Basin, under normal circumstances when the runoff meets the water quality parameters, the discharge from the basins will be controlled via a flow control within a manhole chamber immediately downstream of the basin. This flow control will consist of an orifice plate or vortex flow control device. Where water quality parameters are not met, the discharge will be pumped via a water treatment plant. A penstock will be provided in the flow control manhole to give the option for pumping via the water treatment plant. Refer to Section 7 of this report for further details of the treatment proposed.

In order to operate and maintain the basins throughout the construction stage, vehicular access will be provided to the basin for inspection, debris removal, silt management, operation of the penstock and any pumping requirements.

4.7 Outfalls

The outfall to Gipsy Brook will be a concrete headwall, set back from the edge of the watercourses to minimise scour within the watercourse. A short section of channel will be angled into the watercourse in the direction of the flow to minimise scour within the watercourse. This short section of channel will contain erosion protection where required, downstream of the headwall to prevent scour. Where there is a risk of water backing up into the outfall from the watercourse, a flap valve will be installed on the outlet headwall.

The outfall to the UU combined sewer will be a relatively small piped connection to an existing or new manhole on the sewer.

5. Allowable runoff rate

The temporary haul road, compounds and platform are predicted to take around 1 year to construct and will be in operation for 6 years followed by decommissioning and site reinstatement. Conservatively this gives a design life of about 8 years for the temporary drainage infrastructure. It is proposed that this drainage system is designed for the 1 in 30-year return period. The probability of the 1 in 30-year event being exceeded during the 8-year construction period is 24%.

It is considered appropriate to apply a standard of protection to the construction stage that has the same (or better) level of protection from risk, as that provided by a 1 in 100-year standard of protection over a 100-year period. A 1 in 100-year event has a 63% probability of being exceeded during a 100-year period.

The 1 in 30 year event being exceeded during the construction period has a significantly lower chance of occurring than the 1 in 100-year event during a 100-year design life and is therefore considered a very conservative approach to adopt for the temporary construction drainage infrastructure.

In conclusion, apart from the agreed discharge rate to the United Utilities sewer at 5l/s, the discharge rate from all other developed areas on site will be limited to the theoretical Qbar rate for return periods up to the 1 in 30-year storm for the critical duration event. The drainage infrastructure (swales/ditches/basins/pipes etc) will be designed for no flooding in a 1 in 30-year storm for the critical duration event. In this way the risk of flooding downstream of the site will be minimised to a very conservative level and the discharge from the site will mimic the natural runoff characteristics, as far as reasonably practicable. An allowance for 25% climate change has been included in the design, using the 2050s Epoch central allowance for this catchment.

The Qbar runoff rate has been calculated using HR Wallingford's greenfield runoff rate estimation tool (refer to Appendix A). The Environment Agency recommend using the FEH statistical method. Using the 2025 FEH statistical method, the Qbar runoff rate for the Woodgate Hill site is 5.2 l/s/ha.

6. Hydrogeological Assessment

Historically the site was undeveloped until the construction of the Water Treatment Works (WTW) and adjacent reservoir. An old quarry is indicated adjacent to the eastern end of the site on online historical maps from the 1800s (National Library of Scotland, 2026) and made ground may be present in this area. Available ground investigation data within the WTW site indicates ground conditions comprise made ground up to 8m thick over the underlying Coal Measures bedrock. The made ground is generally cohesive and appears to be reworked natural material, however the source of material is unknown. The made ground is a potential source of contamination which could pose a constraint to infiltration. Currently there is insufficient ground investigation data to assess contamination levels within the made ground soils, and this should be confirmed by ground investigation if infiltration drainage is being considered. The site is not within a groundwater Source Protection Zone.

Based on the above assessment of ground conditions and potential contamination, it is recommended that the drainage design should assume that lining will be required until further information to confirm ground conditions is obtained.

The geology mapping shows Made Ground across the site with Till to the south of the compound area. The Bedrock is Pennine Lower coal measures, siltstone and sandstones. The ground water is variable across the site, typically about 1m to 2m below ground level at the compound area. There is limited GI information for the haul road to the East of the site. The majority of the geology on site is not conducive to infiltration (generally cohesive/low permeability in nature). There could be some infiltration possible in the more granular bedrock, but there is currently no site specific data to support this.

The drainage network and basins will be designed above these groundwater levels where possible to prevent ground water ingress. If drainage features are required below these groundwater levels, liners will be used to exclude ground water from the surface water drainage systems.

Based on the current information available it is recommended that proposed surface water drainage features within the Made Ground extents should be lined to prevent infiltration and potential mobilisation of contaminants. This position should be reviewed if further ground investigation data is obtained which indicates there is a low contamination risk.

7. Treatment

In line with the CCoP, the strategy for managing sediments in the runoff from site incorporates multiple techniques in order to provide redundancy in the drainage networks. The runoff from any exposed soil areas will be intercepted by silt fences at the edges of the disturbed soil where appropriate. These will be maintained throughout the construction period to ensure silt runoff is managed appropriately.

Runoff from the majority of the construction areas will be conveyed through grassed swales with check dams, which provide a natural way of filtering sediments. Some of the runoff will enter permeable paving, and all the surface water runoff from construction areas will be attenuated in attenuation basins.

A Surface Water and Flood Risk Management Plan will be developed which will include monitoring the water quality of the discharge from the attenuation basins. Where water quality parameters are not met, the discharge will be pumped via a water treatment plant at the allowable discharge rate. An Environment Agency Water Discharge Activity Permit will be in place which will detail regulatory requirements for the site including on-site testing and monitoring. The permit also includes a supporting document detailing potential treatment and controls.

Hydrocarbon Interceptors will be designed and installed where there is a risk of spillage of fuel and oils. They will be designed in accordance with BS EN 858-2. Designated refuelling areas will be lined or bunded to prevent the escape or infiltration to the ground of contaminated runoff or accidental spillage incidents.

Using the CIRIA SuDS Manual, simple index calculation was undertaken, based on the level of risk for the site. A pollution hazard level classification of Medium was selected for this site with a SuDS train including permeable paving, a swale and a detention basin. These proposed SuDS components are sufficient in providing pollution risk mitigation for the site as illustrated in the table below.

West and East Drainage Networks – Simple Index Approach				
Car Parking > Permeable Paving > Detention Bain				
Description	Hazard Level	Suspended Solids	Metals	Hydrocarbons
Land use Pollution Hazard Index	Low	0.5	0.4	0.4
Mitigation Indices – Permeable Paving		0.7	0.6	0.7
Mitigation Indices – Detention Basin		0.5	0.5	0.6
Combined Pollution Mitigation Indices		0.95	0.85	>0.95
Sufficiency of Pollution Mitigation Indices		Sufficient	Sufficient	Sufficient
Shaft compound area > Swale > Detention Basin				
Description	Hazard Level	Suspended Solids	Metals	Hydrocarbons
Land use Pollution Hazard Index	Medium	0.7	0.6	0.7
Mitigation Indices – Swale		0.5	0.6	0.6
Mitigation Indices – Detention Basin		0.5	0.5	0.6
Combined Pollution Mitigation Indices		0.75	0.85	0.9
Sufficiency of Pollution Mitigation Indices		Sufficient	Sufficient	Sufficient
Haul Roads > Detention Basins				
Description	Hazard Level	Suspended Solids	Metals	Hydrocarbons
Land use Pollution Hazard Index	Low	0.5	0.4	0.4
Mitigation Indices – Detention Basin		0.5	0.5	0.6
Combined Pollution Mitigation Indices		0.5	0.5	0.6
Sufficiency of Pollution Mitigation Indices		Sufficient	Sufficient	Sufficient

Irrespective of the above table showing the sufficiency of the SuDS train, water treatment plants and hydrocarbon interceptors will also be used where required to further mitigate the risks as described above.

8. Hydraulic Modelling

InfoDrainage 2026.4 has been used to model the drainage networks. The drainage networks are shown in the general arrangement drawing 80061155-ZTK-HASWH-NA-DR-C-00001. Due to the temporary nature and short design life of this construction site, and the conservative approach to the return period chosen for the design, the model simulations have not included an allowance for urban creep.

8.1 Rainfall Data

FEH 2022 catchment descriptors for the site have been obtained to generate storm events within InfoDrainage, refer to Appendix A. A 30-year return period plus 25% climate change event has been used with nine storm durations from 15 minutes up to 1,440 minutes for design simulations in the hydraulic model as presented in Figure 4 below.

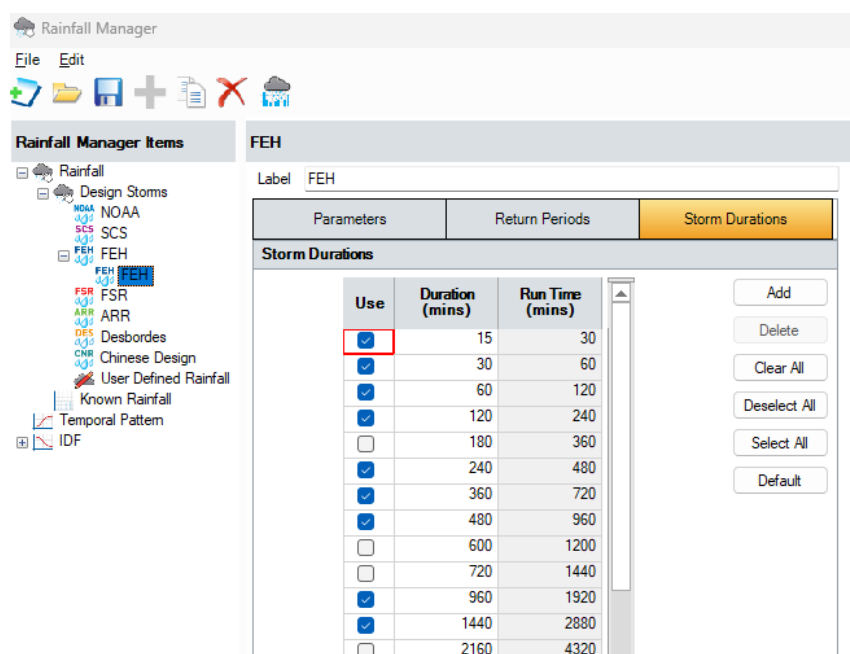


Figure 4 – Storm durations selected for hydraulic model simulations

8.2 Catchments

Catchment areas have been drawn over the proposed development based on site layout drawing 80061155-ZTK-HASWH-NA-DR-C-00001. The catchments have been divided up to represent runoff flowing into the drainage network from all parts of the construction site and surrounding areas that drain towards the construction site. Catchment areas for detention basins have also been included in the hydraulic model to represent rain falling directly into the basins. Figure 5 presents the distribution of runoff from all the catchment areas in the hydraulic model.

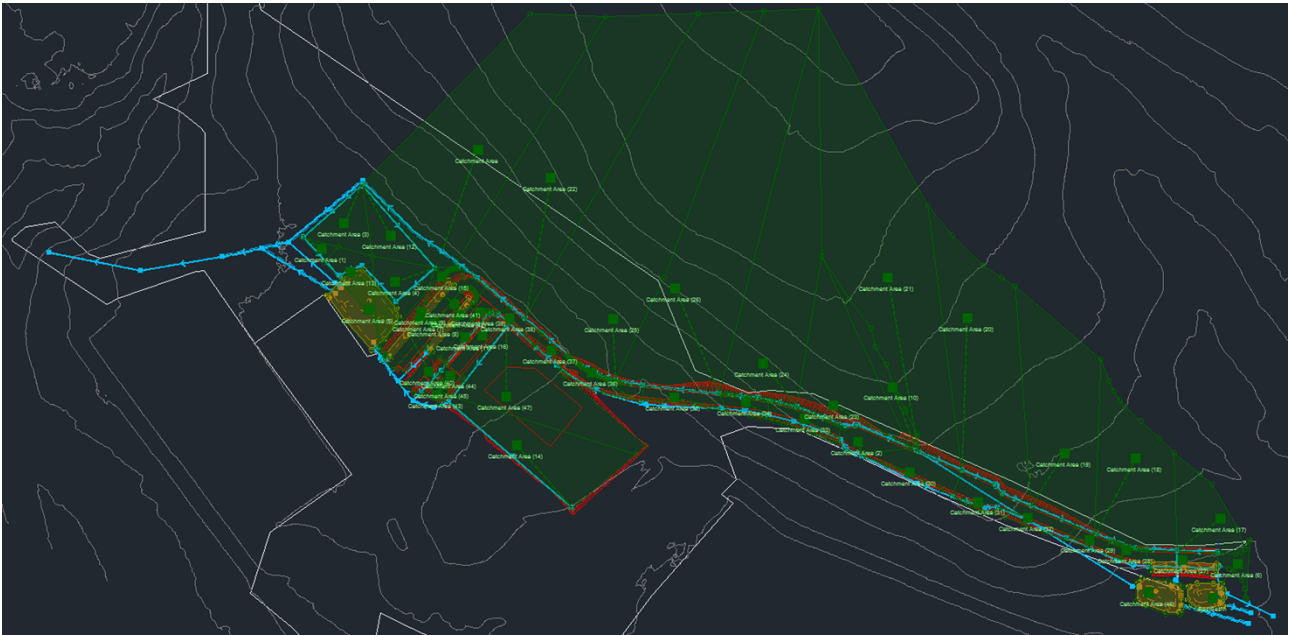


Figure 5 – Distribution of runoff from several catchments

8.3 Drainage Network Design

8.3.1 Drainage Swales and Ditches

Trapezoidal channels have been modelled to represent drainage swales for conveying flow towards the detention basin. Swales have been modelled with 1:3 side slopes, 600 mm wide bases and varying depth to match proposed topography across the site with minimum depths of 500 mm. Trapezoidal channels have also been modelled to represent drainage ditches for conveying intercepted greenfield runoff towards watercourses. Ditches have been modelled with 1:1.5 side slopes, 600 mm wide bases and varying depth to match existing topography across the site with minimum depths of 500 mm. Gradients have been set to ensure velocities remain low, whilst matching closely to existing ground levels based on topographic survey data.

A manning's 'n' roughness coefficient of 0.15 has been set for all drainage swales based on an assumption that during storm events water levels will be above grass height at around 0.15 m depth on average. Figure 17.7 of the CIRIA SuDS Manual has been used to estimate a roughness coefficient which is presented with green lines for clarity in Figure 6 below.

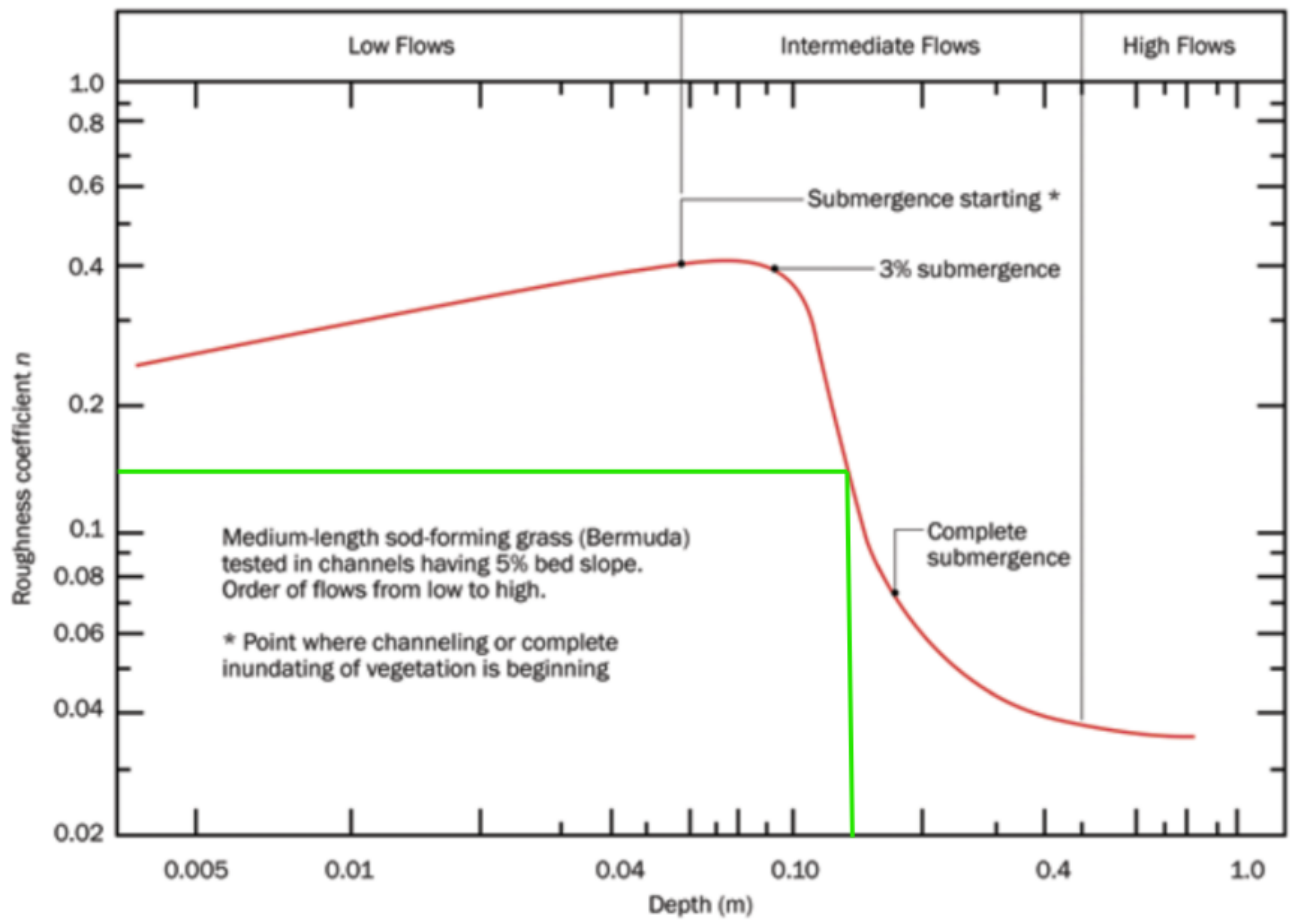


Figure 6 – CIRIA SuDS Manual Guidance on Roughness Coefficients

Figure 7 and Figure 8 below present a plan and a three-dimensional view of the west drainage network and detention basins in the hydraulic model.

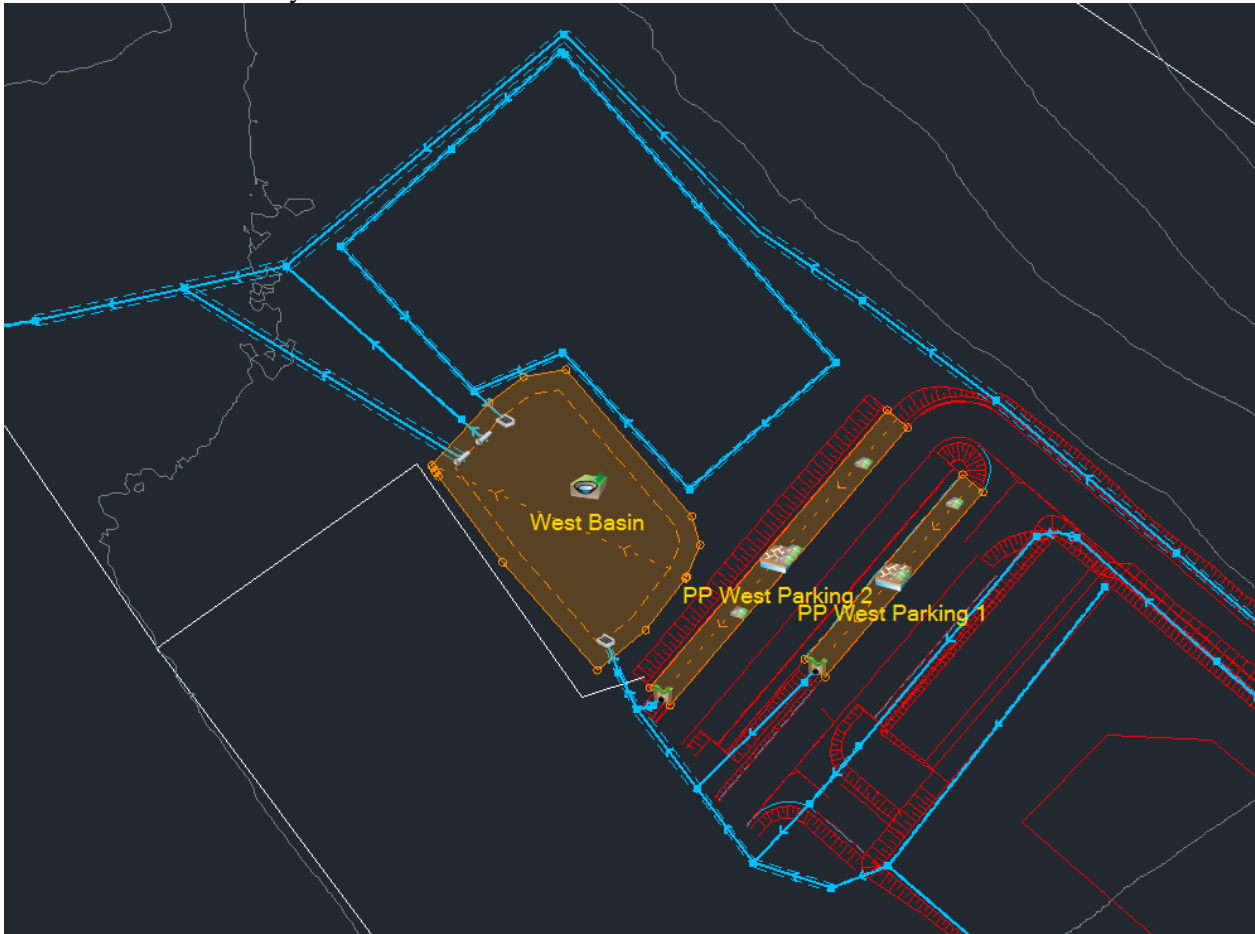


Figure 7 – Plan view of west drainage network and detention basin in the hydraulic model

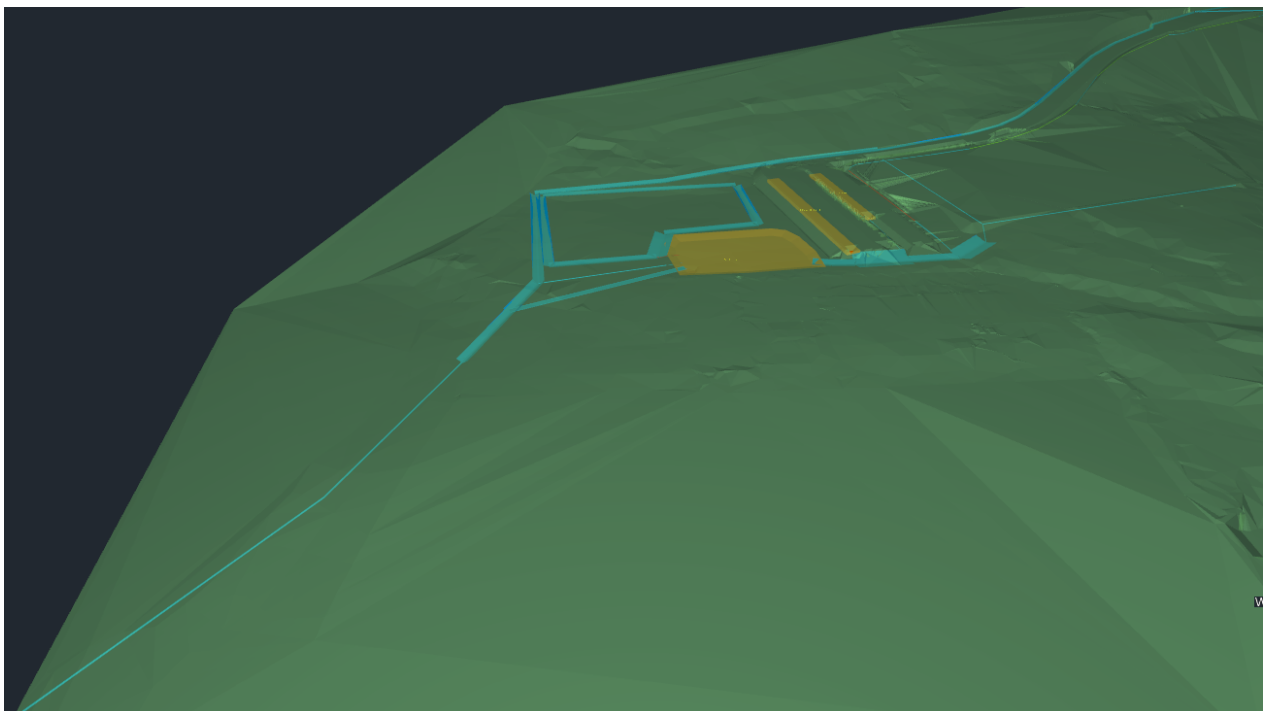


Figure 8 – 3D view of west drainage network and detention basin in the hydraulic model

Figure 9 and Figure 10 below present a plan and a three-dimensional view of the east drainage network and detention basins in the hydraulic model.

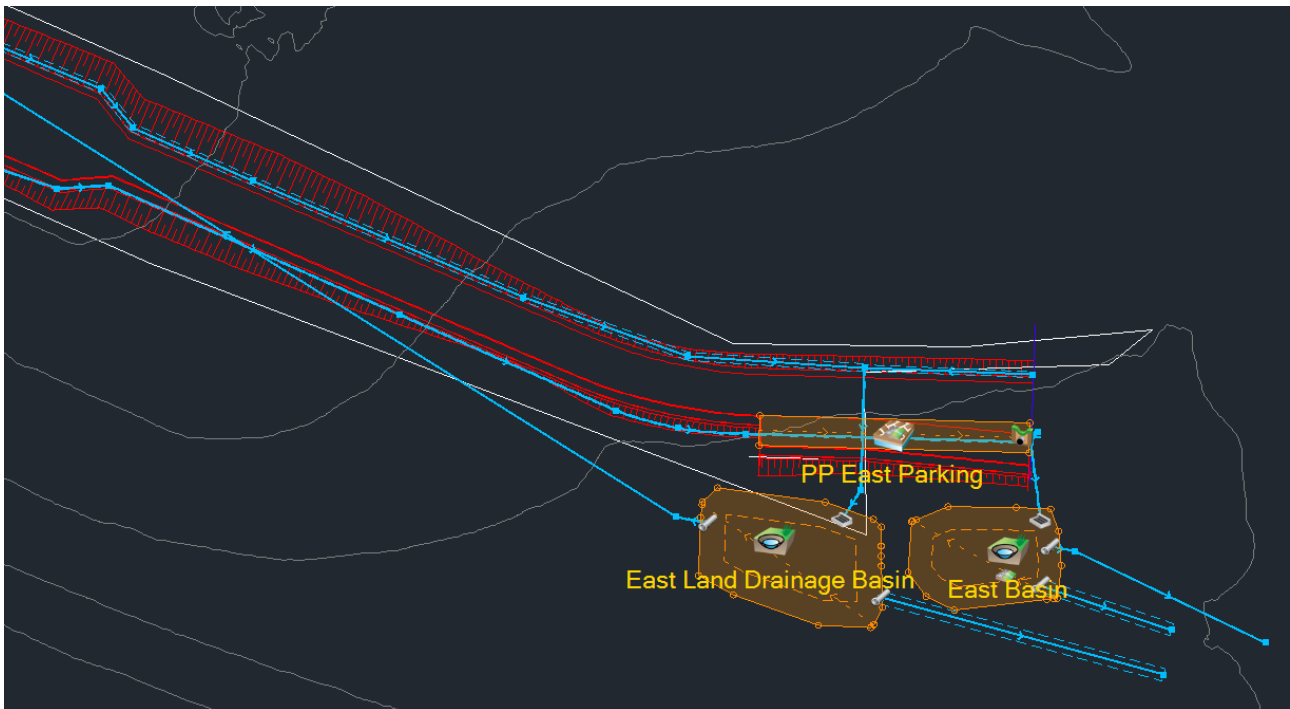


Figure 9 – Plan view of east drainage network and detention basin in the hydraulic model

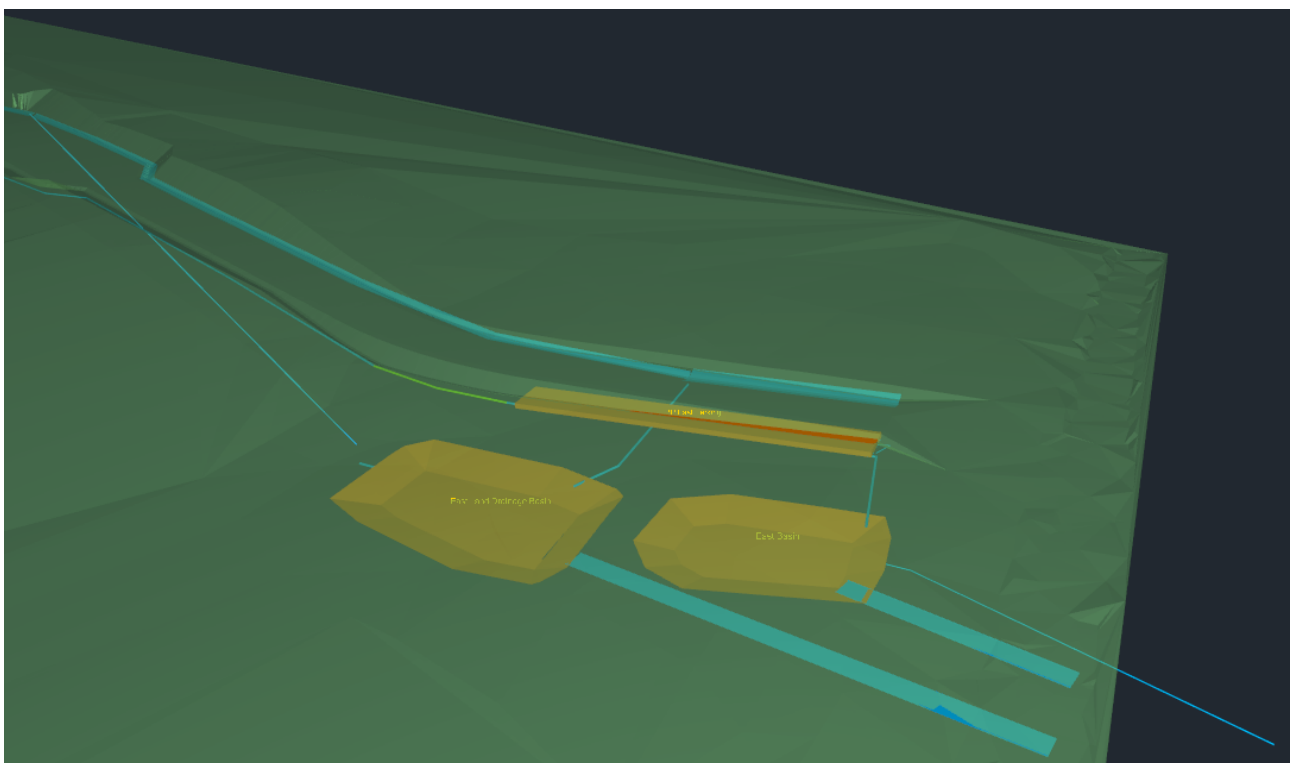


Figure 10 – 3D view of east drainage network and detention basin in the hydraulic model

8.3.2 Detention Basins

Detention basins have been modelled as ponds (with no permanent depth of water) for attenuation storage during storm events. Detention basins have been modelled with 1:3 side slopes with 1.6 m maximum depth of water during the critical design storm and 300 mm freeboard. Outlets from detention basins have been designed as orifice plates at the invert level of the detention basins, except where the discharge is pumped.

Figure 11 below presents the typical design parameters used for detention basins to attenuate stormwater.

Name

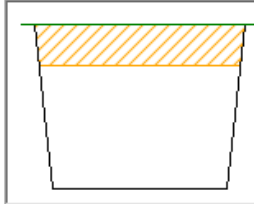
Dimensions	Inlets	Outlets	Advanced	Pollution																																	
Sizing Calculator																																					
☐ Exceedance Level (m) 150.025 ☐ Depth (m) 1.200 ☒ Base Level (m) 148.825 Freeboard (mm) 300 Initial Depth (m) 0.000 Porosity (%) 100 Average Slope (1:X) 3.10	Editable Column Area <table border="1"> <thead> <tr> <th>Depth (m)</th> <th>Area (m²)</th> <th>Volume (m³)</th> </tr> </thead> <tbody> <tr> <td>0.000</td> <td>950.00</td> <td>0.00</td> </tr> <tr> <td>1.200</td> <td>1400.00</td> <td>1401.30</td> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Depth (m)	Area (m²)	Volume (m³)	0.000	950.00	0.00	1.200	1400.00	1401.30																									 Depth incr. (m) 0.100 Delete Row Repeat Clear All	
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1.200	1400.00	1401.30																																			
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Figure 11 – Detention basins typical design parameters in the hydraulic model

8.3.3 Pipes, Culverts and Outfalls

Pipes and culverts below proposed sections of road have been modelled as pipes with Colebrook-White roughness coefficients of 0.6.

Outfalls to the watercourse and sewer have been modelled as pipes with Colebrook-White roughness coefficients of 0.6 and a free discharge.

8.4 Hydraulic Model Results.

Results of the hydraulic modelling are contained in the tables below and in Appendix B. The results demonstrate that in the critical duration 1 in 30-year return period plus 25% climate change event, the drainage network does not flood, the attenuation basins have sufficient storage volume below the 300mm freeboard level and the discharge rate is limited to 5l/s to the UU sewer or the Qbar flow rate for the catchments that are draining construction areas.

Table 1 – Q30+25% climate change hydraulic model storage results

Storage	Critical 1 in 30-year + 25% climate change storm event	Contributing catchment (ha)	Allowable discharge rate (l/s)	Maximum discharge rate (l/s)	Maximum resident volume (m ³)
West Basin	1,440 min Summer	2.114	11.0	10.9	980
East Basin	480 min Summer	0.072	5.0	4.6	185
Land Drainage East Basin	120 min Summer	3.469	N/A	30.0	304

Table 2 – Q100+25% climate change hydraulic model storage results

Storage	Critical 1 in 100-year + 25% climate change storm event	Contributing catchment (ha)	Allowable discharge rate (l/s)	Maximum discharge rate (l/s)	Maximum resident volume (m ³)
West Basin	1,440 min Summer	2.114	N/A	12.1	1,236
East Basin	960 min Summer	0.072	5.0	5.0	240
Land Drainage East Basin	120 min Summer	3.469	N/A	30.0	416

8.4.1 Exceedance Overflow

Formalised exceedance routes have been proposed to safely convey overland flow in the direction of existing natural topography in the event of overtopping of the proposed attenuation storage systems.

Hydraulic modelling of the critical duration 1 in 100 year plus 25% climate change event shows that the proposed drainage networks have no flooding. In this design storm event, exceedance routes for the East Basin and Land Drainage East Basin, which would convey flow safely towards Castle Hill Road, have no flow in them. The West Basin exceedance route, which would convey flow safely towards Gipsy Brook via the proposed outfall ditch, has a maximum flow rate of 1.7 l/s with a maximum flow depth of 17 mm.

If an exceedance event of this magnitude does occur, these exceedance results demonstrate that the flood risk to people and property is very low. This storm event is however very unlikely to occur, having a less than 3% chance of occurring during the entire 8 year design life of the construction site.

9. Discharge of planning condition 11

The table below demonstrates how this report justifies the discharge of the planning condition related to the temporary construction stage drainage at the Woodgate Hill site.

Condition	Justification
Development within each phase approved under Condition 3 above shall not be commenced until a scheme detailing how surface water flows and quality will be controlled and managed during the construction phase of the development for the relevant phase has been submitted to and approved in writing by the Local Planning Authority. For the purposes of this condition the term 'construction work' shall be taken to include any works to include works to prepare the site for development including site access points, haul roads and compound areas but excluding site investigation. The construction phase surface water management plan shall include the following and be implemented before construction starts:	This report sets out the construction phase surface water drainage strategy adopting a sustainable drainage design approach.
a. An assessment of potential flows that would need to be managed during construction, including flows from the existing aqueduct, construction compounds and access roads and as a result of any groundwater dewatering or tunnelling activities;	It details how surface water runoff from the construction site will be captured, managed, treated, attenuated and discharged at a restricted rate, following the principals of Sustainable Drainage. See Sections 3, 4, 5, 7, 8 and Appendices A and B.
b. Details of the measures which would be put in place to capture, manage, treat and discharge flows from the component parts of the site identified in part a.	
c. A programme for the installation, maintenance and removal of the measures set out in part b. This should include provision for adapting the mitigation if it proves not to be effective.	This report explains the construction timescales and treatment measures (see Sections 5 and 7).
d. An assessment of potential contaminants which may be present in surface water runoff, and measures to segregate this surface or ground water from clean runoff;	It includes details of the surface water SuDS train proposed to minimise siltation and pollutants from entering ground water and surface waters and to ensure segregation of clean runoff from the construction runoff, see Sections 3, 4, 6 and 7.
e. Assessment of potential options to retain, test and treat or remove potentially contaminated surface water runoff during the works;	An Environment Agency Surface Water Discharge Permit, reference EPR/ZP3721MC/A002 which was submitted on 2 nd July 2026, details the regulatory requirements for the site including on-site testing and monitoring. The permit also includes a supporting document detailing potential treatment and controls.
f. Details of a monitoring scheme to be implemented to confirm that no contaminants are present in runoff from the site intended for discharge to controlled waters (before, during and post construction)	A Surface Water and Flood Risk Management Plan will be developed which will include monitoring the water quality of the discharges.

g. Details of how existing surface waters will be protected from any surface and ground waters generated. Once approved, the construction phase surface water management plan shall be implemented in its entirety and remain for the duration of the development. Should a need for amendments to the plan be required as a result of changing conditions, these must be submitted to and approved by the LPA.	This report details how surface water runoff from the construction site will be kept separate from other sources of runoff and how it will be managed and treated using sustainable drainage. See Sections 3, 4, 5, 7, 8 and Appendices A and B.
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10. References

CIRIA (2015) The SuDS Manual, CIRIA C753.

Environment Agency (2013) Rainfall runoff management for developments, Report – SC030219.

HR Wallingford (2025) UK SuDS greenfield runoff rate estimation,
<https://www.uksuds.com/tools/greenfield-runoff-rate-estimation>.

Jacobs (2021) Proposed Haslingden and Walmersley Section Environmental Statement, Volume 4 Appendix 3.3: Construction Code of Practice, HBC_RBC_BMBC-HW-TA-003-003 Rev 0.

Environment Agency (2025) Historic Landfill Sites dataset. Available:
<https://www.data.gov.uk/dataset/17edf94f-6de3-4034-b66b-004ebd0dd010/historic-landfill-sites1>

National Library of Scotland (2026) Map Images. Available: <https://maps.nls.uk/>

Soil Engineering (2021) Report on Ground Investigation for Haweswater Aqueduct Resilience Programme TR5&6 Phase 1B

British Water (2022) How To Guide: Applying the CIRIA SuDS Manual (C753) Simple Index Approach to Proprietary/Manufactured Stormwater Treatment Devices.

Appendix A

Hydraulic Model Inputs

A.1 HR Wallingford greenfield runoff rate estimation tool

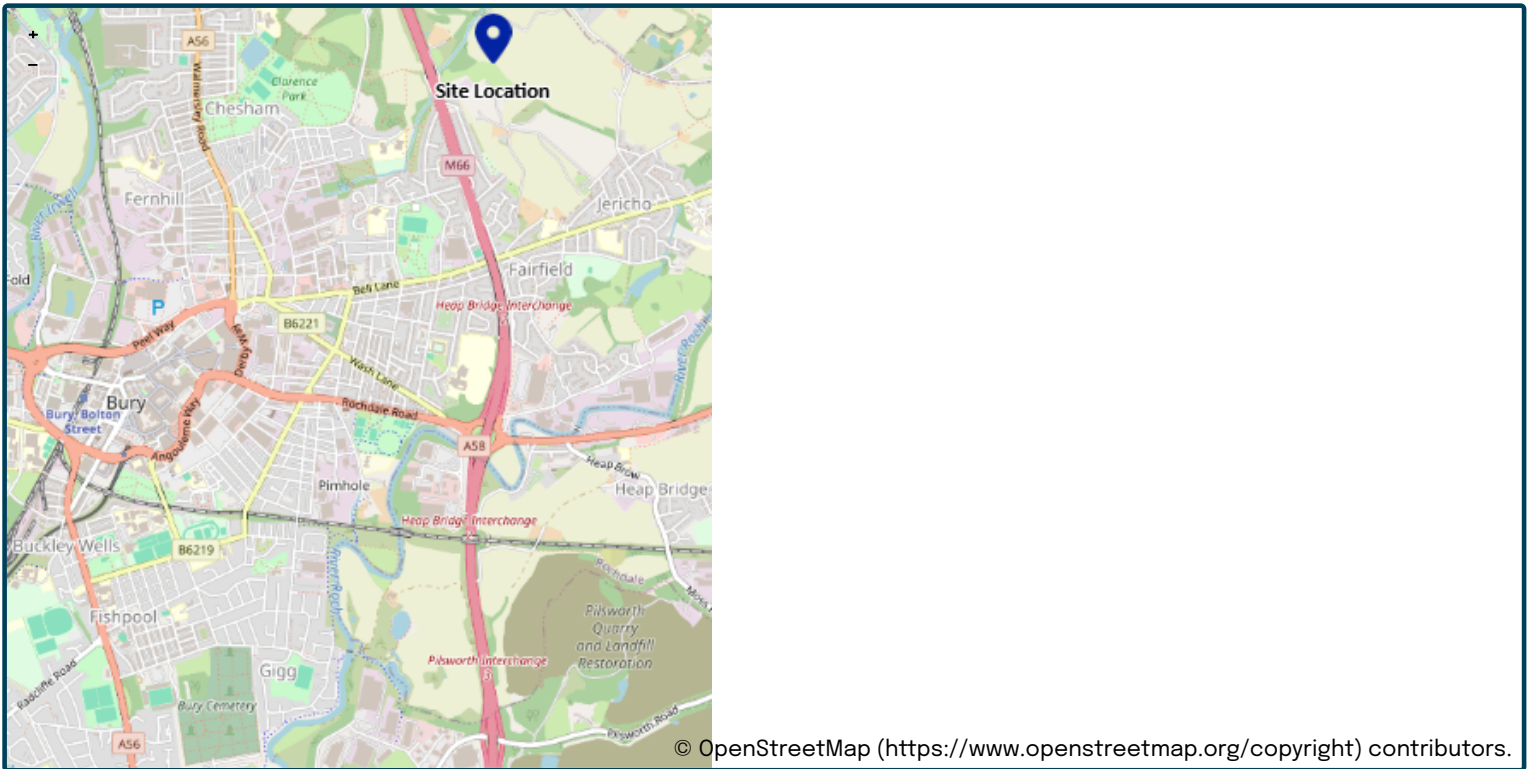
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	19/03/2026
Calculated by	Will Wright
Reference	HARP - Woodgate Hill
Model version	2.2.3

Location

Site name	HARP - Woodgate Hill
Site location	



Site easting (British National Grid)	382137
Site northing (British National Grid)	412186

Site details

Total site area (ha)	1	ha
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Greenfield runoff

Method

Method	FEH statistical (2025)
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FEH statistical (2025)

	<u>My value</u>	<u>Map value</u>
SAAR9120 (mm)	1268	mm
BFIHOST19scaled	0.634	
QMed-QBar conversion	1.075	1.075
QMed (l/s)	4.9	l/s
QBar (FEH statistical 2025) (l/s)	5.2	l/s

Growth curve factors

	<u>My value</u>	<u>Map value</u>
Hydrological region	10	10
1 year growth factor	0.87	
2 year growth factor	0.93	
10 year growth factor	1.38	
30 year growth factor	1.7	
100 year growth factor	2.08	
200 year growth factor	2.37	

Results

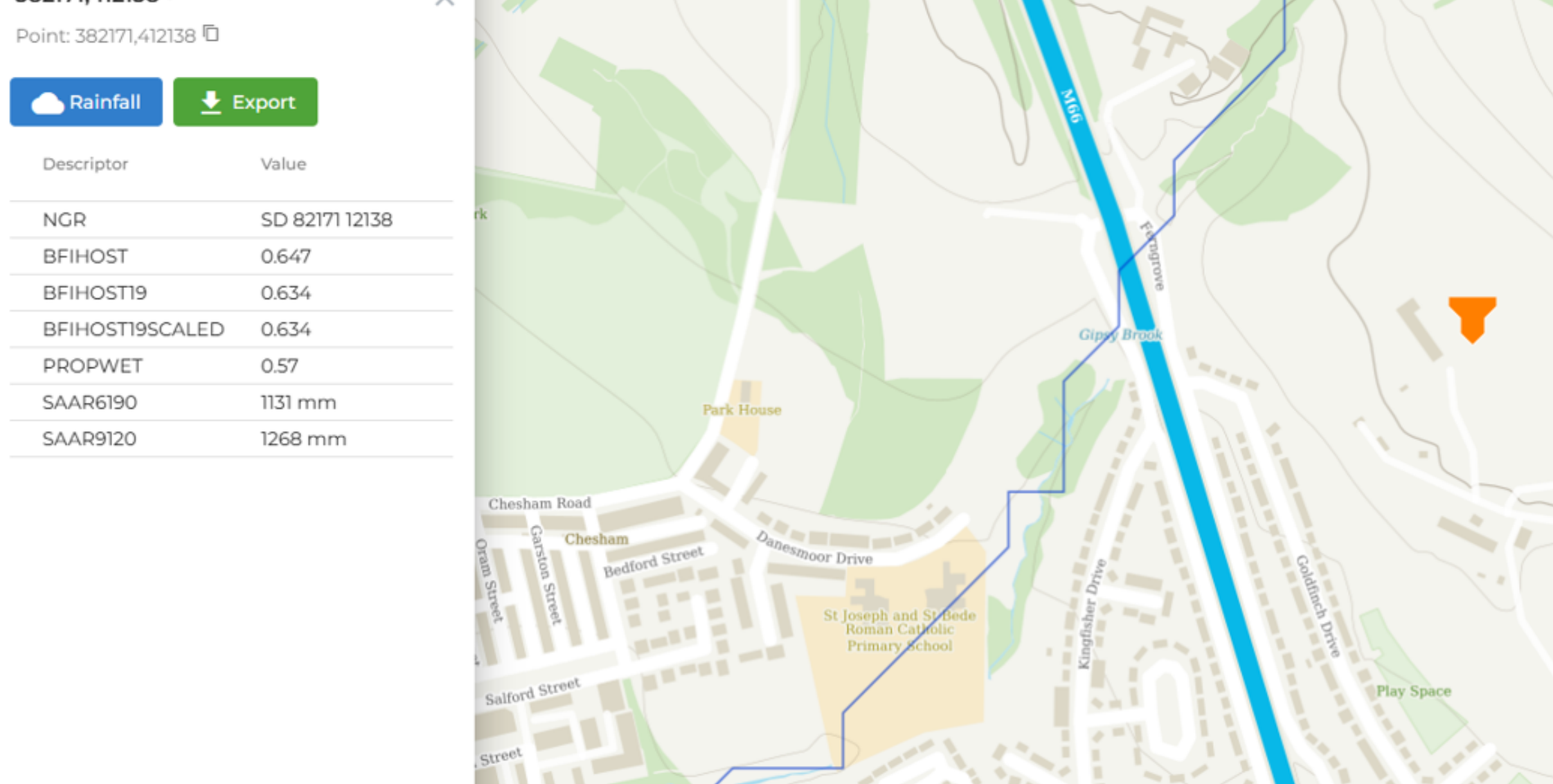
Method	FEH statistical (2025)
Flow rate 1 year (l/s)	4.6
Flow rate 2 year (l/s)	4.9
Flow rate 10 years (l/s)	7.2
Flow rate 30 years (l/s)	8.9
Flow rate 100 years (l/s)	10.9
Flow rate 200 years (l/s)	12.4

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent ‘zero’ figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at uksuds.com (<https://www.uksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

A.2 FEH 2022 Catchment Descriptors



Appendix B

Hydraulic Model Results

B.1 1 in 30 year + 25% critical duration results

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026		
	Designed by: EM	Checked by: WW	Approved By: NF
Report Details: Type: Junctions Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE		





FEH22: 30 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Resident Volume

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Manhole (28)	FEH22: 30 years: +25 %: 15 mins: Summer	155.187	153.950	154.238	0.288	167.8	0.326	0.000	155.5	72.735	OK
Manhole (27)	FEH22: 30 years: +25 %: 15 mins: Summer	154.840	153.024	153.242	0.218	358.8	0.246	0.000	342.9	164.402	OK
Simple Junction (2)	FEH22: 30 years: +25 %: 15 mins: Summer		150.455	150.945	0.490	466.8			424.7	253.623	OK
Simple Junction (3)	FEH22: 30 years: +25 %: 15 mins: Summer		149.694	150.070	0.376	383.5			367.2	261.288	OK
Manhole (3)	FEH22: 30 years: +25 %: 15 mins: Summer	159.250	157.552	157.699	0.147	113.5	0.166	0.000	110.6	62.153	OK
Manhole (6)	FEH22: 30 years: +25 %: 15 mins: Summer	159.407	158.007	158.285	0.278	118.9	0.314	0.000	110.3	57.459	OK
Manhole (7)	FEH22: 30 years: +25 %: 15 mins: Summer	160.291	158.891	159.054	0.163	122.3	0.185	0.000	118.9	57.470	OK
Manhole (9)	FEH22: 30 years: +25 %: 15 mins: Summer	167.330	165.930	166.056	0.126	100.6	0.143	0.000	98.6	46.130	OK
Manhole (10)	FEH22: 30 years: +25 %: 15 mins: Summer	167.760	166.360	166.481	0.121	69.1	0.136	0.000	67.8	31.925	OK
Simple Junction (9)	FEH22: 30 years: +25 %: 15 mins: Summer		168.092	168.229	0.137	45.5			43.4	19.709	OK
Manhole (12)	FEH22: 30 years: +25 %: 15 mins: Summer	169.515	168.015	168.096	0.081	26.0	0.092	0.000	25.7	11.257	OK
Manhole (13)	FEH22: 30 years: +25 %: 15 mins: Summer	169.177	167.677	167.737	0.060	25.7	0.068	0.000	25.4	11.253	OK
Manhole (14)	FEH22: 30 years: +25 %: 15 mins: Summer	168.615	167.115	167.200	0.085	55.1	0.096	0.000	54.0	24.132	OK
Manhole (16)	FEH22: 30 years: +25 %: 15 mins: Summer	162.433	160.933	161.036	0.103	97.1	0.116	0.000	95.4	43.629	OK
Manhole (17)	FEH22: 30 years: +25 %: 15 mins: Summer	158.137	156.637	156.862	0.225	95.4	0.254	0.000	91.3	43.584	OK
Manhole (19)	FEH22: 30 years: +25 %: 15 mins: Summer	154.754	152.922	153.038	0.116	127.1	0.131	0.000	123.4	60.399	OK
Manhole (21)	FEH22: 30 years: +25 %: 15 mins: Summer	153.220	151.720	152.249	0.529	114.0	0.599	0.000	104.9	66.833	Surcharged
Manhole (22)	FEH22: 30 years: +25 %: 15 mins: Summer	153.042	151.442	152.134	0.692	142.9	0.783	0.000	134.3	83.067	Surcharged
Simple Junction (18)	FEH22: 30 years: +25 %: 15 mins: Summer		151.430	151.522	0.092	15.8			11.4	7.037	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026		
	Designed by: EM	Checked by: WW	Approved By: NF
Report Details: Type: Junctions Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE		



Simple Junction (19)	FEH22: 30 years: +25 %: 15 mins: Summer		149.487	149.605	0.117	13.7			8.0	5.157	OK
Simple Junction (20)	FEH22: 30 years: +25 %: 15 mins: Summer		149.378	149.599	0.221	36.7			22.1	19.751	Surcharged
Simple Junction (21)	FEH22: 30 years: +25 %: 15 mins: Summer		151.514	151.600	0.086	14.6			7.2	5.707	OK
Simple Junction (22)	FEH22: 30 years: +25 %: 15 mins: Summer		150.923	151.043	0.120	34.1			20.8	16.459	OK
Simple Junction (24)	FEH22: 30 years: +25 %: 15 mins: Summer		149.289	149.814	0.525	367.2			384.9	259.941	OK
Manhole	FEH22: 30 years: +25 %: 60 mins: Summer	149.845	148.645	148.831	0.186	379.8	0.328	0.000	378.9	876.719	OK
Manhole (1)	FEH22: 30 years: +25 %: 60 mins: Summer	149.007	147.807	148.097	0.290	378.5	0.513	0.000	377.6	874.608	OK
Sealed Manhole	FEH22: 30 years: +25 %: 15 mins: Summer		149.699	149.855	0.156	30.7			28.8	19.288	OK
Simple Junction (30)	FEH22: 30 years: +25 %: 15 mins: Summer		170.412	170.619	0.207	53.7			53.4	56.047	OK
Simple Junction (31)	FEH22: 30 years: +25 %: 15 mins: Summer		168.690	168.844	0.154	53.4			53.6	53.265	OK
Simple Junction (32)	FEH22: 30 years: +25 %: 15 mins: Summer		168.102	168.259	0.157	53.6			53.8	50.720	OK
Simple Junction (33)	FEH22: 30 years: +25 %: 15 mins: Summer		165.697	165.905	0.207	89.1			89.0	92.497	OK
Simple Junction (34)	FEH22: 30 years: +25 %: 15 mins: Summer		163.850	164.062	0.212	89.0			88.1	87.544	OK
Simple Junction (35)	FEH22: 30 years: +25 %: 15 mins: Summer		162.253	162.537	0.284	142.8			143.2	150.325	OK
Simple Junction (36)	FEH22: 30 years: +25 %: 15 mins: Summer		158.766	159.016	0.250	143.2			143.5	141.857	OK
Simple Junction (37)	FEH22: 30 years: +25 %: 15 mins: Summer		157.115	157.428	0.313	205.3			205.4	218.916	OK
Simple Junction (38)	FEH22: 30 years: +25 %: 15 mins: Summer		156.064	156.398	0.333	205.4			205.4	205.163	OK
Simple Junction (39)	FEH22: 30 years: +25 %: 15 mins: Summer		152.552	153.196	0.644	254.9			249.3	224.186	OK
Simple Junction (40)	FEH22: 30 years: +25 %: 15 mins: Summer		152.314	152.872	0.558	249.3			247.1	193.193	OK
Simple Junction (41)	FEH22: 30 years: +25 %: 15 mins: Summer		152.007	152.617	0.610	291.7			293.6	221.707	OK
Simple Junction (42)	FEH22: 30 years: +25 %: 15 mins: Summer		151.299	151.957	0.658	293.6			275.7	152.200	OK
Simple Junction (43)	FEH22: 30 years: +25 %: 15 mins: Summer		150.253	150.406	0.153	27.7			30.7	20.609	OK
Simple Junction (44)	FEH22: 30 years: +25 %: 15 mins: Summer		170.500	170.670	0.170	46.8			46.8	60.849	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026				
	Designed by: EM	Checked by: WW	Approved By: NF		
Report Details: Type: Junctions Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE				

Simple Junction (45)	FEH22: 30 years: +25 %: 15 mins: Summer		169.265	169.461	0.196	78.8			78.8	98.682	OK
Simple Junction (46)	FEH22: 30 years: +25 %: 15 mins: Summer		167.582	167.773	0.190	78.8			78.8	96.063	OK
Simple Junction (47)	FEH22: 30 years: +25 %: 15 mins: Summer		166.999	167.192	0.193	78.8			78.8	93.628	OK
Simple Junction (48)	FEH22: 30 years: +25 %: 15 mins: Summer		165.532	165.758	0.226	105.9			105.9	122.549	OK
Simple Junction (49)	FEH22: 30 years: +25 %: 15 mins: Summer		162.242	162.500	0.258	130.0			129.6	142.853	OK
Simple Junction (50)	FEH22: 30 years: +25 %: 15 mins: Summer		160.473	160.835	0.362	129.6			127.9	127.411	OK
Manhole (5)	FEH22: 30 years: +25 %: 60 mins: Summer	159.988	157.800	158.017	0.217	184.3	0.245	0.000	184.3	383.539	OK
Manhole (2)	FEH22: 30 years: +25 %: 60 mins: Summer	159.079	156.827	157.094	0.267	184.3	0.302	0.000	184.2	383.515	OK
Manhole (24)	FEH22: 30 years: +25 %: 15 mins: Summer	152.292	150.792	151.252	0.460	140.1	0.520	0.000	134.1	89.031	Surcharged
Manhole (23)	FEH22: 30 years: +25 %: 15 mins: Summer	152.391	150.928	151.323	0.395	139.1	0.447	0.000	131.6	85.360	Surcharged
Manhole (20)	FEH22: 30 years: +25 %: 15 mins: Summer	153.911	152.311	152.571	0.260	138.2	0.294	0.000	114.0	66.728	OK
Manhole (8)	FEH22: 30 years: +25 %: 15 mins: Summer	163.911	162.511	162.626	0.115	112.0	0.131	0.000	109.4	51.917	OK
Manhole (11)	FEH22: 30 years: +25 %: 15 mins: Summer	169.050	167.439	167.554	0.115	71.6	0.130	0.000	69.1	31.937	OK
Manhole (15)	FEH22: 30 years: +25 %: 15 mins: Summer	164.803	163.294	163.404	0.110	72.4	0.124	0.000	70.4	32.057	OK
Manhole (18)	FEH22: 30 years: +25 %: 15 mins: Summer	158.075	156.482	156.631	0.149	119.6	0.169	0.000	116.3	55.838	OK
Simple Junction (55)	FEH22: 30 years: +25 %: 15 mins: Summer		158.942	158.942	0.000	0.0			0.0	0.000	OK
EB land Drainage outfall	FEH22: 30 years: +25 %: 120 mins: Summer	158.000	155.449	156.520	1.071	31.6	3.711	0.000	30.0	366.201	OK
Simple Junction (52)	FEH22: 30 years: +25 %: 15 mins: Summer		134.780	134.918	0.138	281.8			281.8	139.290	OK
Manhole (4)	FEH22: 30 years: +25 %: 60 mins: Summer	147.012	145.812	145.979	0.168	377.6	0.296	0.000	377.2	873.897	OK
Simple Junction (26)	FEH22: 30 years: +25 %: 15 mins: Summer		155.225	155.263	0.038	3.2			3.2	3.845	OK
East Basin outfall Control	FEH22: 30 years: +25 %: 480 mins: Summer	158.000	155.761	156.704	0.942	4.6	1.066	0.000	4.6	199.949	Surcharged
Simple Junction (27)	FEH22: 30 years: +25 %: 15 mins: Summer		155.899	155.899	0.000	0.0			0.0	0.000	OK
Simple Junction (29)	FEH22: 30 years: +25 %: 15 mins: Summer		156.480	156.480	0.000	0.0			0.0	0.000	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage		Date: 23/03/2026		
		Designed by: EM	Checked by: WW	Approved By: NF
Report Details: Type: Junctions Summary Storm Phase: with Pipes		Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE		



west basin control	FEH22: 30 years: +25 %: 1440 mins: Summer	150.478	148.780	149.683	0.903	10.9	1.021	0.000	10.9	1328.114	Surcharged
Manhole (26)	FEH22: 30 years: +25 %: 15 mins: Summer	155.044	153.844	154.153	0.309	211.7	0.349	0.000	203.3	91.821	OK
Manhole (29)	FEH22: 30 years: +25 %: 15 mins: Summer	152.819	151.619	151.949	0.330	342.9	0.373	0.000	332.7	164.743	OK
Manhole (30)	FEH22: 30 years: +25 %: 60 mins: Summer	159.415	158.314	158.773	0.459	4.2	0.519	0.000	4.1	22.522	Surcharged
Manhole (31)	FEH22: 30 years: +25 %: 120 mins: Summer	152.380	151.135	151.598	0.463	3.9	0.524	0.000	3.9	37.675	Surcharged
Manhole (32)	FEH22: 30 years: +25 %: 120 mins: Winter	152.200	150.866	151.583	0.717	5.3	0.811	0.000	5.2	58.276	Surcharged
Simple Junction	FEH22: 30 years: +25 %: 15 mins: Summer		150.087	150.594	0.508	426.7			379.9	256.384	OK
Simple Junction (1)	FEH22: 30 years: +25 %: 15 mins: Summer		148.303	148.451	0.148	282.2			282.2	147.858	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage		Date: 23/03/2026			
		Designed by: EM	Checked by: WW		Approved By: NF
Report Details: Type: Stormwater Controls Summary Storm Phase: with Pipes		Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			



FEH22: 30 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Resident Volume

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
East Basin	FEH22: 30 years: +25 %: 480 mins: Summer	156.707	156.707	0.907	0.907	184.855	0.000	4.6	200.523	23.627	OK
West Basin	FEH22: 30 years: +25 %: 1440 mins: Summer	149.710	149.710	0.885	0.885	980.244	0.000	10.9	1328.466	1.930	OK
East Land Drainage Basin	FEH22: 30 years: +25 %: 120 mins: Summer	156.528	156.528	1.028	1.028	303.874	0.000	31.6	368.275	25.388	OK
PP East Parking	FEH22: 30 years: +25 %: 60 mins: Summer	158.785	158.783	0.214	0.298	15.793	0.000	4.4	22.928	57.046	OK
PP West Parking 2	FEH22: 30 years: +25 %: 120 mins: Winter	151.599	151.596	0.469	0.596	49.968	0.000	5.3	59.087	43.628	OK
PP West Parking 1	FEH22: 30 years: +25 %: 120 mins: Summer	151.607	151.605	0.371	0.455	25.679	0.000	4.0	38.045	48.105	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026		
	Designed by: EM	Checked by: WW	Approved By: NF
Report Details: Type: Connections Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE		





FEH22: 30 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
East Pipe 1.005	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (6)	160.291	159.054	0.221	57.470	2.1	0.52	118.9	OK
East Pipe 1.003	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (8)	167.330	166.056	0.121	46.130	3.7	0.34	98.6	OK
East Pipe 1.002	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (9)	167.760	166.481	0.123	31.925	2.5	0.27	67.8	OK
East Pipe 1.000	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Simple Junction (9)	Manhole (11)	169.492	168.229	0.126	19.709	1.5	0.39	43.4	OK
West Pipe 1.002	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (14)	Manhole (15)	168.615	167.200	0.098	24.132	2.7	0.18	54.0	OK
West Pipe 1.004	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (17)	162.433	161.036	0.164	43.629	2.4	0.25	95.4	OK
West Pipe 1.005	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (17)	Manhole (18)	158.137	156.862	0.187	43.584	2.0	0.82	91.3	OK
West Pipe 1.007	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (19)	Manhole (20)	154.754	153.038	0.188	60.399	1.3	0.3	123.4	OK
West Pipe 1.009	FEH22: 30 years: +25 %: 15 mins: Winter	Pipe	Manhole (21)	Manhole (22)	153.220	152.142	0.300	66.834	1.5	0.51	108.9	Surcharged
West Pipe 1.010	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (22)	Manhole (23)	153.042	152.134	0.300	83.067	1.9	1.18	134.3	Surcharged
West Pipe 3.000	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (28)	Manhole (27)	155.187	154.238	0.253	72.735	2.0	0.84	155.5	OK
Trapezoidal Channel (7)	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (27)	Manhole (29)	154.840	153.242	0.274	164.402	4.0	0.47	342.9	OK
West Swale 1.013	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (2)	Simple Junction	151.155	150.945	0.499	253.623	0.4	0.43	424.7	OK
West Swale 1.015	FEH22: 30 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (3)	Simple Junction (24)	150.394	150.086	0.463	368.309	0.4	0.26	402.6	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
			Designed by: EM	Checked by: WW	Approved By: NF	
Report Details: Type: Connections Summary Storm Phase: with Pipes			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

West Swale 1.016	FEH22: 30 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (24)	West Basin	149.989	149.822	0.388	367.224	0.6	0.47	401.2	OK
West Swale 7.000	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (18)	Simple Junction (19)	151.930	151.522	0.089	7.037	0.2	0.02	11.4	OK
West Swale 7.001	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (19)	Simple Junction (20)	149.987	149.605	0.167	5.157	0.1	0.05	8.0	OK
West Swale 6.002	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (43)	Sealed Manhole	150.815	150.406	0.154	20.609	0.2	0.06	30.7	OK
West Swale 6.000	FEH22: 30 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (21)	Simple Junction (22)	152.014	151.606	0.108	8.430	0.1	0.03	8.0	OK
West Swale 6.001	FEH22: 30 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (22)	Simple Junction (43)	151.423	151.048	0.138	24.655	0.2	0.05	22.5	OK
West Pipe 6.004	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Simple Junction (20)	West Basin	150.492	149.631	0.150	56.099	1.4	1.37	24.4	Surcharged
West Pipe 1.011	FEH22: 30 years: +25 %: 30 mins: Summer	Pipe	Manhole (23)	Manhole (24)	152.391	151.313	0.300	116.798	1.1	0.6	133.7	Surcharged
West Outfall Ditch 1	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Manhole	Simple Junction (1)	149.845	148.831	0.183	876.719	2.4	0.02	378.9	OK
East Land Drainage Basin Outfall	FEH22: 30 years: +25 %: 30 mins: Summer	Pipe	East Land Drainage Basin	EB land Drainage outfall	157.956	156.319	0.300	79.744	1.2	0.31	34.4	Surcharged
West Pipe 1.000	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	169.515	168.096	0.071	11.257	2.0	0.13	25.7	OK
West Pipe 1.001	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	169.177	167.737	0.073	11.253	1.9	0.08	25.4	OK
East Pipe 1.006	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (6)	Manhole (3)	159.407	158.285	0.212	57.459	2.1	0.99	110.3	OK
East Pipe 1.007	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (3)	East Basin	159.250	157.699	0.138	62.153	3.5	0.38	110.6	OK
West Swale 6.003	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Sealed Manhole	Simple Junction (20)	150.701	149.855	0.172	19.288	0.2	0.01	28.8	OK
West ID (0)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (30)	Simple Junction (31)	170.912	170.632	0.192	224.249	0.4	0.15	59.7	OK
West ID (1)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (31)	Simple Junction (32)	169.190	168.853	0.164	222.014	0.4	0.11	59.4	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
Report Details: Type: Connections Summary Storm Phase: with Pipes			Designed by:	Checked by:	Approved By:	
			EM	WW	NF	
			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

West ID (2)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (32)	Simple Junction (33)	168.602	168.268	0.197	220.067	0.3	0.12	59.1	OK
West ID (3)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (33)	Simple Junction (34)	166.197	165.926	0.232	312.454	0.5	0.21	106.6	OK
West ID (4)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (34)	Simple Junction (35)	164.350	164.085	0.277	309.927	0.4	0.22	106.8	OK
West ID (5)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (35)	Simple Junction (36)	162.753	162.572	0.300	453.792	0.6	0.36	180.3	OK
West ID (6)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (36)	Simple Junction (37)	159.266	159.047	0.318	450.762	0.5	0.32	180.2	OK
West ID (7)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (37)	Simple Junction (38)	157.615	157.470	0.366	615.958	0.6	0.5	263.0	OK
West ID (8)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (38)	Simple Junction (39)	156.564	156.441	0.500	612.634	0.4	0.56	262.5	OK
West ID (9)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (39)	Simple Junction (40)	153.552	153.273	0.676	735.354	0.3	0.49	323.5	OK
West ID (10)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (40)	Simple Junction (41)	153.314	152.948	0.659	728.123	0.3	0.36	323.0	OK
West ID (11)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (41)	Simple Junction (42)	153.007	152.691	0.718	849.220	0.3	0.43	376.0	OK
West ID (12)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (42)	Manhole	152.299	152.050	0.468	833.331	0.6	0.21	372.0	OK
East ID	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (44)	Simple Junction (45)	171.000	170.707	0.220	151.253	0.3	0.18	67.1	OK
East ID (1)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (45)	Simple Junction (46)	169.765	169.499	0.231	237.495	0.5	0.22	109.9	OK
East ID (2)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (46)	Simple Junction (47)	168.082	167.810	0.229	237.459	0.5	0.21	109.8	OK
East ID (3)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (47)	Simple Junction (48)	167.499	167.229	0.249	237.427	0.5	0.21	109.7	OK
East ID (4)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (48)	Simple Junction (49)	166.032	165.800	0.284	310.264	0.5	0.29	145.8	OK
East ID (5)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (49)	Simple Junction (50)	162.742	162.542	0.359	362.352	0.4	0.36	173.6	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
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Report Details: Type: Connections Summary Storm Phase: with Pipes			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

East ID (6)	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (50)	Manhole (5)	160.973	160.891	0.296	361.726	0.6	0.37	172.6	OK
East Land Drainage Pipe 1	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Manhole (5)	Manhole (2)	159.988	158.017	0.242	383.539	3.0	0.74	184.3	OK
West Basin Outfall 1	FEH22: 30 years: +25 %: 1440 mins: Summer	Pipe	West Basin	west basin control	150.478	149.710	0.150	1328.466	0.6	0.67	10.9	Surcharged
West Pipe 1.012	FEH22: 30 years: +25 %: 30 mins: Summer	Pipe	Manhole (24)	Simple Junction (2)	152.292	151.244	0.300	121.823	2.0	0.82	139.4	Surcharged
West Pipe 1.008	FEH22: 30 years: +25 %: 15 mins: Winter	Pipe	Manhole (20)	Manhole (21)	153.911	152.544	0.300	66.740	1.9	0.86	127.3	OK
East Pipe 1.004	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (8)	Manhole (7)	163.911	162.626	0.139	51.917	3.4	0.32	109.4	OK
East Pipe 1.001	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	169.050	167.554	0.118	31.937	2.7	0.28	69.1	OK
West Pipe 1.003	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (15)	Manhole (16)	164.803	163.404	0.102	32.057	3.3	0.23	70.4	OK
West Pipe 1.006	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (18)	Manhole (19)	158.075	156.631	0.132	55.838	3.9	0.44	116.3	OK
East ID (7)	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (55)	Manhole (5)	159.442	158.942	0.000	0.000	0.0	0	0.0	OK
East Land Drainage Pipe 2	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Manhole (2)	East Land Drainage Basin	159.079	157.094	0.229	383.515	3.2	0.74	184.2	OK
Rising Main - No Delay	FEH22: 30 years: +25 %: 15 mins: Summer	No Delay	EB land Drainage outfall	Simple Junction (30)		155.971	0.011	30.803	0.0		30.0	
West Outfall Pipe 3	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Manhole (4)	Simple Junction (52)	147.012	145.979	0.164	873.897	7.2	0.28	377.2	OK
West Outfall Pipe 2	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Manhole (1)	Manhole (4)	149.007	148.097	0.229	874.608	4.6	0.61	377.6	OK
East Basin Outfall 1	FEH22: 30 years: +25 %: 360 mins: Winter	Pipe	East Basin	East Basin outfall Control	158.219	156.707	0.150	154.488	0.3	0.26	4.6	Surcharged
East Basin Outfall 2	FEH22: 30 years: +25 %: 480 mins: Summer	Pipe	East Basin outfall Control	Simple Junction (26)	158.000	156.704	0.046	199.867	1.0	0.2	4.6	Surcharged
East Land Drainage Basin Exceedance Route	FEH22: 30 years: +25 %: 15 mins: Summer	Rectangular Channel	East Land Drainage Basin	Simple Junction (27)	157.077	155.980	0.000	0.000	0.0	0	0.0	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage				Date: 23/03/2026								
Report Details: Type: Connections Summary Storm Phase: with Pipes				Designed by:	Checked by:	Approved By:						
				EM	WW	NF						
				Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE								

East Basin Exceedance Route	FEH22: 30 years: +25 %: 15 mins: Summer	Rectangular Channel	East Basin	Simple Junction (29)	157.048	156.241	0.000	0.000	0.0	0	0.0	OK
West Basin Outfall 2	FEH22: 30 years: +25 %: 1440 mins: Summer	Pipe	west basin control	Manhole	150.478	149.683	0.080	1327.794	1.1	0.1	10.9	Surcharged
West Basin Exceedance Route	FEH22: 30 years: +25 %: 15 mins: Summer	Rectangular Channel	West Basin	Simple Junction (1)	150.025	149.129	0.000	0.000	0.0	0	0.0	OK
West Pipe 2.000	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	Manhole (26)	Manhole (27)	155.044	154.153	0.263	91.821	2.5	0.89	203.3	OK
Trapezoidal Channel (11)	FEH22: 30 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Manhole (29)	Simple Junction (2)	152.819	151.949	0.410	164.743	0.4	0.05	332.7	OK
PP East Parking Outfall 1	FEH22: 30 years: +25 %: 15 mins: Summer	Pipe	PP East Parking	Manhole (30)	158.941	158.664	0.150	5.311	0.6	0.09	4.3	Surcharged
PP East Parking Outfall 2	FEH22: 30 years: +25 %: 60 mins: Summer	Pipe	Manhole (30)	Manhole (3)	159.415	158.773	0.029	22.487	1.7	0.07	4.1	Surcharged
West Swale 1.014	FEH22: 30 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction	Simple Junction (3)	151.776	150.599	0.452	355.427	0.5	0.05	399.5	OK
PP West Parking 2 Outfall	FEH22: 30 years: +25 %: 120 mins: Winter	Pipe	PP West Parking 2	Manhole (32)	152.054	151.533	0.150	58.801	0.2	0.04	5.3	Surcharged
West Pipe 5.000	FEH22: 30 years: +25 %: 120 mins: Winter	Pipe	Manhole (32)	Simple Junction (3)	152.200	151.583	0.150	58.251	1.4	0.05	5.2	Surcharged
PP West Parking 1 Outfall	FEH22: 30 years: +25 %: 120 mins: Summer	Pipe	PP West Parking 1	Manhole (31)	152.295	151.563	0.150	37.912	0.1	0.12	3.9	Surcharged
West Pipe 4.000	FEH22: 30 years: +25 %: 120 mins: Summer	Pipe	Manhole (31)	Simple Junction	152.380	151.598	0.067	37.493	0.5	0.48	3.9	Surcharged
West Outfall Ditch 2	FEH22: 30 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (1)	Manhole (1)	149.261	148.483	0.235	876.063	1.7	0.03	378.5	OK

B.2 1 in 100 year + 25% critical duration results

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026			
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Report Details: Type: Junctions Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			



FEH22: 100 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Resident Volume

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Manhole (28)	FEH22: 100 years: +25 %: 15 mins: Summer	155.187	153.950	154.318	0.368	210.2	0.416	0.000	187.0	91.098	OK
Manhole (27)	FEH22: 100 years: +25 %: 15 mins: Summer	154.840	153.024	153.278	0.254	426.5	0.287	0.000	414.4	205.977	OK
Simple Junction (2)	FEH22: 100 years: +25 %: 15 mins: Summer		150.455	150.994	0.539	568.9			529.0	317.924	OK
Simple Junction (3)	FEH22: 100 years: +25 %: 15 mins: Summer		149.694	150.106	0.412	481.4			449.4	326.492	OK
Manhole (3)	FEH22: 100 years: +25 %: 15 mins: Summer	159.250	157.552	157.718	0.166	138.2	0.188	0.000	133.6	77.089	OK
Manhole (6)	FEH22: 100 years: +25 %: 15 mins: Summer	159.407	158.007	158.634	0.627	151.1	0.709	0.000	134.8	71.989	Surcharged
Manhole (7)	FEH22: 100 years: +25 %: 15 mins: Summer	160.291	158.891	159.072	0.181	153.7	0.205	0.000	151.1	71.953	OK
Manhole (9)	FEH22: 100 years: +25 %: 15 mins: Summer	167.330	165.930	166.074	0.144	126.3	0.163	0.000	123.8	57.787	OK
Manhole (10)	FEH22: 100 years: +25 %: 15 mins: Summer	167.760	166.360	166.500	0.140	86.7	0.158	0.000	85.2	39.998	OK
Simple Junction (9)	FEH22: 100 years: +25 %: 15 mins: Summer		168.092	168.249	0.157	56.9			54.4	24.687	OK
Manhole (12)	FEH22: 100 years: +25 %: 15 mins: Summer	169.515	168.015	168.106	0.091	32.5	0.103	0.000	32.2	14.100	OK
Manhole (13)	FEH22: 100 years: +25 %: 15 mins: Summer	169.177	167.677	167.745	0.068	32.2	0.077	0.000	31.8	14.095	OK
Manhole (14)	FEH22: 100 years: +25 %: 15 mins: Summer	168.615	167.115	167.211	0.096	69.0	0.108	0.000	67.7	30.232	OK
Manhole (16)	FEH22: 100 years: +25 %: 15 mins: Summer	162.433	160.933	161.049	0.116	121.8	0.132	0.000	119.8	54.669	OK
Manhole (17)	FEH22: 100 years: +25 %: 15 mins: Summer	158.137	156.637	156.908	0.271	119.8	0.306	0.000	114.8	54.623	OK
Manhole (19)	FEH22: 100 years: +25 %: 30 mins: Summer	154.754	152.922	153.255	0.333	121.5	0.377	0.000	113.1	105.091	Surcharged
Manhole (21)	FEH22: 100 years: +25 %: 30 mins: Summer	153.220	151.720	152.720	1.000	124.4	1.131	0.000	123.3	116.293	Surcharged
Manhole (22)	FEH22: 100 years: +25 %: 15 mins: Summer	153.042	151.442	152.568	1.126	160.6	1.273	0.000	154.1	104.257	Surcharged
Simple Junction (18)	FEH22: 100 years: +25 %: 15 mins: Summer		151.430	151.534	0.103	19.8			15.4	8.875	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026		
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Simple Junction (19)	FEH22: 100 years: +25 %: 15 mins: Summer		149.487	149.639	0.151	18.3			10.4	5.733	OK
Simple Junction (20)	FEH22: 100 years: +25 %: 15 mins: Summer		149.378	149.638	0.260	52.7			24.8	23.833	Surcharged
Simple Junction (21)	FEH22: 100 years: +25 %: 15 mins: Summer		151.514	151.612	0.098	18.3			9.2	7.253	OK
Simple Junction (22)	FEH22: 100 years: +25 %: 15 mins: Summer		150.923	151.060	0.137	43.1			26.6	20.960	OK
Simple Junction (24)	FEH22: 100 years: +25 %: 15 mins: Summer		149.289	149.854	0.565	449.4			468.4	325.065	OK
Manhole	FEH22: 100 years: +25 %: 60 mins: Summer	149.845	148.645	148.860	0.216	483.0	0.381	0.000	482.6	1091.212	OK
Manhole (1)	FEH22: 100 years: +25 %: 60 mins: Summer	149.007	147.807	148.157	0.350	482.4	0.618	0.000	481.5	1089.062	OK
Sealed Manhole	FEH22: 100 years: +25 %: 15 mins: Summer		149.699	149.874	0.175	38.4			42.3	24.947	OK
Simple Junction (30)	FEH22: 100 years: +25 %: 15 mins: Summer		170.412	170.632	0.220	59.7			59.6	64.888	OK
Simple Junction (31)	FEH22: 100 years: +25 %: 15 mins: Summer		168.690	168.853	0.163	59.6			59.5	61.982	OK
Simple Junction (32)	FEH22: 100 years: +25 %: 15 mins: Summer		168.102	168.268	0.166	59.5			59.5	59.292	OK
Simple Junction (33)	FEH22: 100 years: +25 %: 15 mins: Summer		165.697	165.922	0.225	103.7			103.7	112.375	OK
Simple Junction (34)	FEH22: 100 years: +25 %: 15 mins: Summer		163.850	164.081	0.231	103.7			103.6	106.876	OK
Simple Junction (35)	FEH22: 100 years: +25 %: 15 mins: Summer		162.253	162.566	0.313	172.1			172.2	186.700	OK
Simple Junction (36)	FEH22: 100 years: +25 %: 15 mins: Summer		158.766	159.040	0.275	172.2			171.9	177.059	OK
Simple Junction (37)	FEH22: 100 years: +25 %: 15 mins: Summer		157.115	157.460	0.346	249.3			249.4	274.110	OK
Simple Junction (38)	FEH22: 100 years: +25 %: 15 mins: Summer		156.064	156.432	0.368	249.4			249.6	258.272	OK
Simple Junction (39)	FEH22: 100 years: +25 %: 15 mins: Summer		152.552	153.258	0.707	311.7			308.5	286.932	OK
Simple Junction (40)	FEH22: 100 years: +25 %: 15 mins: Summer		152.314	152.930	0.616	308.5			303.5	250.758	OK
Simple Junction (41)	FEH22: 100 years: +25 %: 15 mins: Summer		152.007	152.681	0.675	365.9			364.7	290.027	OK
Simple Junction (42)	FEH22: 100 years: +25 %: 15 mins: Summer		151.299	152.026	0.727	364.7			346.0	208.268	OK
Simple Junction (43)	FEH22: 100 years: +25 %: 15 mins: Summer		150.253	150.424	0.171	35.9			38.4	26.379	OK
Simple Junction (44)	FEH22: 100 years: +25 %: 15 mins: Summer		170.500	170.692	0.192	58.6			58.6	76.390	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage	Date: 23/03/2026				
	Designed by: EM	Checked by: WW	Approved By: NF		
Report Details: Type: Junctions Summary Storm Phase: with Pipes	Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE				

Simple Junction (45)	FEH22: 100 years: +25 %: 15 mins: Summer		169.265	169.486	0.221	98.7			98.7	124.131	OK
Simple Junction (46)	FEH22: 100 years: +25 %: 15 mins: Summer		167.582	167.797	0.215	98.7			98.7	121.056	OK
Simple Junction (47)	FEH22: 100 years: +25 %: 15 mins: Summer		166.999	167.216	0.218	98.7			98.7	118.196	OK
Simple Junction (48)	FEH22: 100 years: +25 %: 15 mins: Summer		165.532	165.787	0.255	132.6			132.6	154.950	OK
Simple Junction (49)	FEH22: 100 years: +25 %: 15 mins: Summer		162.242	162.532	0.290	162.9			162.5	181.015	OK
Simple Junction (50)	FEH22: 100 years: +25 %: 15 mins: Summer		160.473	160.876	0.403	162.5			160.2	163.011	OK
Manhole (5)	FEH22: 100 years: +25 %: 60 mins: Summer	159.988	157.800	158.612	0.812	236.9	0.918	0.000	236.8	492.154	Surcharged
Manhole (2)	FEH22: 100 years: +25 %: 60 mins: Summer	159.079	156.827	157.491	0.664	236.8	0.751	0.000	236.7	492.101	Surcharged
Manhole (24)	FEH22: 100 years: +25 %: 15 mins: Summer	152.292	150.792	151.444	0.652	167.3	0.737	0.000	164.3	111.689	Surcharged
Manhole (23)	FEH22: 100 years: +25 %: 15 mins: Summer	152.391	150.928	151.544	0.616	160.2	0.697	0.000	156.7	107.080	Surcharged
Manhole (20)	FEH22: 100 years: +25 %: 30 mins: Summer	153.911	152.311	153.192	0.881	126.0	0.997	0.000	124.4	116.175	Surcharged
Manhole (8)	FEH22: 100 years: +25 %: 15 mins: Summer	163.911	162.511	162.642	0.131	140.6	0.148	0.000	137.6	65.037	OK
Manhole (11)	FEH22: 100 years: +25 %: 15 mins: Summer	169.050	167.439	167.570	0.131	89.8	0.149	0.000	86.7	40.011	OK
Manhole (15)	FEH22: 100 years: +25 %: 15 mins: Summer	164.803	163.294	163.418	0.124	90.8	0.140	0.000	88.4	40.175	OK
Manhole (18)	FEH22: 100 years: +25 %: 15 mins: Summer	158.075	156.482	156.644	0.162	150.3	0.183	0.000	150.4	69.728	OK
Simple Junction (55)	FEH22: 100 years: +25 %: 15 mins: Summer		158.942	158.942	0.000	0.0			0.0	0.000	OK
EB land Drainage outfall	FEH22: 100 years: +25 %: 120 mins: Winter	158.000	155.449	156.789	1.340	31.6	4.642	0.000	30.0	372.915	OK
Simple Junction (52)	FEH22: 100 years: +25 %: 15 mins: Summer		134.780	134.936	0.156	355.2			355.2	192.261	OK
Manhole (4)	FEH22: 100 years: +25 %: 60 mins: Summer	147.012	145.812	146.005	0.193	481.5	0.341	0.000	481.2	1088.335	OK
Simple Junction (26)	FEH22: 100 years: +25 %: 15 mins: Summer		155.225	155.265	0.040	3.5			3.5	4.258	OK
East Basin outfall Control	FEH22: 100 years: +25 %: 960 mins: Summer	158.000	155.761	156.888	1.127	5.0	1.275	0.000	5.0	392.077	Surcharged
Simple Junction (27)	FEH22: 100 years: +25 %: 15 mins: Summer		155.899	155.899	0.000	0.0			0.0	0.000	OK
Simple Junction (29)	FEH22: 100 years: +25 %: 15 mins: Summer		156.480	156.480	0.000	0.0			0.0	0.000	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage		Date: 23/03/2026		
		Designed by: EM	Checked by: WW	Approved By: NF
Report Details: Type: Junctions Summary Storm Phase: with Pipes		Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE		



west basin control	FEH22: 100 years: +25 %: 1440 mins: Summer	150.478	148.780	149.873	1.093	12.1	1.236	0.000	12.1	1536.906	Surcharged
Manhole (26)	FEH22: 100 years: +25 %: 15 mins: Summer	155.044	153.844	154.371	0.527	265.2	0.595	0.000	239.5	114.967	Surcharged
Manhole (29)	FEH22: 100 years: +25 %: 15 mins: Summer	152.819	151.619	151.980	0.361	414.4	0.408	0.000	404.7	206.400	OK
Manhole (30)	FEH22: 100 years: +25 %: 60 mins: Summer	159.415	158.314	158.862	0.548	4.6	0.620	0.000	4.5	25.209	Surcharged
Manhole (31)	FEH22: 100 years: +25 %: 60 mins: Winter	152.380	151.135	151.724	0.589	4.5	0.666	0.000	4.5	24.179	Surcharged
Manhole (32)	FEH22: 100 years: +25 %: 120 mins: Winter	152.200	150.866	151.747	0.881	5.8	0.996	0.000	5.8	65.463	Surcharged
Simple Junction	FEH22: 100 years: +25 %: 15 mins: Summer		150.087	150.644	0.557	531.3			477.6	321.115	OK
Simple Junction (1)	FEH22: 100 years: +25 %: 15 mins: Summer		148.303	148.475	0.172	354.2			354.6	202.578	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage		Date: 23/03/2026			
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Report Details: Type: Stormwater Controls Summary Storm Phase: with Pipes		Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			



FEH22: 100 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Resident Volume

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
East Basin	FEH22: 100 years: +25 %: 960 mins: Summer	156.893	156.893	1.093	1.093	240.318	0.000	5.0	392.296	0.712	OK
West Basin	FEH22: 100 years: +25 %: 1440 mins: Summer	149.905	149.905	1.080	1.080	1236.172	0.000	13.8	1565.392	-23.675	Flood Risk
East Land Drainage Basin	FEH22: 100 years: +25 %: 120 mins: Winter	156.797	156.797	1.297	1.297	416.075	0.000	31.6	376.242	-2.162	Flood Risk
PP East Parking	FEH22: 100 years: +25 %: 60 mins: Summer	158.876	158.874	0.305	0.389	21.430	0.000	4.9	25.801	41.715	OK
PP West Parking 2	FEH22: 100 years: +25 %: 120 mins: Winter	151.766	151.763	0.637	0.763	65.665	0.000	5.9	66.565	25.919	OK
PP West Parking 1	FEH22: 100 years: +25 %: 60 mins: Winter	151.735	151.734	0.499	0.584	33.671	0.000	4.7	25.147	31.953	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage		Date: 23/03/2026			
		Designed by: EM	Checked by: WW		Approved By: NF
Report Details: Type: Connections Summary Storm Phase: with Pipes		Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			



FEH22: 100 years: Increase Rainfall (%): +25: Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
East Pipe 1.005	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (7)	Manhole (6)	160.291	159.072	0.300	71.953	2.1	0.66	151.1	OK
East Pipe 1.003	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (9)	Manhole (8)	167.330	166.074	0.138	57.787	3.9	0.43	123.8	OK
East Pipe 1.002	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (10)	Manhole (9)	167.760	166.500	0.142	39.998	2.6	0.33	85.2	OK
East Pipe 1.000	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Simple Junction (9)	Manhole (11)	169.492	168.249	0.144	24.687	1.6	0.49	54.4	OK
West Pipe 1.002	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (14)	Manhole (15)	168.615	167.211	0.110	30.232	2.9	0.22	67.7	OK
West Pipe 1.004	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (16)	Manhole (17)	162.433	161.049	0.193	54.669	2.5	0.32	119.8	OK
West Pipe 1.005	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (17)	Manhole (18)	158.137	156.908	0.216	54.623	2.1	1.03	114.8	OK
West Pipe 1.007	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (19)	Manhole (20)	154.754	153.157	0.300	75.718	1.1	0.29	117.7	OK
West Pipe 1.009	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (21)	Manhole (22)	153.220	152.701	0.300	83.851	1.9	0.62	132.2	Surcharged
West Pipe 1.010	FEH22: 100 years: +25 %: 30 mins: Summer	Pipe	Manhole (22)	Manhole (23)	153.042	152.559	0.300	144.720	2.2	1.36	155.2	Surcharged
West Pipe 3.000	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (28)	Manhole (27)	155.187	154.318	0.311	91.098	1.9	1.01	187.0	OK
Trapezoidal Channel (7)	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (27)	Manhole (29)	154.840	153.278	0.307	205.977	4.3	0.57	414.4	OK
West Swale 1.013	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (2)	Simple Junction	151.155	150.994	0.548	317.924	0.4	0.54	529.0	OK
West Swale 1.015	FEH22: 100 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (3)	Simple Junction (24)	150.394	150.126	0.506	465.110	0.5	0.33	501.2	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
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Report Details: Type: Connections Summary Storm Phase: with Pipes			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

West Swale 1.016	FEH22: 100 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (24)	West Basin	149.989	149.868	0.425	463.282	0.6	0.59	500.4	OK
West Swale 7.000	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (18)	Simple Junction (19)	151.930	151.534	0.101	8.875	0.2	0.03	15.4	OK
West Swale 7.001	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (19)	Simple Junction (20)	149.987	149.639	0.206	5.393	0.1	0.06	10.4	OK
West Swale 6.002	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (43)	Sealed Manhole	150.815	150.424	0.173	26.379	0.2	0.08	38.4	OK
West Swale 6.000	FEH22: 100 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (21)	Simple Junction (22)	152.014	151.620	0.125	10.769	0.1	0.04	10.5	OK
West Swale 6.001	FEH22: 100 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction (22)	Simple Junction (43)	151.423	151.067	0.158	31.515	0.2	0.07	29.5	OK
West Pipe 6.004	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Simple Junction (20)	West Basin	150.492	149.689	0.150	69.165	1.6	1.56	27.6	Surcharged
West Pipe 1.011	FEH22: 100 years: +25 %: 30 mins: Summer	Pipe	Manhole (23)	Manhole (24)	152.391	151.532	0.300	148.571	1.1	0.71	159.1	Surcharged
West Outfall Ditch 1	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Manhole	Simple Junction (1)	149.845	148.860	0.214	1091.212	2.4	0.02	482.6	OK
East Land Drainage Basin Outfall	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	East Land Drainage Basin	EB land Drainage outfall	157.956	156.112	0.300	35.091	1.1	0.32	35.1	Surcharged
West Pipe 1.000	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (12)	Manhole (13)	169.515	168.106	0.080	14.100	2.1	0.17	32.2	OK
West Pipe 1.001	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (13)	Manhole (14)	169.177	167.745	0.082	14.095	2.0	0.1	31.8	OK
East Pipe 1.006	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (6)	Manhole (3)	159.407	158.634	0.300	71.989	2.0	1.21	134.8	Surcharged
East Pipe 1.007	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (3)	East Basin	159.250	157.718	0.155	77.089	3.6	0.46	133.6	OK
West Swale 6.003	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Sealed Manhole	Simple Junction (20)	150.701	149.874	0.198	24.947	0.2	0.02	42.3	OK
West ID (0)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (30)	Simple Junction (31)	170.912	170.648	0.206	243.907	0.4	0.18	68.2	OK
West ID (1)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (31)	Simple Junction (32)	169.190	168.865	0.177	241.670	0.4	0.13	67.7	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
Report Details: Type: Connections Summary Storm Phase: with Pipes			Designed by: EM	Checked by: WW	Approved By: NF	
			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

West ID (2)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (32)	Simple Junction (33)	168.602	168.280	0.215	239.720	0.3	0.13	67.4	OK
West ID (3)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (33)	Simple Junction (34)	166.197	165.949	0.255	358.980	0.5	0.25	128.3	OK
West ID (4)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (34)	Simple Junction (35)	164.350	164.109	0.307	356.442	0.4	0.27	128.5	OK
West ID (5)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (35)	Simple Junction (36)	162.753	162.607	0.334	541.996	0.6	0.44	222.8	OK
West ID (6)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (36)	Simple Junction (37)	159.266	159.079	0.355	538.931	0.6	0.39	222.8	OK
West ID (7)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (37)	Simple Junction (38)	157.615	157.511	0.409	751.217	0.7	0.62	329.0	OK
West ID (8)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (38)	Simple Junction (39)	156.564	156.485	0.500	747.972	0.5	0.7	328.5	OK
West ID (9)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (39)	Simple Junction (40)	153.552	153.348	0.750	908.464	0.3	0.61	407.9	OK
West ID (10)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (40)	Simple Junction (41)	153.314	153.022	0.734	901.083	0.3	0.45	405.7	OK
West ID (11)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (41)	Simple Junction (42)	153.007	152.768	0.797	1058.502	0.3	0.54	474.8	OK
West ID (12)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (42)	Manhole	152.299	152.132	0.524	1042.191	0.7	0.27	474.4	OK
East ID	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (44)	Simple Junction (45)	171.000	170.736	0.251	194.027	0.4	0.23	86.1	OK
East ID (1)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (45)	Simple Junction (46)	169.765	169.531	0.263	304.666	0.5	0.28	141.0	OK
East ID (2)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (46)	Simple Junction (47)	168.082	167.842	0.261	304.627	0.5	0.27	140.9	OK
East ID (3)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (47)	Simple Junction (48)	167.499	167.261	0.283	304.592	0.5	0.28	140.8	OK
East ID (4)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (48)	Simple Junction (49)	166.032	165.836	0.322	398.059	0.5	0.37	187.1	OK
East ID (5)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (49)	Simple Junction (50)	162.742	162.583	0.405	464.924	0.5	0.46	222.8	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage			Date: 23/03/2026			
			Designed by: EM	Checked by: WW	Approved By: NF	
Report Details: Type: Connections Summary Storm Phase: with Pipes			Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE			

East ID (6)	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (50)	Manhole (5)	160.973	160.943	0.336	464.252	0.6	0.47	222.0	OK
East Land Drainage Pipe 1	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Manhole (5)	Manhole (2)	159.988	158.612	0.300	492.154	3.3	0.95	236.8	Surcharged
West Basin Outfall 1	FEH22: 100 years: +25 %: 1440 mins: Winter	Pipe	West Basin	west basin control	150.478	149.905	0.150	1539.845	0.7	0.74	12.1	Flood Risk
West Pipe 1.012	FEH22: 100 years: +25 %: 30 mins: Summer	Pipe	Manhole (24)	Simple Junction (2)	152.292	151.431	0.300	154.967	2.4	0.98	166.2	Surcharged
West Pipe 1.008	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (20)	Manhole (21)	153.911	153.109	0.300	83.704	1.8	0.86	127.7	Surcharged
East Pipe 1.004	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (8)	Manhole (7)	163.911	162.642	0.156	65.037	3.7	0.4	137.6	OK
East Pipe 1.001	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (11)	Manhole (10)	169.050	167.570	0.135	40.011	2.8	0.36	86.7	OK
West Pipe 1.003	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (15)	Manhole (16)	164.803	163.418	0.116	40.175	3.5	0.29	88.4	OK
West Pipe 1.006	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (18)	Manhole (19)	158.075	156.644	0.198	69.728	3.0	0.57	150.4	OK
East ID (7)	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Simple Junction (55)	Manhole (5)	159.442	158.942	0.000	0.000	0.0	0	0.0	OK
East Land Drainage Pipe 2	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Manhole (2)	East Land Drainage Basin	159.079	157.491	0.300	492.101	3.3	0.95	236.7	Surcharged
Rising Main - No Delay	FEH22: 100 years: +25 %: 15 mins: Summer	No Delay	EB land Drainage outfall	Simple Junction (30)		156.103	0.011	32.592	0.0		30.0	
West Outfall Pipe 3	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Manhole (4)	Simple Junction (52)	147.012	146.005	0.188	1088.335	7.6	0.35	481.2	OK
West Outfall Pipe 2	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Manhole (1)	Manhole (4)	149.007	148.157	0.271	1089.062	4.8	0.78	481.5	OK
East Basin Outfall 1	FEH22: 100 years: +25 %: 960 mins: Summer	Pipe	East Basin	East Basin outfall Control	158.219	156.893	0.150	392.296	0.3	0.28	5.0	Surcharged
East Basin Outfall 2	FEH22: 100 years: +25 %: 960 mins: Summer	Pipe	East Basin outfall Control	Simple Junction (26)	158.000	156.888	0.048	392.017	1.0	0.22	5.0	Surcharged
East Land Drainage Basin Exceedance Route	FEH22: 100 years: +25 %: 15 mins: Summer	Rectangular Channel	East Land Drainage Basin	Simple Junction (27)	157.077	156.112	0.000	0.000	0.0	0	0.0	OK

Haweswater Aqueduct Resilience Programme: Woodgate Hill Construction Phase Surface Water Drainage				Date: 23/03/2026								
Report Details: Type: Connections Summary Storm Phase: with Pipes				Designed by:	Checked by:	Approved By:						
				EM	WW	NF						
				Company Address: 3 St Paul's Pl, Norfolk St Sheffield City Centre, Sheffield S1 2JE								

East Basin Exceedance Route	FEH22: 100 years: +25 %: 15 mins: Summer	Rectangular Channel	East Basin	Simple Junction (29)	157.048	156.330	0.000	0.000	0.0	0	0.0	OK
West Basin Outfall 2	FEH22: 100 years: +25 %: 1440 mins: Winter	Pipe	west basin control	Manhole	150.478	149.873	0.079	1538.921	1.2	0.11	12.1	Surcharged
West Basin Exceedance Route	FEH22: 100 years: +25 %: 1440 mins: Summer	Rectangular Channel	West Basin	Simple Junction (1)	150.025	149.905	0.017	23.361	0.1	0.03	1.7	Flood Risk
West Pipe 2.000	FEH22: 100 years: +25 %: 15 mins: Summer	Pipe	Manhole (26)	Manhole (27)	155.044	154.371	0.375	114.967	2.2	1.05	239.5	Surcharged
Trapezoidal Channel (11)	FEH22: 100 years: +25 %: 15 mins: Summer	Trapezoidal Channel	Manhole (29)	Simple Junction (2)	152.819	151.980	0.450	206.400	0.5	0.06	404.7	OK
PP East Parking Outfall 1	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	PP East Parking	Manhole (30)	158.941	158.832	0.150	25.615	0.6	0.1	4.6	Surcharged
PP East Parking Outfall 2	FEH22: 100 years: +25 %: 60 mins: Summer	Pipe	Manhole (30)	Manhole (3)	159.415	158.862	0.030	25.171	1.8	0.08	4.5	Surcharged
West Swale 1.014	FEH22: 100 years: +25 %: 30 mins: Summer	Trapezoidal Channel	Simple Junction	Simple Junction (3)	151.776	150.647	0.496	450.866	0.5	0.06	497.3	OK
PP West Parking 2 Outfall	FEH22: 100 years: +25 %: 60 mins: Winter	Pipe	PP West Parking 2	Manhole (32)	152.054	151.697	0.150	34.213	0.3	0.05	5.8	Surcharged
West Pipe 5.000	FEH22: 100 years: +25 %: 120 mins: Winter	Pipe	Manhole (32)	Simple Junction (3)	152.200	151.747	0.150	65.437	1.4	0.05	5.8	Surcharged
PP West Parking 1 Outfall	FEH22: 100 years: +25 %: 60 mins: Winter	Pipe	PP West Parking 1	Manhole (31)	152.295	151.691	0.150	24.722	0.2	0.13	4.5	Surcharged
West Pipe 4.000	FEH22: 100 years: +25 %: 60 mins: Winter	Pipe	Manhole (31)	Simple Junction	152.380	151.724	0.072	23.922	0.5	0.55	4.5	Surcharged
West Outfall Ditch 2	FEH22: 100 years: +25 %: 60 mins: Summer	Trapezoidal Channel	Simple Junction (1)	Manhole (1)	149.261	148.515	0.281	1090.546	1.7	0.04	482.4	OK