

Land at Newburn Haugh Industrial Estate, Riversdale Way, Newcastle Upon Tyne

# Flood Risk Assessment and Drainage Strategy

For Balance Power Projects Ltd KRS.0310.064.R.001.B July 2023

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Date

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#### Flood Risk Assessment and Drainage Strategy



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#### **EXECUTIVE SUMMARY**

The Site would be expected to remain dry in all but the most extreme conditions. The consequences of flooding are acceptable, and the development would be in accordance with the requirements of the National Planning Policy Framework (NPPF). The Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-site locations due to the adoption of a Sustainable Drainage Systems (SuDS) Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.



#### 1.0 INTRODUCTION

#### 1.1 Background

This Flood Risk Assessment and Drainage Strategy (FRA) has been prepared by KRS Enviro at the request of Balance Power Projects Ltd to support a planning application for the development of a Battery Storage Facility ("the Proposed Development") on land at Newburn Haugh Industrial Estate, Riversdale Way, Newburn ("the Site").

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)<sup>1</sup>, associated Planning Practice Guidance on flood risk and coastal change<sup>2</sup> (PPG) and the PPG 'Site-specific flood risk assessment checklist. This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

## 1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk-based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a proposed development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary, provide the evidence to the Local Planning Authority (LPA) that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes rainfall data from the Flood Estimation Handbook (FEH) and hydrogeological information from the British

Ministry for Housing, Communities and Local Government (2021) National Planning Policy Framework: <a href="https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/1005759/NPPF\_July\_2021.pdf">https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/1005759/NPPF\_July\_2021.pdf</a>
Communities and Local Government (2022) Planning Practice Guidance - Flood Risk and Coastal Change: <a href="https://www.gov.uk/guidance/flood-risk-and-coastal-change">https://www.gov.uk/guidance/flood-risk-and-coastal-change</a>



Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

#### 1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location and the existing and Proposed Development;
- Section 3 outlines the flood risk to the existing and Proposed Development;
- Section 4 details the proposed surface water drainage for the Site and assesses the
  potential impacts of the proposed development on surface water drainage;
- Section 5 provides details of the foul water drainage for the Proposed Development;
- Section 6 details the Sequential and Exception Tests; and
- Section 7 presents a summary and conclusions.



#### 2.0 LOCATION & DEVELOPMENT DESCRIPTION

#### 2.1 Site Location

The Site is located on land at Newburn Haugh Industrial Estate, Riversdale Way, Newcastle Upon Tyne (see Figure 1). The National Grid Reference (NGR) of the Site is 418359, 564426.

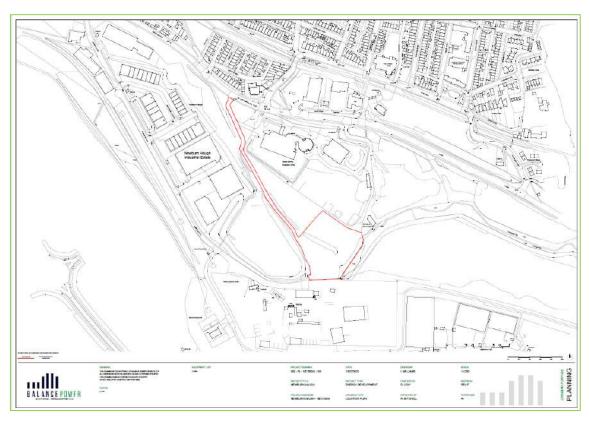


Figure 1 - Site Location

### 2.2 Existing Development

The existing Site is a brownfield development and the Site currently comprises grassland and commercial premises (see Appendix 1).

#### 2.3 Proposed Development

The Proposed Development is for a Battery Storage Facility (BSF) and associated infrastructure (see Appendix 1). Further details with regard to the Proposed Development can be found in the accompanying information submitted with the planning application.

#### 2.4 Ground Levels

A topographical survey of the Site has recently been completed (see Appendix 1). The Site falls from west to east with ground levels of between 9.63 metres Above Ordnance Datum (mAOD) and 5.92mAOD. The Site entrance rises to over 11.08mAOD.



# 2.5 Catchment Hydrology / Drainage

The Lemington Gut is located approximately 50m to the north east of the Site and the River Tyne is located the east, south and west of the Site with the closest point being approximately 500m to the east of the Site.

Previously Newcastle City Council as the Lead Local Flood Authority (LLFA) have suggested that there was possible private culvert/underground watercourse running north west to south east through this area and then discharging into the Lemington Gut, as shown as the red dashed line in Figure 2.

A culvert drainage survey was undertaken in 2020 (see Appendix 2), which concluded the following "Having explored the site in great detail using metal detectors, tracing dye, lifting manholes in and around the site, we confirm WE HAVE NOT located the assumed culvert anywhere within the area shown as per the drawing. We have walked the area around the Lemington Gut and 100m downstream to identify any outfalls but none have been located.

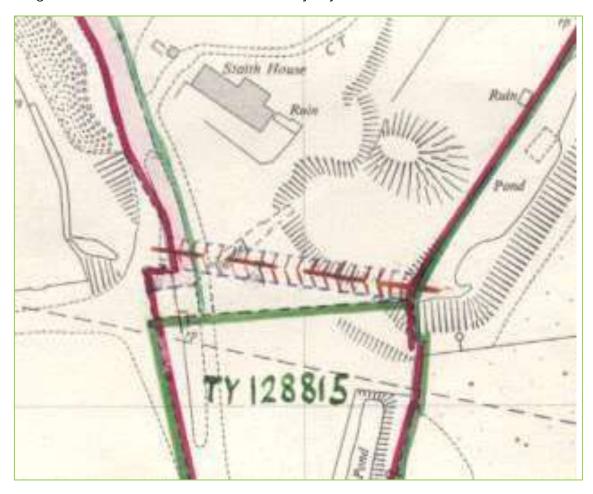


Figure 2 - Possible Culvert

There are a number of Northumbrian Water public combined and surface water sewers located within the Site, as shown Figure 3 (see Appendix 3). There is a 1050mm diameter public surface water sewer which outfalls into the Lemington Gut and a number of public combined sewers.

A 600mm diameter public combined sewer is shown to be cross the Site. this sewer will need to be diverted within the Site to enable the infrastructure to fit in whilst maintaining a suitable easement from the sewer. The sewer diversion will require an agreement under Section 106



of the Water Industry Act 1991 between the developer and Northumbrian Water, and written approval from Northumbrian Water. A 5m easement either side of the centreline of the diverted sewer will be maintained as shown in Appendix 5.

The culvert drainage survey identified the 1050mm diameter public surface water sewer as being located to the north west of the Site and it was confirmed that the sewer discharges into the Lemington Gut to the south east of the Site.

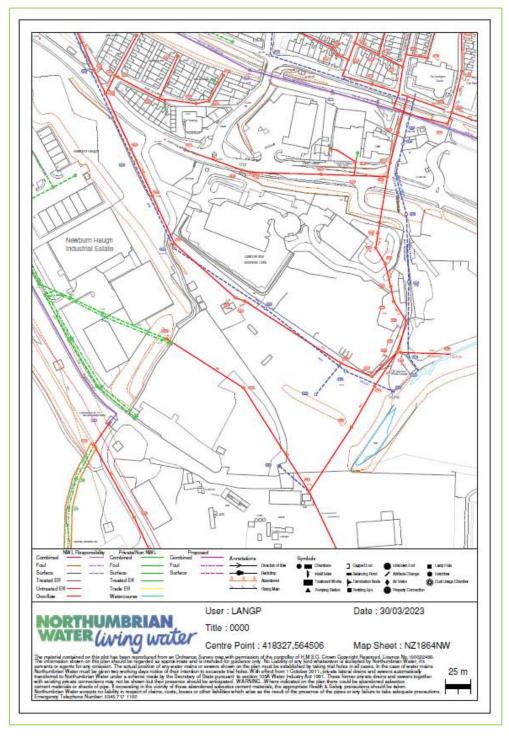


Figure 3 - Public Sewer Plan



#### 2.6 Ground Conditions

The Site is underlain by Made Ground of an unknown depth, composition and maybe contaminated. During a Site walkover, ashy made ground soils were exposed at the surface. The British Geological Survey (BGS) map shows that the bedrock deposits consist of the Pennine Lower Coal Measures Formation - mudstone, siltstone and sandstone. Sedimentary bedrock formed between 319 and 318 million years ago during the Carboniferous period. The superficial deposits consist of Till, Devensian - diamicton. Superficial deposits formed between 116 and 11.8 thousand years ago during the Quaternary period.

The superficial deposits are variable permeability clay dominant alluvium, over low permeability mudstone (Pennine Lower Coal Measures Formation) bedrock. Shallow boreholes in the vicinity record over 4.50m of sandy clay and silt. No groundwater was recorded within the boreholes.

Information from the National Soil Resources Institute details the Site area as being situated on freely draining floodplain soils. The Wallingford Winter Rain Acceptance Potential (WRAP) map indicates that the Site lies within WRAP Class 4: Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

#### 2.7 Source Protection Zone

The Site is not located within a Source Protection Zone (SPZ). SPZ's have been defined by the Environment Agency around major public water supplies with the intent to show the risk of contamination from any activities that might cause pollution in the area. Three zones are defined: SPZ 1 is the Inner Zone (highest risk); SPZ 2 is the Outer Zone (average risk); and SPZ 3 is the Total Catchment (least risk).



#### 3.0 FLOOD RISK

#### 3.1 Sources of Flooding

All sources of flooding have been considered, these are; fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

### 3.2 Historic Flooding

Environment Agency data shows that the Site has not historically flooded. There are no records of anecdotal information of flooding at the Site including within the British Hydrological Society "Chronology of British Hydrological Events". No other historical records of flooding for the Site have been recorded. Therefore, it has been concluded that the Site has not flooded within the recent past.

#### 3.3 Existing and Planned Flood Defence Measures

Environment Agency data confirms that the Site is not protected against flooding by existing flood defence measures.

#### 3.4 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the Site is located within Flood Zone 1 and therefore has a 'low probability' of flooding as shown in Figure 4, with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. They show the worst-case scenario.

The Environment Agency Flood Zones and acceptable development types are explained in Table 1. Table 1 shows that all development types are generally acceptable in Flood Zone 1.



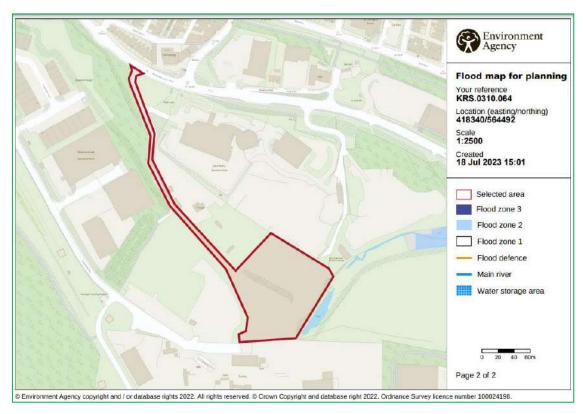


Figure 4 - Environment Agency Flood Zones

**Table 1 - Environment Agency Flood Zones and Appropriate Land Use** 

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable
Zone 3b	'Functional Floodplain'	<ul> <li>This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:</li> <li>land having a 3.3% or greater annual probability of flooding, with any existing flood risk</li> </ul>	Some development types not acceptable



management infrastructure operating effectively; or	
<ul> <li>land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).</li> </ul>	
Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)	

#### 3.5 Flood Vulnerability

In the PPG, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the PPG, the Proposed Development (use) is classified as 'essential infrastructure'. Table 2 of this report and the PPG states that both uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA.

Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b 'Functional Floodplain'	Exception test required	✓	*	×	×

**Key:**  $\checkmark$ : Development is appropriate,  $\overset{\checkmark}{}$ : Development should not be permitted.

#### 3.6 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA's. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance<sup>3</sup>. Table 3 shows peak river flow allowances by river catchment.

As per Environment Agency guidance, the anticipated lifetime of the development is deemed to be 75 years however, the actual lifetime of the development will be less. The flood risk assessments: climate change allowances guidance recommends that for 'essential infrastructure' uses in Flood Zone 1 that the central allowances are used. Therefore, the design flood level for the Site is the 1 in 100 year (+34%) event.

<sup>&</sup>lt;sup>3</sup> https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances



**Table 3 - Peak River Flow Allowances** 

Catchment	Allowance Category	2020s	2050s	2080s
	Upper	+31%	+42%	+64%
Tyne Management Catchment	Higher	+22%	+28%	+42%
	Central	+18%	+22%	+34%

#### 3.7 Fluvial (River) Flooding

The Site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+34%) and 1 in 1000 year events. The Site will be flood free during the 1 in 100 year (+34%) and 1 in 1000 year events. The Site is not located within the vicinity of fluvial flooding sources and the risk of fluvial flooding is considered to be **not significant**.

#### 3.8 Tidal (Coastal) Flooding

The Site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be **not significant**.

#### 3.9 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers). Site ground conditions suggest a low potential for groundwater flooding. The risk of flooding from groundwater flooding is considered to be **not significant**.

#### 3.10 Surface Water (Pluvial) Flooding

The Site is not situated near to large areas of poor permeability which may result in surface water flooding. The Environment Agency Surface Water flood map shows that the Site has a very low risk of surface water flooding (see Figure 5) with a chance of flooding of less than 1 in 1000 (0.1%) years.

Small areas within the vicinity of the Site have a low to high risk of surface water flooding with a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) years. These areas correspond with low spots/depressions within the vicinity of the Site however, these areas are located outside of the Site boundary.

The Site will be surfaced with permeable surfaces (crushed permeable stone which will help mitigate the effect of surface water flooding. The free draining stone will allow infiltration of rainfall. Given the scale and nature of the proposed development and the size and location of the surface water flooding sources it has been concluded that surface water flooding poses a low flood risk to the Site and the risk of surface water flooding is considered to be not significant.





Figure 5 - Environment Agency Surface Water Flood Map

#### 3.11 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment. There are no public sewers located within the vicinity of the Site therefore, the risk of flooding from sewer flooding is considered to be not significant.

# 3.12 Flooding from Artificial Drainage Systems/Infrastructure Failure

Reservoirs are located within the vicinity of the Site and is located within the confines of a corridor along the River Tyne which may be at risk of reservoir flooding. The Environment Agency flood map shows that the Site is at risk of reservoir flooding (see Figure 6). This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The Environment Agency Reservoir flood map has been prepared for emergency planning purposes and for this reason they reflect a worst-case scenario. Since this is a prediction of a worst-case scenario, it is unlikely that any actual flood would be this large.

Reservoir flooding is extremely unlikely; reservoirs in the UK have a very good safety record. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to make sure reservoirs are well maintained.

The hazard is well managed through effective legislation and it is unlikely that the impact zone downstream of these reservoirs should not allow the Proposed Development. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be not significant.





Figure 6 - Environment Agency Reservoir Flood Map

#### 3.13 The Effect of the Development on Flood Risk

The Proposed Development will have no impact on flood risk and the overall direction of the movement of water will be maintained within the developed Site and surrounding area. There will be no net loss in flood storage capacity. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the Site will not be altered; therefore, the overland flow routes will not be altered.

#### 3.14 Summary of Site Specific Flood Risk

A summary of the sources of flooding and a review of the risk posed by each source at the Site is shown in Table 4.

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

There will be no net loss in flood storage capacity or impact on movement of floodwater across the Site. The overall direction of the movement of water will be maintained within the developed Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed.

The proposed use of the Site is classed as 'essential infrastructure', 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Flood Zone 1, with a very low annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.



**Table 4 - Risk Posed by Flooding Sources** 

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	No	None Reported	None
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	No	None Reported	None
Sewer Flooding	No	None Reported	None
Flooding from Artificial Drainage Systems/Infrastructure Failure	Yes	Reservoirs	None



#### 4.0 SURFACE WATER DRAINAGE

#### 4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the Site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the Site. The assessment considers the impact of the proposals compared to current conditions. Therefore, the surface water attenuation requirement for the developed Site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the predeveloped nature of the Site. If it is an undeveloped greenfield site, then the impact of the proposals will need to be mitigated so that the runoff from the site replicates the natural drainage characteristics of the pre-developed site. The surface water drainage arrangements for any site should be such that the volumes and peak flow rates of surface water leaving a site are no greater than the rates prior to the proposed development unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance and the National Sustainable Drainage Systems (SuDS) Standards. It is necessary to demonstrate that the surface water from the proposals can be discharged safety and sustainably.

## 4.2 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA's. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance<sup>4</sup>.

The recommended precautionary sensitivity range for peak rainfall intensity are summarised in Table 5. The proposals will take into account a 45% increase in rainfall intensity due to climate change.

2050s 2070s **River Catchment** Return Period (yrs) Allowance Category Upper end +35% +40% 30 +25% +30% Central Tyne Management Catchment +45% +40% Upper end 100 +25% Central +35%

**Table 5 - Peak Rainfall Intensity Allowances** 

<sup>&</sup>lt;sup>4</sup> https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances



#### 4.3 Opportunities for Discharge of Surface Water

Possible receptors for runoff generated on Site have been assessed in line with the prioritisation set out in the Defra non-statutory technical standards for SuDS. There are four possible options to discharge the surface water. The Runoff Destination is (in order of preference):

- a) To ground;
- b) To surface water body;
- c) To road drain or surface water sewer;
- d) To combined sewer

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

#### 4.3.1 Discharge to Ground

In determining the future surface runoff from the Site, the potential of using infiltration devices has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application. Due to the Site ground conditions of Made Ground and likely contamination, the potential for the use of infiltration methods has been assessed as negligible due to the risk of contamination from the underlying Made ground and due to the low infiltration capacity. The ground conditions suggest infiltration would not provide a suitable option at the Site.

## 4.3.2 Discharge to Surface Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a surface water body. The Lemington Gut is located approximately 100m to the north east of the Site however, a direct connection to the Lemington Gut will not be possible as the land between the Site and the watercourse is in third party ownership (Cambridge Power Ltd and Stag Grid Services Ltd).

Therefore, it would not be possible to directly discharge surface water runoff from the Site into a surface water body. However, there is a short section of 1050mm diameter public surface water sewer which outfalls into the Lemington Gut. The culvert drainage survey identified the 1050mm diameter public surface water sewer as being located to the north of the Site and it was confirmed that the sewer discharges into the Lemington Gut to the north east of the Site.

The surface water runoff from the Site would be attenuated on-site before being discharged to the watercourse at Greenfield runoff rates. Any attenuated and controlled surface water discharge to the Lemington Gut would have minimal effect on the water levels of the watercourse. Therefore, it would be possible to discharge surface water runoff from the Site into a surface water body via the public surface water sewer which outfalls into the Lemington Gut.

# 4.3.3 Discharge to Road Drain, Surface Water Sewer or Combined Sewer

In the event that discharge of surface water via infiltration or discharge to a watercourse is deemed unsuitable, then discharge to the public sewer may be possible. However, at this stage



this option is not required as the surface water runoff from the Site will discharge to the Lemington Gut via a short section of public surface water sewer.

#### 4.3.4 Summary

For the purposes of this assessment the most likely scenario is as of discharging into a surface water body via the short section of the public surface water sewer which outfalls into the Lemington Gut.

#### 4.4 Surface Water Runoff

Currently the majority of rainfall infiltrates into the soil substrate and/or runoff from the Site. It is proposed that the Site will be surfaced with grass, crushed permeable stone and compacted impermeable stone or similar.

The proposed structures such as the battery containers, transformers and ancillary equipment will be situated on small concrete sleepers which will sit on and be surrounded by permeable surfaces. Any rainfall falling on this infrastructure will runoff onto permeable surfaces and therefore, they have been treated as permeable surfaces within the calculations below. The rest of the Site, including the gravel tracks, (with the exception of the substation, switchrooms, storage container and concrete sleepers upon which the transformer will be installed) will be constructed from free draining stone or grass which will allow infiltration of rainfall.

The proposed impermeable area is associated with the substation, switchrooms, storage container and concrete sleepers upon which the transformer will be installed. All other areas will be constructed in stone surfacing which will be permeable.

An estimation of surface water runoff is required to permit effective Site surface water management and prevent any increase in flood risk to off-Site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the Site has been calculated using the Institute of Hydrology (IoH124) method. Table 6 shows the IoH124 method Greenfield runoff rates calculated for the Site area of 4,680m<sup>2</sup>. The mean annual maximum flow rate from a Greenfield Site (QBAR: approximately a 2.30 year return period) has been calculated to be 2.10 litres/second (I/s) (see Appendix 4).

Rainfall Event	Runoff Rate
1	1.80
QBAR (rural)	2.10
30	3.67
100	4.36

Table 6 - IoH124 Method Greenfield Runoff Rates (I/s)

The method used for calculating the runoff complies with the NPPF, as well as the Defra non-statutory technical standards for SuDS and assumes that the excess runoff associated with the proposed development (plus an allowance for future climate change) will need to be managed by the proposed SuDS scheme.

### 4.5 Proposed SuDS Strategy

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site. The SuDS Strategy takes into account the following principles:



- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the Site.
- The proposals take into account a 45% increase in rainfall intensity due to climate change.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The Outline SuDS Strategy will take the form of:

- Permeable surfaces crushed stone.
- Attenuation storage with a restricted runoff rate of 2.00l/s before discharge to the nearby watercourse via the public surface water sewers.

The proposed SuDS Strategy is shown in Appendix 5. One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a Greenfield site prior to development.

The SuDS Strategy will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this Site. The adoption of a SuDS Strategy for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

The QBAR Greenfield runoff rate has been calculated to be 2.10l/s. Using a control device and practical minimum pipe sizes it is not practical to control the discharge rate to below 2.00l/s. Therefore, a value of 2.00l/s has been used as the limiting discharge rate before discharge into the watercourse or public sewers. The surface water runoff from the Proposed Development for all events up to and including the 1 in 100 year (+45%) event will be attenuated on Site before discharged into the public surface water sewer which outfalls into the Lemington Gut. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+45%) event. The MicroDrainage Calculations are shown in Appendix 6.

It would not be practical to include a basin, pond, or lagoon within the Site and it would also not be sustainable to install a green roof on the buildings/structures therefore, at this stage it is proposed that the attenuation storage will be provided underground. These options will be explored further during pre-construction activities with the agreement of the Environment Agency, the Local Planning Authority, the LLFA and Northumbrian Water where required and it is suggested that a suitably worded planning condition requiring the detailed drainage proposals to be submitted and approved is included in any permission.



### 4.6 Designing for Local Drainage System Failure

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the Site and this reduces the risk of flooding however, it is not possible to completely remove the risk.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground. However, this is considered unlikely in the immediate future.

The design of the Proposed Development provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur. There will not be an extensive sewerage network on the Proposed Development and therefore It is very unlikely that a catastrophic failure would occur. Exceedance flows would be contained within the permeable areas within the Site and would flow to the lower ground levels. It is not considered that there is an increased risk to the Site or properties located adjacent to the Site.

Surface water runoff would be directed to the drainage system through contouring of the hardstanding areas. When considering the impacts of a storm event that exceeds the design event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the adjacent premises and Site infrastructure from surface water runoff generated by the Proposed Development.



#### **5.0 FOUL WATER DRAINAGE**

#### 5.1 Foul Water Drainage Strategy

Development of the Site will take place with separate systems for foul and surface water drainage. The separate system will extend to the public sewer. The foul water from the welfare unit will discharge to the public combined sewer at manhole 4400.

#### **5.2 Conditions**

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage can be connected/discharged to the public sewer.

#### **5.3 Application to Make Connections**

The developer will write to Northumbrian Water requesting an application form that will be duly completed and returned. No works on the public sewer will be carried out until a letter of consent is received from Northumbrian Water.

### **5.4** Adoption Agreements

Prospective adoptable sewers and pumping stations will be designed and in constructed in accordance with 'Sewers for Adoption' as supplemented by Northumbrian Water's requirements, pursuant to an agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement will be made in writing prior to any works commencing on Site.

#### 5.5 Easements

As requested by Northumbrian Water, an easement either side of the public sewer will be maintained within the proposed Site layout.



#### **6.0 SEQUENTIAL APPROACH**

### **6.1 Sequential and Exception Tests**

The Sequential Test ensures that a sequential, risk-based approach is followed to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account. The approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The flood risk posed to the Site can be considered to be limited; the Site is located within Flood Zone 1 and has a low or less annual probability of flooding from all sources. The Site is unlikely to flood except in very extreme conditions.

Therefore, the Sequential and Exception Tests will not need to be undertaken as part of this planning application.



#### 7.0 SUMMARY AND CONCLUSIONS

#### 7.1 Introduction

This report presents a FRA in accordance with the NPPF for the Proposed Development on land at Newburn Haugh Industrial Estate, Riversdale Way, Newcastle Upon Tyne ("the Site").

This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

#### 7.2 Flood Risk

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

There will be no net loss in flood storage capacity or impact on movement of floodwater across the Site. The overall direction of the movement of water will be maintained within the developed Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed.

The proposed use of the Site is classed as 'essential infrastructure', 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Flood Zone 1, with a very low annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.

#### 7.3 SuDS Strategy

The SuDS Strategy ensures that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the Site.
- The proposals take into account a 45% increase in rainfall intensity due to climate change.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The Outline SuDS Strategy will take the form of:

- Permeable surfaces crushed stone.
- Attenuation storage with a restricted runoff rate of 2.00l/s before discharge to the nearby watercourse or public sewers.



The SuDS Strategy will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this Site. The adoption of a SuDS Strategy for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

#### 7.4 Foul Water Drainage Strategy

Development of the Site will take place with separate systems for foul and surface water drainage. The separate system will extend to the public sewer. The foul water from the welfare unit will discharge to the public combined sewer at manhole 4400.

As requested by Northumbrian Water, an easement either side of the public sewer will be maintained within the proposed Site layout.

#### 7.5 Sequential Approach

The flood risk posed to the Site can be considered to be limited; the Site is located within Flood Zone 1 and has a low or less annual probability of flooding from all sources. The Site is unlikely to flood except in very extreme conditions. Therefore, the Sequential and Exception Tests will not need to be undertaken as part of this planning application.

#### 7.6 Conclusion

In conclusion, the Site would be expected to remain dry in all but the most extreme conditions. The consequences of flooding are acceptable, and the development would be in accordance with the requirements of the NPPF. The Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-Site locations due to the adoption of a SuDS Strategy.

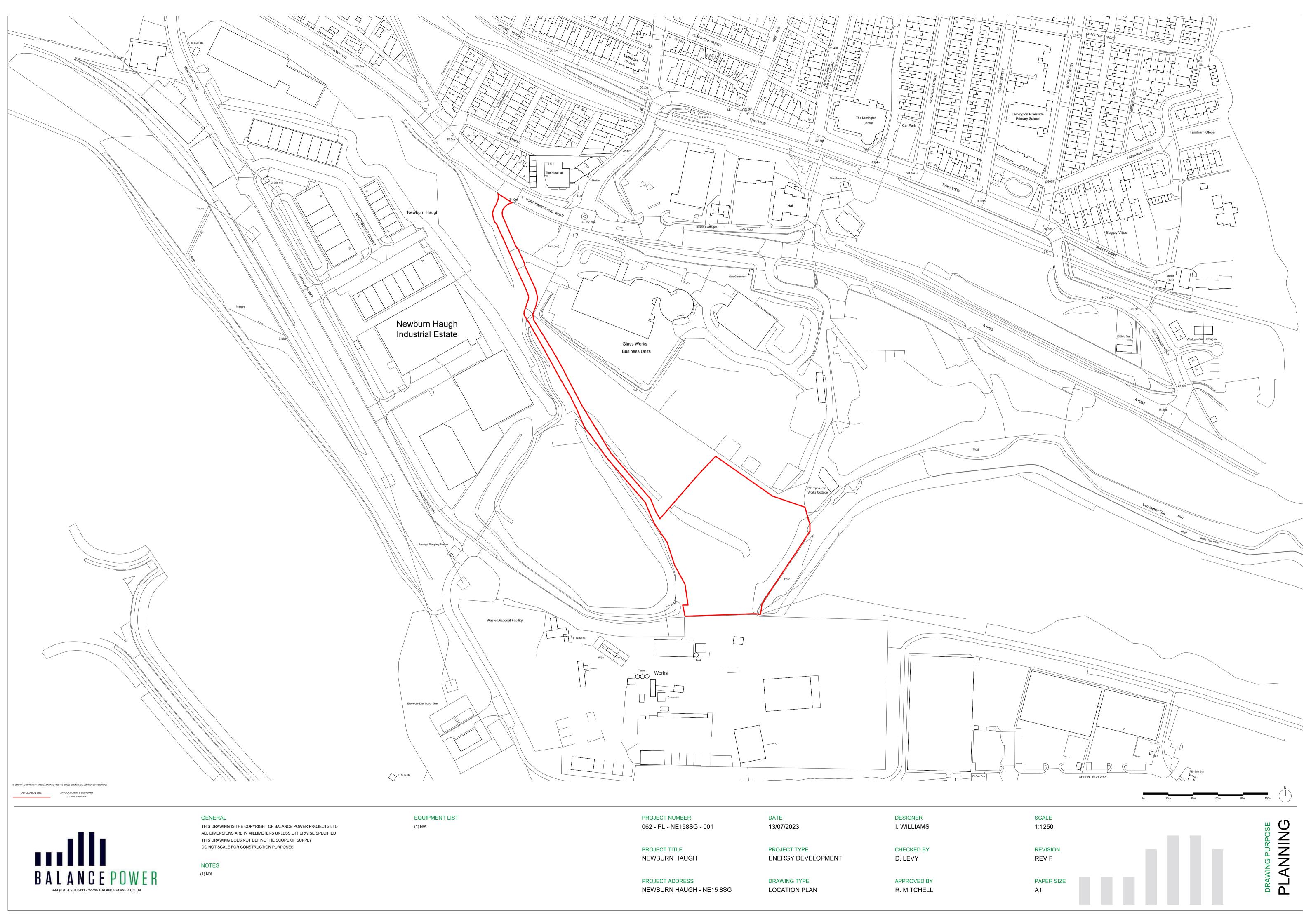
The detailed drainage design would be subject to Site investigations and it is suggested that the final configuration could be secured by a suitably worded planning condition. The Proposed Development is as appropriate use of the land and would be at low risk of flooding. With opportunities for SuDS solutions to be used. As such, planning consent should not be withheld on the grounds of flood risk or drainage.

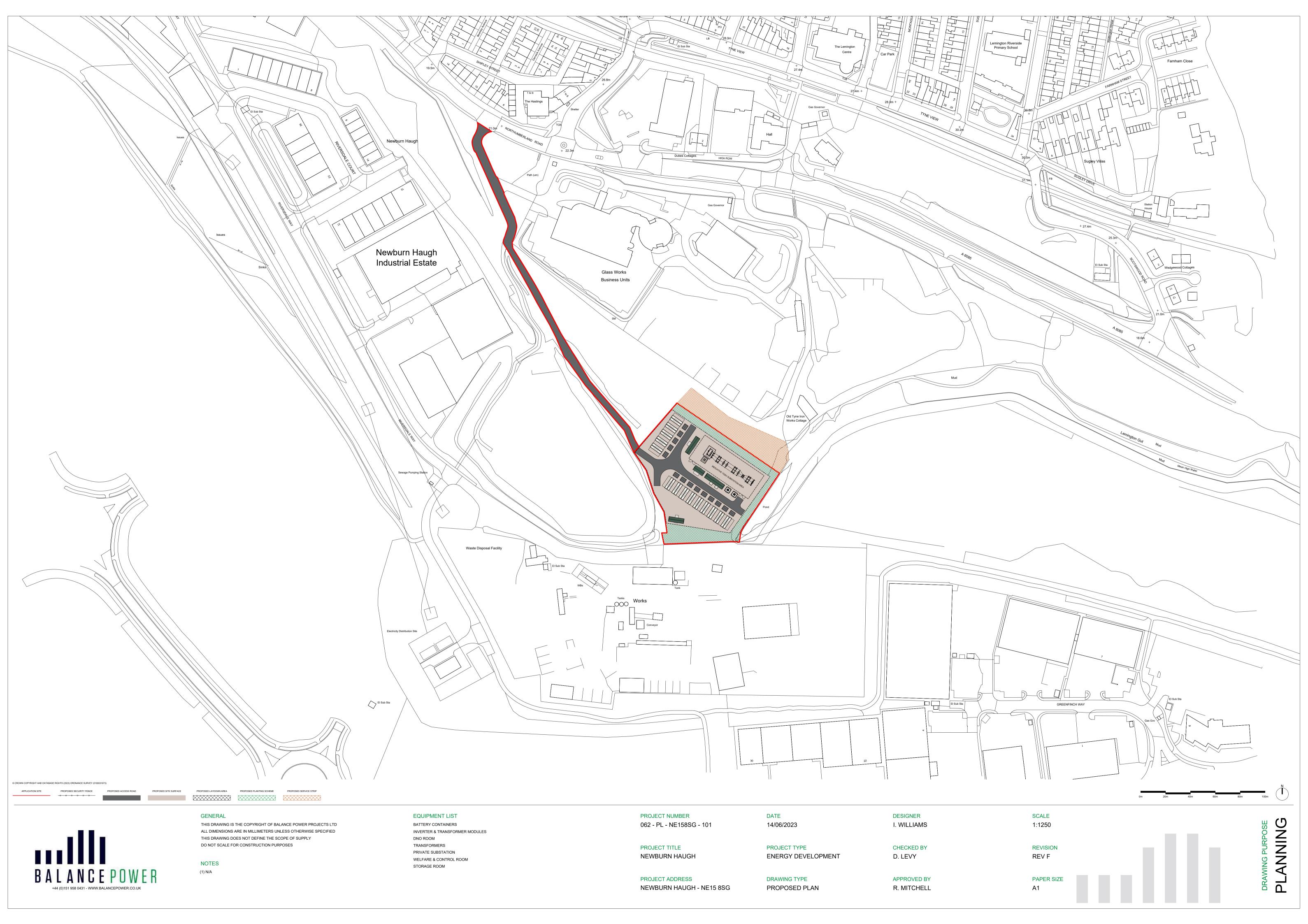


# **APPENDICES**



# **APPENDIX 1 – Existing and Proposed Site Layout**







# **APPENDIX 2 – Culvert Drainage Survey**



# CULVERT DRAINAGE SURVEY REPORT

Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG















# **CULVERT SURVEY – Summary of Findings**

Client:	Enzygo Ltd	Contact:	Ben Fleming
Site Address:	Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG	Position:	Principal Consultant
Date of Report:	7 <sup>th</sup> May 2020	Job No:	20/141

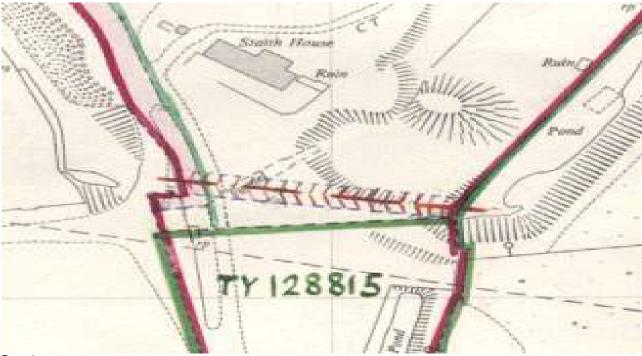
Sewer Surveys UK Limited were instructed by Enzygo Ltd to carry out a Culvert inspection survey at Newburn Haugh Industrial. Estate in Newcastle upon Tyne.

The survey was carried out on Tuesday 21st April 2020.

Site Area shown within the blue highlighted boundary line in below picture.



Having gained access to the entire site, we spent 4 hours on site trying to determine whether a culvert existing (shown in the below drawing as the red dotted line heading from West to East). We were given full and uninterrupted access to all areas of the site and also neighboring land including MGL Group site to the south.





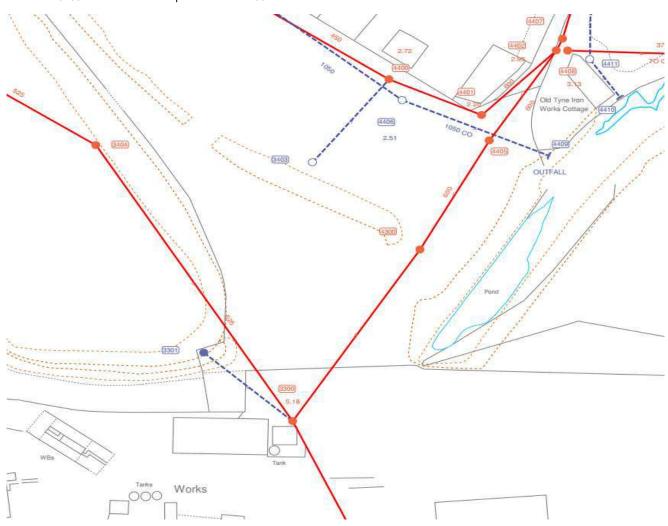
Client:	Enzygo Ltd	Contact:	Ben Fleming
Site Address:	Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG	Position:	Principal Consultant
Date of Report:	7 <sup>th</sup> May 2020	Job No:	20/141

Having explored the site in great detail using metal detectors, tracing dye, lifting manholes in and around the site, we confirm WE HAVE NOT located the assumed culvert anywhere within the area shown as per the drawing.

We have walked the area around the Lemington Gut and 100m downstream to identify any outfalls but none have been located. The only culvert located on this site is the 1050mm concrete circular culvert which is located to north west of the site flow downstream to an outfall south east of the site into the lamington gut.

We have been into the MGL Group site and spoken to a long serving employee and he also confirms he has not seen any traces of a culvert in this area. We have lifted a manhole up within there site and confirm it does have a side connection which we believe could be an old culvert which comes from the land to the west of the site. This manhole is shown on the sewer records below as MH3300.

We believe the sewer records shown in the drawing below are a true reflection of the sewers on site with the exception of the surface water drain from 3403 which could not be proven as MH4400 is buried.





Client:	Enzygo Ltd	Contact:	Ben Fleming
Site Address:	Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG	Position:	Principal Consultant
Date of Report:	7 <sup>th</sup> May 2020	Job No:	20/141

# Please find below some site photos from the survey: View inside $MH4406\,$



View of outfall downstream from MH4406



 $\begin{tabular}{ll} View of the inner site-ground conditions very high level compared to surrounding areas of the site-level compared to surrounding areas of the site-leve$ 





Client:	Enzygo Ltd	Contact:	Ben Fleming
Site Address:	Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG	Position:	Principal Consultant
Date of Report:	7 <sup>th</sup> May 2020	Job No:	20/141

View down manhole near to MGL group entrance – approx 30m from location of assumed MH3301. Full of silt, pipes contained within are 100mm. Surface water manhole.



MH3300 within MGL Group site had to be excavated out as this was buried.





Client:	Enzygo Ltd	Contact:	Ben Fleming
Site Address:	Newburn Haugh Ind.Estate, Newcastle upon Tyne, NE15 8SG	Position:	Principal Consultant
Date of Report:	7 <sup>th</sup> May 2020	Job No:	20/141

## View inside MH3300



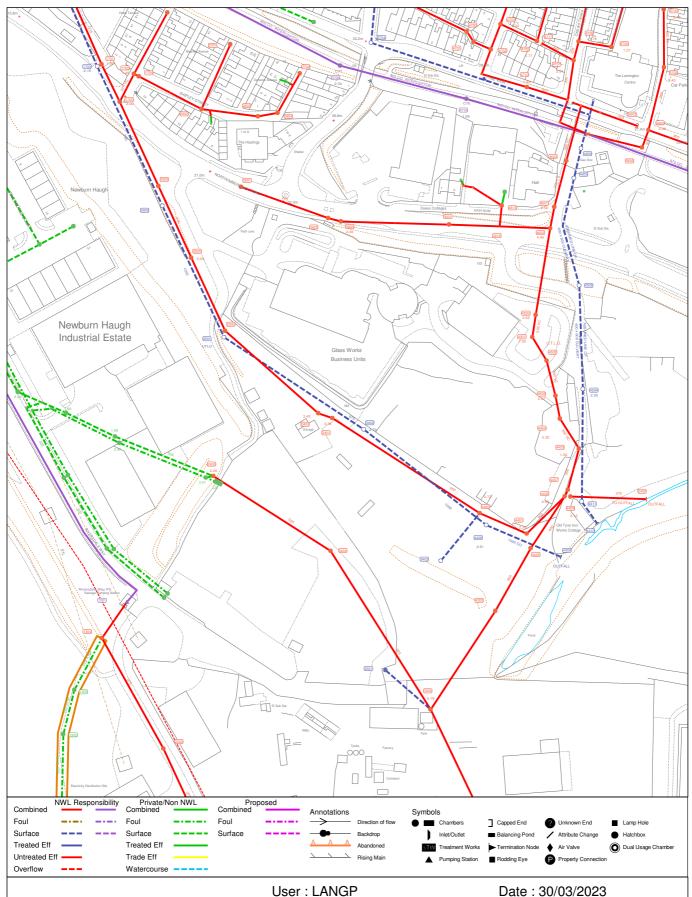
Location of MH4406



For any further questions relating to the drainage survey please do not hesitate to us.



# **APPENDIX 3 – Public Sewer Plan**



Title: 0000

Centre Point: 418327,564506

Map Sheet: NZ1864NW

The material contained on this plot has been reproduced from an Ordnance Survey map with permission of the controller of H.M.S.O. Crown Copyright Reserved. Licence No.10022480. The information shown on this plan should be regarded as approximate and is intended for guidance only. No Liability of any kind whatsoever is accepted by Northumbrian Water, it's servants or agents for any omission. The actual position of any water mains or sewers shown on the plan must be established by taking trial holes in all cases. In the case of water mains Northumbrian Water must be given two working days notice of their intention to excavate trial holes. With effect from 1 October 2011, private lateral drains and sewers automatically transferred to Northumbrian Water under a scheme made by the Secretary of State pursuant to section 105A Water Industry Act 1991. These former private drains and sewers together with existing private connections may not be shown but their presence should be anticipated. WARNING...Where indicated on the plan there could be abandoned asbestos cement materials or shards of pipe. If excavating in the vicinity of these abandoned asbestos cement materials, the appropriate Health & Safety precautions should be taken. Northumbrian Water accepts no liability in respect of claims, costs, losses or other liabilities which arise as the result of the presence of the pipes or any failure to take adequate precautions. Emergency Telephone Number: 0345 717 1100





# **APPENDIX 4 – Greenfield Runoff Calculations**



# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Emma Serjeant
Site name:	Newburn Haugh
Site location:	Newburn

Site Details

Latitude: 54.97360° N

Longitude: 1.71424° W

This is an estimation of the greenfield runoff rates that are used to meet normal best practice Reference: 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.

e: 872705120

Jul 18 2023 21:40

# Runoff estimation approach

IH124

Site characteristics

Total site area (ha):

0.468

Methodology

**QBAR** estimation method:

Calculate from SPR and SAAR

SPR estimation method:

Calculate from SOIL type

#### **Notes**

(1) Is  $Q_{BAR} < 2.0 \text{ l/s/ha}$ ?

When  $Q_{BAR}$  is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

# Soil characteristics

Default

HOST class:

SOIL type:

SPR/SPRHOST:

t	Edited	
	4	

N/A N/A

0.47 0.47

# Hydrological characteristics

Default Edited

SAAR (mm):

657 657

Hydrological region:

Growth curve factor 1 year: 0.86 0.86

-

Growth curve factor 30 years:

Growth curve factor 100

years:

Growth curve factor 200 years:

3 3 0.86 0.86 1.75 1.75 2.08 2.08

2.37

# (2) Are flow rates < 5.0 l/s?

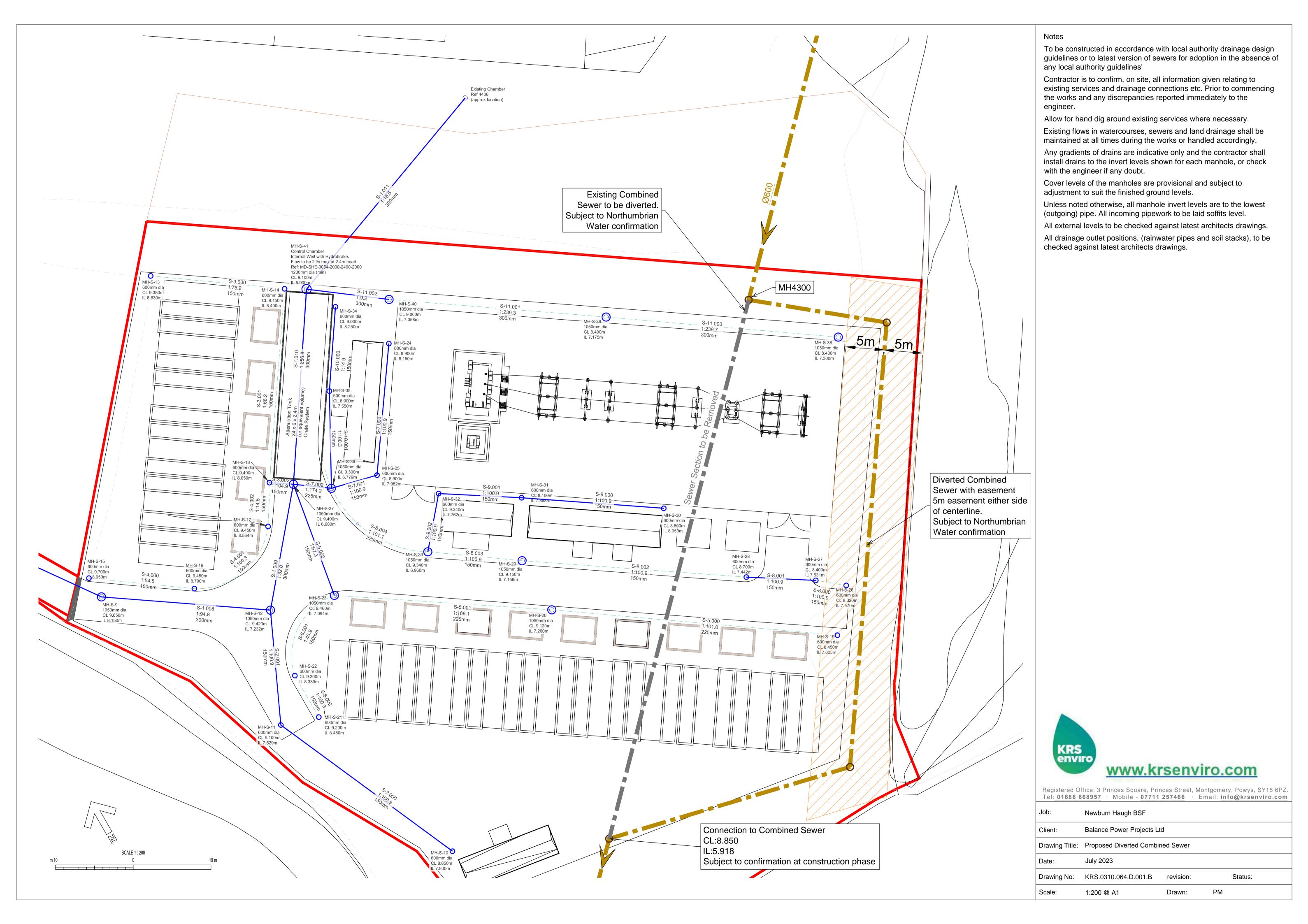
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

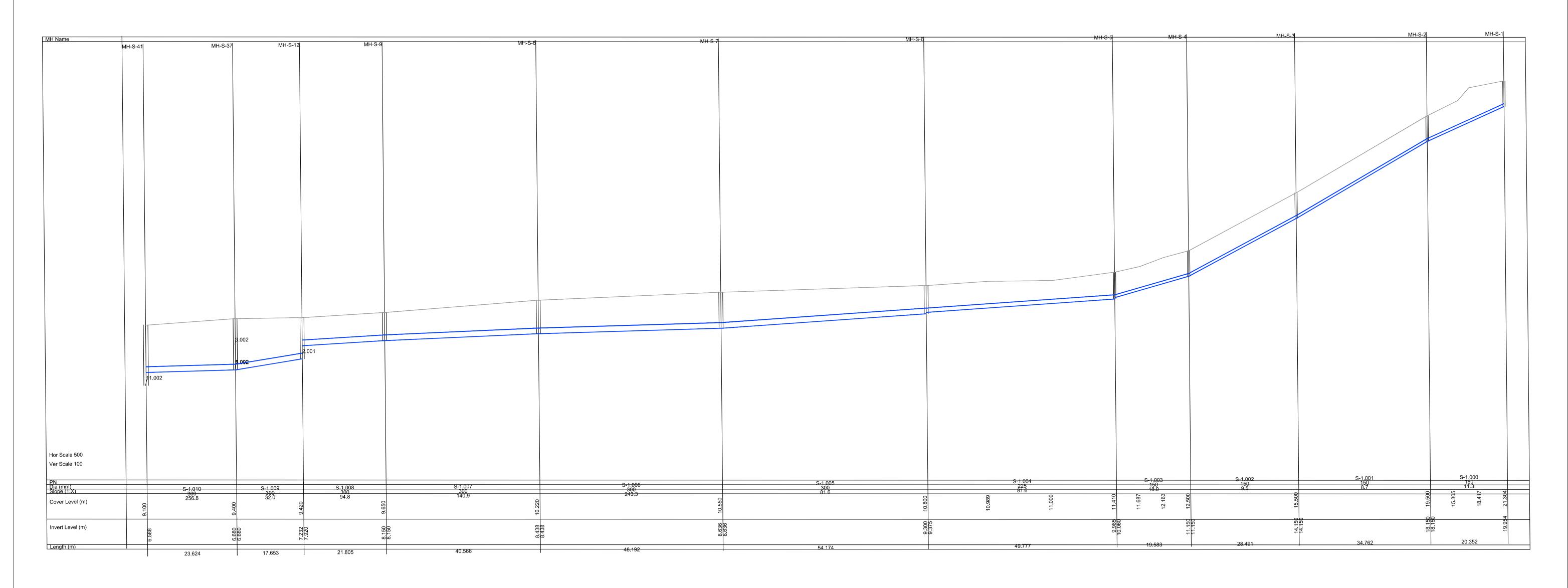
# (3) Is $SPR/SPRHOST \le 0.3$ ?

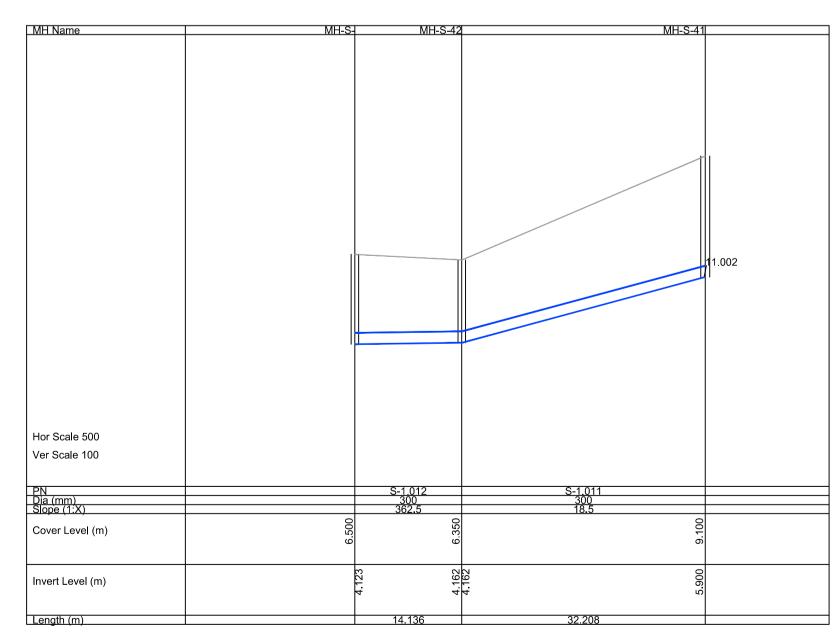
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

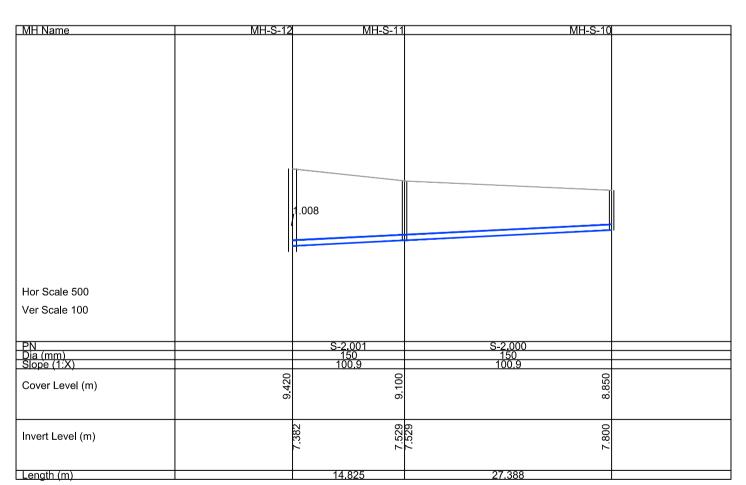


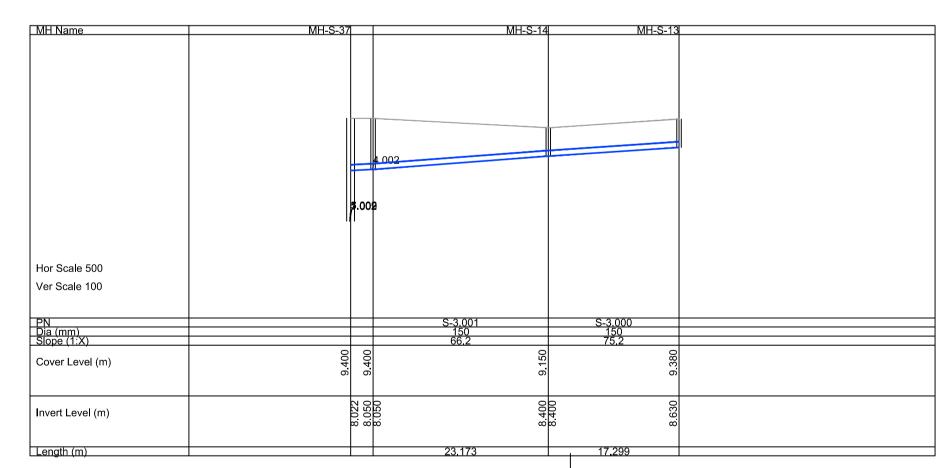
# **APPENDIX 5 – Proposed Drainage Layout**







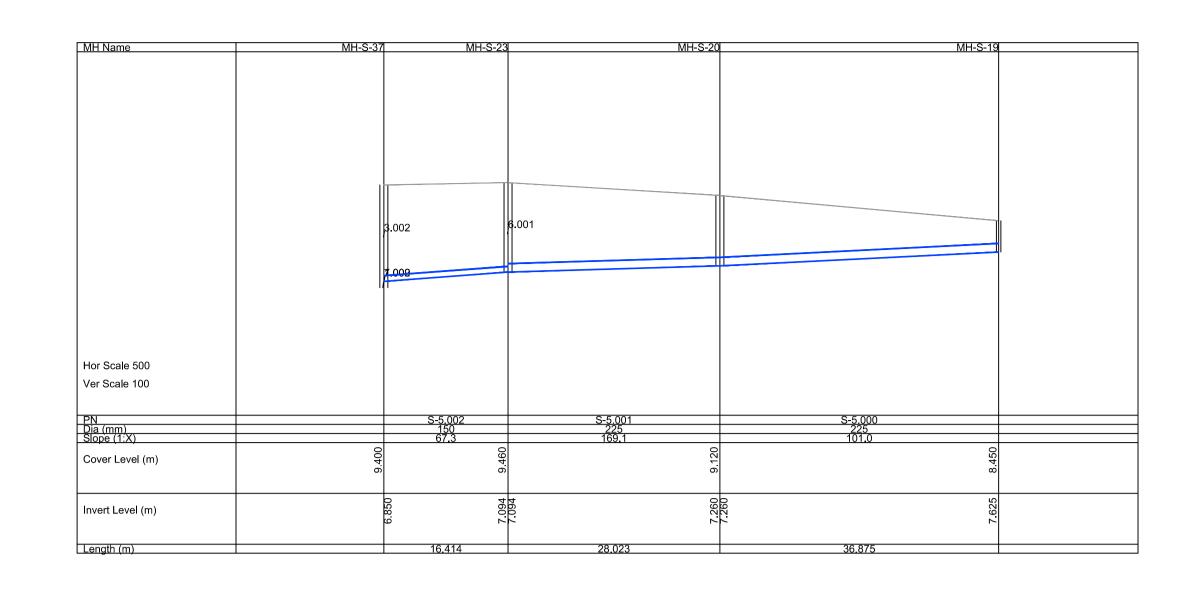




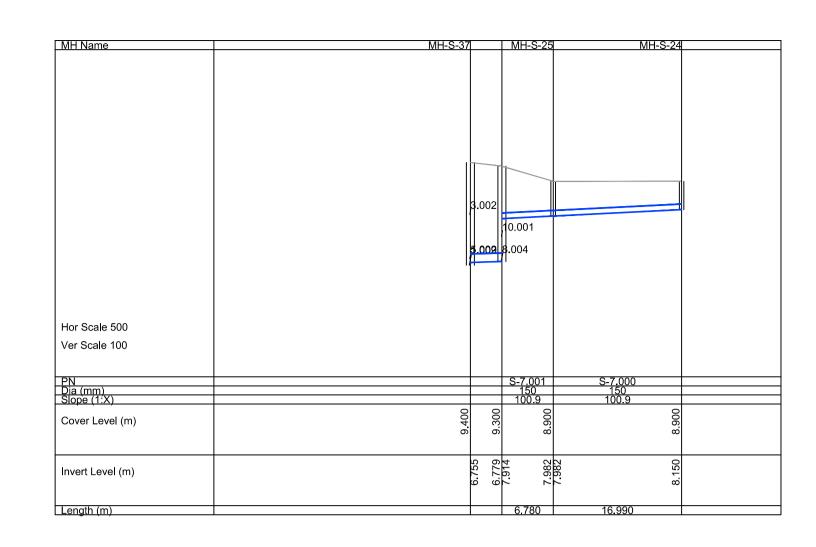


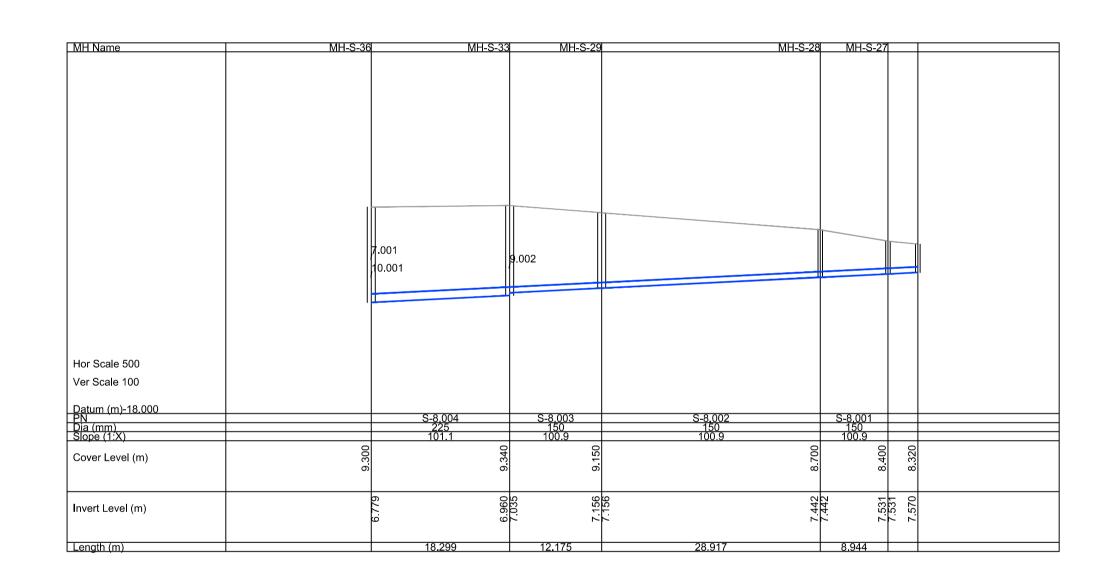
Registered Office: 3 Princes Square, Princes Street, Montgomery, Powys, SY15 6PZ.
Tel: 01686 668957 · Mobile - 07711 257466 · Email: info@krsenviro.com

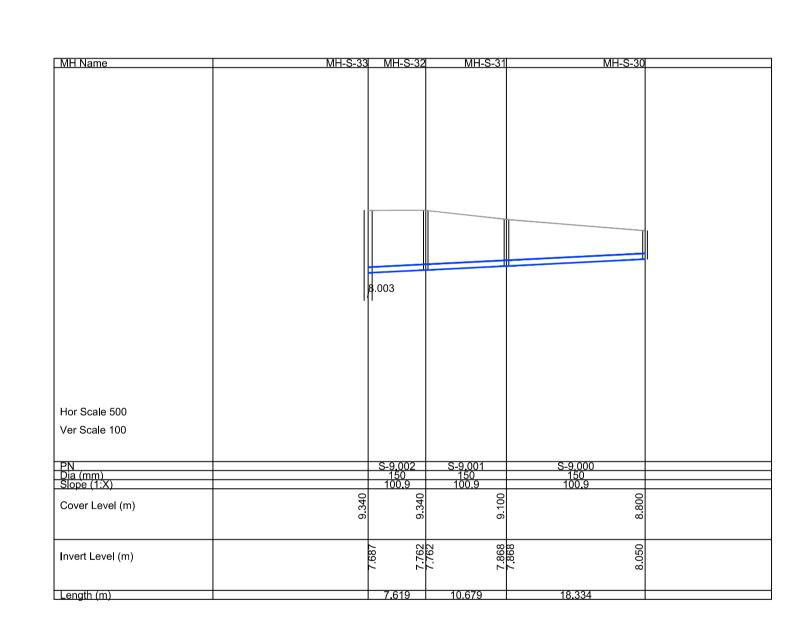
Job:	Newburn Haugh BSF									
Client:	Balance Power Projects Ltd									
Drawing Title:	Proposed Surface Water P	Proposed Surface Water Profiles (1 of 2)								
Date:	July 2023									
Drawing No:	KRS.0310.064.D.002.B	revision:		Status:						
Scale:	NTS @ A1	Drawn:	PM							

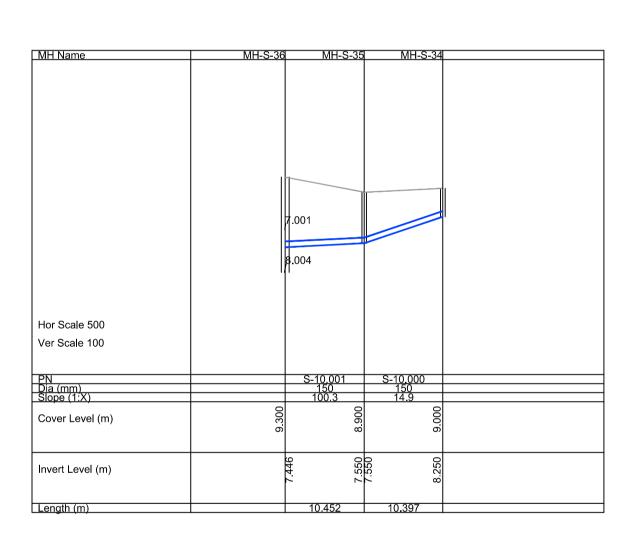


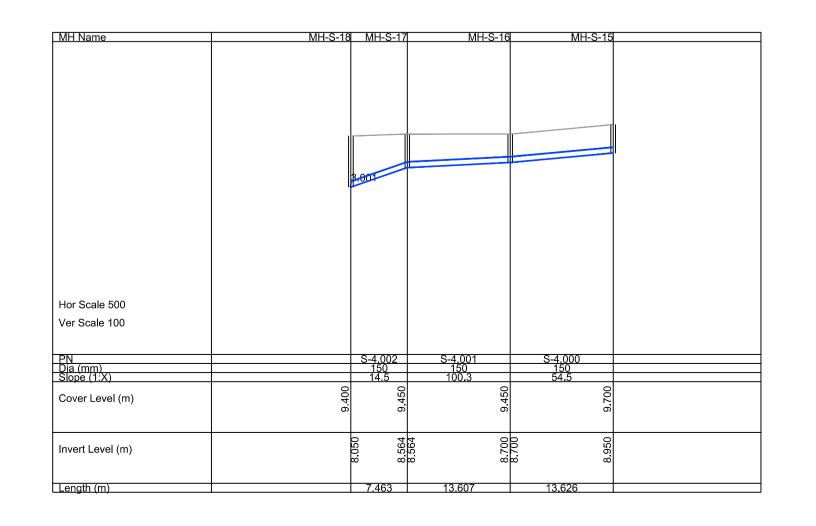
MH Name	MH-S-23	MH-S-22 N	1H-S-21	
	5.00			
Hor Scale 500 Ver Scale 100				
PN Dia (mm) Slope (1:X)		S-6,001 S 150 45.9	6-6.000 150 100.9	
Cover Level (m)	9.460	9.200	9.200	
Invert Level (m)	8.110	8.389 8.389	8.450	
Length (m)		12,798	6,161	

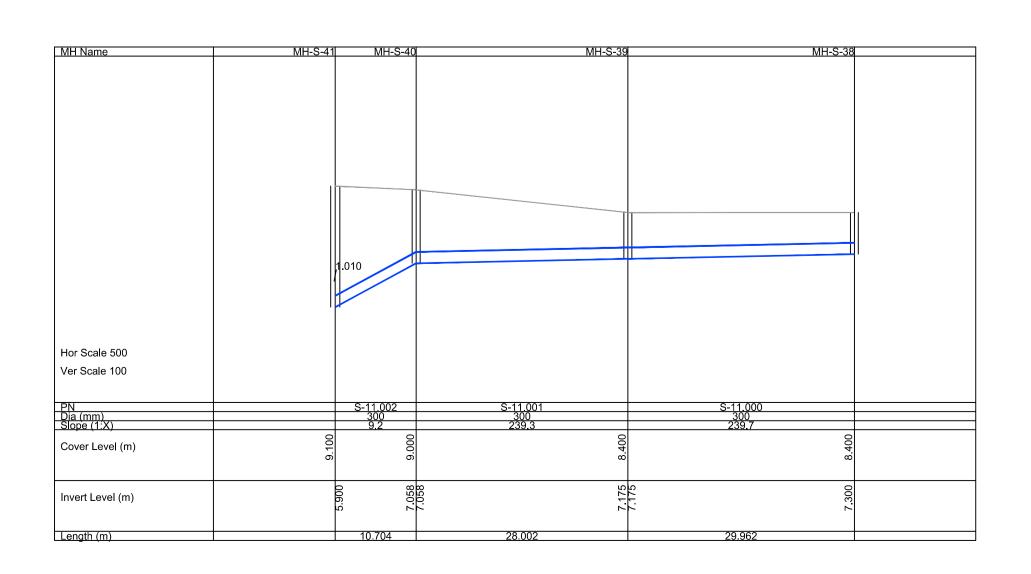














	Cover	MH Depth	Manhole	Manhole	Pipe O	out	Pipe Out Invert	Pipe Out	Pipes	s In	Pipes In	Pipes In	Pipes In
Manhole Name	Level (m)	(m)	Connection	Diam.,L*W (mm)	PN		Level (m)	Diameter (mm)	PN		Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-1	21.304	1.350	Open Manhole	600	S-1.0	000	19.954	· · · ·		_	Love. (,	(11111.)	(,
MH-S-2	19.500	1.350	Open Manhole	600	S-1.0	001	18.150	150	S-1	1.000	18.150	150	
MH-S-3	15.500	1.350	Open Manhole	600	S-1.0	002	14.150	150	S-1	1.001	14.150	150	
MH-S-4	12.500	1.350	Open Manhole	600	S-1.0	003	11.150	150	S-1	1.002	11.150	150	
MH-S-5			Open Manhole	600			9.985			1.003		150	
MH-S-6			Open Manhole	1050		_	9.300			1.004		225	
MH-S-7			Open Manhole	1050			8.636			1.005		300	
MH-S-8			Open Manhole	1050		_	8.438			1.006		300	-
MH-S-9			Open Manhole	1050			8.150		S-1	1.007	8.150	300	
MH-S-10			Open Manhole	600			7.800			200	7 520	150	
MH-S-11			Open Manhole	600			7.529			2.000		150	
MH-S-12	9.420	2.100	Open Manhole	1050	S-1.0	)09	7.232	300		2.001		300 150	-
MH-S-13	9.380	0.750	Open Manhole	600	S-3.0	000	8.630	150	<u> </u>	.001	1.002	100	
MH-S-14			Open Manhole	600			8.400		S-3	3.000	8.400	150	
MH-S-15		_	Open Manhole	600			8.950			.000	0.700	100	
MH-S-16		_	Open Manhole	600			8.700		S-4	1.000	8.700	150	
MH-S-17			Open Manhole	600			8.564			1.001		150	-
MH-S-17			Open Manhole	600	S-3.0		8.050			3.001		150	-
WII 1-0-10	3.400	1.000	Open mannois			702	0.000	100		1.002		150	
MH-S-19	8.450	0.825	Open Manhole	600	S-5.0	000	7.625	225		.00_	0.000		
MH-S-20			Open Manhole	1050			7.260		S-5	5.000	7.260	225	
MH-S-21			Open Manhole	600		_	8.450		+	.000	11		
MH-S-22			Open Manhole	600		_	8.389		S-€	5.000	8.389	150	
MH-S-23			Open Manhole	1050		_	7.094			5.001		225	-
					-	<del></del>				3.001		150	
MH-S-24	8.900	0.750	Open Manhole	600	S-7.0	000	8.150	150	+			-	
MH-S-25			Open Manhole	600			7.982		S-7	7.000	7.982	150	
MH-S-26			Open Manhole	600			7.570		+				
MH-S-27			Open Manhole	600			7.531		S-8	3.000	7.531	150	
MH-S-28			Open Manhole	600			7.442			3.001			-
MH-S-29			Open Manhole	1050			7.156			3.002		150	
MH-S-30			Open Manhole	600			8.050						
MH-S-31	9.100		Open Manhole	600			7.868	150	S-9	9.000	7.868	150	
MH-S-32	9.340	1.578	Open Manhole	600	S-9.0	002	7.762	150	S-9	9.001	7.762	150	
MH-S-33	9.340	2.380	Open Manhole	1050	S-8.0	004	6.960	225	S-8	3.003	7.035	150	
									S-9	9.002	7.687	150	652
MH-S-34	9.000	0.750	Open Manhole	600	S-10.0	000	8.250	150					
MH-S-35	8.900	1.350	Open Manhole	600	S-10.0	J01	7.550	150	S-10.	.000	7.550	150	
MH-S-36	9.300	2.521	Open Manhole	1050	S-7.0	ე02	6.779	225	S-7	7.001	7.914	150	-
	<u> </u>	<u> </u>							_	3.004			
	<u> </u>	<u> </u>							S-10.				
MH-S-37	9.400	2.720	Open Manhole	1050	S-1.0	J10	6.680	300		1.009			_
	<del>                                     </del>	ļ								3.002			
	<del></del>					$\rightarrow$				5.002			
		<u> </u>		12-0		-			S-7	7.002	6.755	225	$\leftarrow$
MH-S-38			Open Manhole	1050		_	7.300		24		- 4==		
MH-S-39			Open Manhole	1050		_	7.175		S-11.				
MH-S-40			Open Manhole	1050			7.058		S-11.				
MH-S-41	9.100	3.200	Open Manhole	1200	S-1.0	)11	5.900	300		1.010			
MH S 42	6 250	2 100	Chan Manhala	Svicting		$\rightarrow$		200	S-11.				
MH-S-42	6.350	2.100	Open Manhole	Existing		+		300	3-1,	1.011	4.162	300	
<del> </del>		+	-	+		+							
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# **APPENDIX 6 – MicroDrainage Calculations**

RS Environmental Ltd						
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File Newburn-SW-revA.MDX	Checked by	Drainage				
Micro Drainage	Network 2020.1	1				

#### STORM SEWER DESIGN by the Modified Rational Method

#### Design Criteria for Storm

Pipe Sizes SLS-1 Manhole Sizes 600mm +

FSR Rainfall Model - England and Wales

Return Period (years) 2 Foul Sewage (l/s/ha) 0.000 Maximum Backdrop Height (m) 2.000 M5-60 (mm) 18.900 Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200 Ratio R 0.350 PIMP (%) 100 Min Vel for Auto Design only (m/s) 1.00 Maximum Rainfall (mm/hr) 50 Add Flow / Climate Change (%) 0 Min Slope for Optimisation (1:X) 500 Maximum Time of Concentration (mins) 30 Minimum Backdrop Height (m) 0.500

Designed with Level Soffits

#### Network Design Table for Storm

PN	Length	Fall	Slope	I.Area	T.E.	Ba	ıse	k	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-1.000	20.352	1.804	11.3	0.011	5.00		0.0	0.600	0	150	Pipe/Conduit	€
S-1.001	34.762	4.000	8.7	0.024	0.00		0.0	0.600	0	150	Pipe/Conduit	Ā
S-1.002	28.491	3.000	9.5	0.018	0.00		0.0	0.600	0	150	Pipe/Conduit	š
S-1.003	19.583	1.090	18.0	0.015	0.00		0.0	0.600			Pipe/Conduit	_

#### Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	ΣΕ	Base	Foul	Add Flow	Vel	Cap	Flow
	(mm/hr)	(mins)	(m)	(ha)	Flow	(1/s)	(1/s)	(1/s)	(m/s)	(1/s)	(1/s)
S-1.000	50.00	5.11	19.954	0.011		0.0	0.0	0.0	3.02	53.3	1.5
S-1.001	50.00	5.28	18.150	0.035		0.0	0.0	0.0	3.44	60.8	4.7
S-1.002	50.00	5.43	14.150	0.053		0.0	0.0	0.0	3.29	58.1	7.1
s-1.003	50.00	5.56	11.150	0.067		0.0	0.0	0.0	2.39	42.2	9.1

KRS Environmental Ltd	Page 2	
Date 20/07/2023 07:21	Designed by ss	Micro
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Micro Drainage	Network 2020.1	'

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-1.004 S-1.005			81.6 81.6	0.023 0.031	0.00		0.600	0		Pipe/Conduit Pipe/Conduit	€
S-1.006 S-1.007	40.566	0.288	140.9	0.029 0.022	0.00	0.0	0.600	0	300	Pipe/Conduit Pipe/Conduit	<b>6</b>
S-1.008			94.8	0.005	0.00		0.600	0		Pipe/Conduit	•
S-2.000 S-2.001				0.005	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
S-1.009	17.653	0.552	32.0	0.000	0.00	0.0	0.600	0	300	Pipe/Conduit	•
S-3.000 S-3.001			75.2 66.2	0.006 0.017	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	€

#### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-1.004 S-1.005 S-1.006 S-1.007 S-1.008	50.00 50.00 50.00 50.00 49.73		9.300	0.090 0.121 0.150 0.172 0.177	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	1.45 1.74 1.00 1.32 1.62	57.6 123.1 70.9 93.5 114.2	12.2 16.4 20.4 23.3 23.8
S-2.000 S-2.001 S-1.009	50.00 50.00	5.70	7.800 7.529	0.005	0.0	0.0	0.0	1.00	17.7 17.7	0.7
S-3.000 S-3.001	50.00	5.25	8.630 8.400	0.182 0.006 0.023	0.0	0.0	0.0	1.16 1.24	20.5	0.8

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PN	Length	Fall	Slope	I.Area	T.E.	Ba	ıse	k	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-4.000	13.626	0.250	54.5	0.010	5.00		0.0	0.600	0	150	Pipe/Conduit	₫*
S-4.001	13.607	0.136	100.3	0.007	0.00		0.0	0.600	0	150	Pipe/Conduit	<u>-</u>
S-4.002	7.463	0.514	14.5	0.009	0.00		0.0	0.600	0	150	Pipe/Conduit	•
												•
s-3,002	2.971	0.028	104.9	0.000	0.00		0.0	0.600	0	150	Pipe/Conduit	₫*
											1 -,	•
S-5.000	36 875	0 365	101 0	0.027	5.00		0 0	0.600	0	225	Pipe/Conduit	<u> </u>
									-		± '	ð
S-5.001	28.023	0.166	169.1	0.035	0.00		0.0	0.600	0	225	Pipe/Conduit	₩.
S-6.000	6.161	0.061	100.9	0.003	5.00		0.0	0.600	0	150	Pipe/Conduit	₩.
S-6.001	12.798	0.279	45.9	0.010	0.00		0.0	0.600	0	150	Pipe/Conduit	

#### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-4.000 S-4.001 S-4.002	50.00 50.00 50.00	5.39	8.950 8.700 8.564	0.010 0.017 0.026	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.37 1.00 2.66	24.1 17.7 47.0	1.3 2.3 3.5
S-3.002	50.00	5.61	8.050	0.049	0.0	0.0	0.0	0.98	17.3	6.6
S-5.000 S-5.001	50.00 50.00		7.625 7.260	0.027 0.062	0.0	0.0	0.0	1.30 1.00	51.7 39.9	3.7 8.4
S-6.000 S-6.001	50.00		8.450 8.389	0.003 0.013	0.0	0.0	0.0	1.00 1.49	17.7 26.3	0.4

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-5.002	16.414	0.244	67.3	0.000	0.00	0.0	0.600	0	150	Pipe/Conduit	•
s-7.000	16.990	0.168	100.9	0.002	5.00	0.0	0.600	0	150	Pipe/Conduit	₩
S-7.001	6.780	0.067	100.9	0.002	0.00	0.0	0.600	0	150	Pipe/Conduit	ď
S-8.000	3.952	0.039	100.9	0.002	5.00	0.0	0.600	0	150	Pipe/Conduit	₩.
S-8.001	8.944	0.089	100.9	0.008	0.00	0.0	0.600	0	150	Pipe/Conduit	
S-8.002	28.917	0.287	100.9	0.018	0.00	0.0	0.600	0	150	Pipe/Conduit	<u>-</u>
S-8.003	12.175	0.121	100.9	0.014	0.00	0.0	0.600	0	150	Pipe/Conduit	ď
S-9.000	18.334	0.182	100.9	0.002	5.00	0.0	0.600	0	150	Pipe/Conduit	₩
S-9.001	10.679	0.106	100.9	0.003	0.00	0.0	0.600	0	150	Pipe/Conduit	<del>-</del>
S-9.002	7.619	0.075	100.9	0.002	0.00	0.0	0.600	0	150	Pipe/Conduit	ē

#### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	$\Sigma$ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-5.002	50.00	6.16	7.094	0.075	0.0	0.0	0.0	1.23	21.7	10.2
S-7.000 S-7.001	50.00 50.00		8.150 7.982	0.002	0.0	0.0	0.0	1.00	17.7 17.7	0.2
S-8.000 S-8.001 S-8.002 S-8.003	50.00 50.00 50.00 50.00	5.21 5.70	7.570 7.531 7.442 7.156	0.002 0.010 0.028 0.042	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00 1.00	17.7 17.7 17.7 17.7	0.3 1.4 3.8 5.8
S-9.000 S-9.001 S-9.002	50.00 50.00 50.00	5.48	8.050 7.868 7.762	0.002 0.004 0.007	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00	17.7 17.7 17.7	0.2 0.6 0.9

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-8.004	18.299	0.181	101.1	0.025	0.00	0.0	0.600	0	225	Pipe/Conduit	•
S-10.000 S-10.001	10.397 10.452		14.9 100.3	0.014	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
S-7.002	4.181	0.024	174.2	0.002	0.00	0.0	0.600	0	225	Pipe/Conduit	₫*
S-1.010	23.624	0.092	256.8	0.000	0.00	0.0	0.600	0	300	Pipe/Conduit	₫*
S-11.000 S-11.001 S-11.002	28.002	0.117		0.035 0.030 0.000	5.00 0.00 0.00	0.0	0.600 0.600 0.600	0 0	300	Pipe/Conduit Pipe/Conduit Pipe/Conduit	<del>0</del>

#### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	$\Sigma$ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-8.004	50.00	6.13	6.960	0.074	0.0	0.0	0.0	1.30	51.7	10.1
S-10.000 S-10.001	50.00 50.00		8.250 7.550	0.014 0.017	0.0	0.0	0.0	2.63	46.4 17.7	1.8
s-7.002	50.00	6.20	6.779	0.096	0.0	0.0	0.0	0.99	39.3	13.0
S-1.010	48.28	8.70	6.680	0.402	0.0	0.0	0.0	0.98	69.0	52.6
S-11.000	50.00	5.49	7.300	0.035	0.0	0.0	0.0	1.01	71.5	4.8
S-11.001	50.00	5.96	7.175	0.066	0.0	0.0	0.0	1.01	71.5	8.9
S-11.002	50.00	5.99	7.058	0.066	0.0	0.0	0.0	5.20	367.7	8.9
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PN Length Fall Slope I.Area T.E. Base k HYD DIA Section Type Auto (m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT (mm) Design

S-1.011 32.208 1.738 18.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit of S-1.012 14.136 0.039 362.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit

#### Network Results Table

PN Rain T.C. US/IL Σ I.Area Σ Base Foul Add Flow Vel Cap Flow (mm/hr) (mins) (m) (ha) Flow (1/s) (1/s) (1/s) (m/s) (1/s) (1/s)

S-1.011 47.88 8.84 5.900 0.468 0.0 0.0 0.0 3.67 259.4 60.7 S-1.012 50.00 5.29 4.162 0.000 10.0 0.0 0.0 0.82 58.0 10.0

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MH Name	MH CL (		MH Depth (m)	Coni	MH nection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-1	21.3	304	1.350	Open	Manhole	600	S-1.000	19.954	150				
MH-S-2	19.5	500	1.350	Open	Manhole	600	s-1.001	18.150	150	s-1.000	18.150	150	
MH-S-3	15.5	500	1.350	Open	Manhole	600	s-1.002	14.150	150	s-1.001	14.150	150	
MH-S-4	12.5	500	1.350	Open	Manhole	600	s-1.003	11.150	150	s-1.002	11.150	150	
MH-S-5	11.4	10	1.425	Open	Manhole	600	S-1.004	9.985	225	s-1.003	10.060	150	
MH-S-6	10.8	300	1.500	Open	Manhole	1050	s-1.005	9.300	300	s-1.004	9.375	225	
MH-S-7	10.5	550	1.914	Open	Manhole	1050	s-1.006	8.636	300	s-1.005	8.636	300	
MH-S-8	10.2	220	1.782	Open	Manhole	1050	s-1.007	8.438	300	s-1.006	8.438	300	
MH-S-9	9.6	550	1.500	Open	Manhole	1050	S-1.008	8.150	300	s-1.007	8.150	300	
MH-S-10	8.8	350	1.050	Open	Manhole	600	S-2.000	7.800	150				
MH-S-11	9.1	.00	1.571	Open	Manhole	600	s-2.001	7.529	150	s-2.000	7.529	150	
MH-S-12	9.4	20	2.188	Open	Manhole	1050	s-1.009	7.232	300	s-1.008	7.920	300	688
										s-2.001	7.382	150	
MH-S-13	9.3	880	0.750	Open	Manhole	600	s-3.000	8.630	150				
MH-S-14	9.1	.50	0.750	Open	Manhole	600	s-3.001	8.400	150	s-3.000	8.400	150	
MH-S-15	9.7	00	0.750	Open	Manhole	600	S-4.000	8.950	150				
MH-S-16	9.4	150	0.750	Open	Manhole	600	S-4.001	8.700	150	s-4.000	8.700	150	
MH-S-17	9.4	150	0.886	Open	Manhole	600	S-4.002	8.564	150	s-4.001	8.564	150	
MH-S-18	9.4	100	1.350	Open	Manhole	600	s-3.002	8.050	150	s-3.001	8.050	150	
										s-4.002	8.050	150	
MH-S-19	8.4	150	0.825	Open	Manhole	600	s-5.000	7.625	225				
MH-S-20	9.1	.20	1.860	Open	Manhole	1050	s-5.001	7.260	225	s-5.000	7.260	225	
MH-S-21	9.2	200	0.750	Open	Manhole	600	s-6.000	8.450	150				
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MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-22	9.200	0.811	Open Manhole	600	S-6.001	8.389	150	S-6.000	8.389	150	
MH-S-23	9.460	2.366	Open Manhole	1050	S-5.002	7.094	150	S-5.001	7.094	225	
								S-6.001	8.110	150	1016
MH-S-24	8.900	0.750	Open Manhole	600	s-7.000	8.150	150				
MH-S-25	8.900	0.918	Open Manhole	600	s-7.001	7.982	150	S-7.000	7.982	150	
MH-S-26	8.320	0.750	Open Manhole	600	S-8.000	7.570	150				
MH-S-27	8.400	0.869	Open Manhole	600	S-8.001	7.531	150	S-8.000	7.531	150	
MH-S-28	8.700	1.258	Open Manhole	600	S-8.002	7.442	150	S-8.001	7.442	150	
MH-S-29	9.150	1.994	Open Manhole	1050	S-8.003	7.156	150	S-8.002	7.156	150	
MH-S-30	8.800	0.750	Open Manhole	600	S-9.000	8.050	150				
MH-S-31	9.100	1.232	Open Manhole	600	S-9.001	7.868	150	S-9.000	7.868	150	
MH-S-32	9.340	1.578	Open Manhole	600	S-9.002	7.762	150	S-9.001	7.762	150	
MH-S-33	9.340	2.380	Open Manhole	1050	S-8.004	6.960	225	S-8.003	7.035	150	
								S-9.002	7.687	150	652
MH-S-34	9.000	0.750	Open Manhole	600	S-10.000	8.250	150				
MH-S-35	8.900	1.350	Open Manhole	600	S-10.001	7.550	150	S-10.000	7.550	150	
MH-S-36	9.300	2.521	Open Manhole	1050	S-7.002	6.779	225	S-7.001	7.914	150	1060
								S-8.004	6.779	225	
								S-10.001	7.446	150	592
MH-S-37	9.400	2.720	Open Manhole	1050	S-1.010	6.680	300	S-1.009	6.680	300	
								S-3.002	8.022	150	1192
								S-5.002	6.850	150	20
								S-7.002	6.755	225	
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MH Name	MH CL (m)	MH Depth (m)		MH nection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-38	8.400	1.100	Open	Manhole	1050	S-11.000	7.300	300				
MH-S-39	8.400	1.225	Open	Manhole	1050	s-11.001	7.175	300	s-11.000	7.175	300	
MH-S-40	9.000	1.942	Open	Manhole	1050	S-11.002	7.058	300	s-11.001	7.058	300	
MH-S-41	9.100	3.200	Open	Manhole	1200	S-1.011	5.900	300	S-1.010	6.588	300	688
									S-11.002	5.900	300	
MH-S-42	6.350	2.188	Open	Manhole	1000	S-1.012	4.162	300	S-1.011	4.162	300	
MH-S-	6.500	2.377	Open	Manhole	1000		OUTFALL		S-1.012	4.123	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-1	418218.177	564656.696	418218.177	564656.696	Required	•
MH-S-2	418217.419	564636.359	418217.419	564636.359	Required	
MH-S-3	418230.888	564604.312	418230.888	564604.312	Required	
MH-S-4	418242.414	564578.257	418242.414	564578.257	Required	1

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-5	418243.918	564558.732	418243.918	564558.732	Required	
MH-S-6	418269.068	564515.776	418269.068	564515.776	Required	
MH-S-7	418294.334	564467.855	418294.334	564467.855	Required	
MH-S-8	418323.940	564429.830	418323.940	564429.830	Required	
MH-S-9	418347.372	564396.716	418347.372	564396.716	Required	
MH-S-10	418370.109	564345.830	418370.109	564345.830	Required	6
MH-S-11	418359.115	564370.915	418359.115	564370.915	Required	4
MH-S-12	418365.344	564384.368	418365.344	564384.368	Required	
MH-S-13	418373.491	564429.297	418373.491	564429.297	Required	, Q
MH-S-14	418387.573	564419.248	418387.573	564419.248	Required	
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-15	418347.184	564399.604	418347.184	564399.604	Required	•
MH-S-16	418358.254	564391.659	418358.254	564391.659	Required	1
MH-S-17	418370.457	564393.844	418370.457	564393.844	Required	
MH-S-18	418374.456	564400.144	418374.456	564400.144	Required	
MH-S-19	418426.874	564345.131	418426.874	564345.131	Required	
MH-S-20	418396.692	564366.318	418396.692	564366.318	Required	<b>So.</b>
MH-S-21	418363.851	564369.353	418363.851	564369.353	Required	Ţ
MH-S-22	418363.851	564375.514	418363.851	564375.514	Required	
MH-S-23	418373.407	564381.908	418373.407	564381.908	Required	
MH-S-24	418395.667	564406.447	418395.667	564406.447	Required	,
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-25	418385.888	564392.553	418385.888	564392.553	Required	V
MH-S-26	418431.043	564350.108	418431.043	564350.108	Required	<b>\</b>
MH-S-27	418427.989	564352.616	418427.989	564352.616	Required	6
MH-S-28	418420.465	564357.451	418420.465	564357.451	Required	6
MH-S-29	418396.545	564373.700	418396.545	564373.700	Required	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
MH-S-30	418415.688	564370.425	418415.688	564370.425	Required	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
MH-S-31	418400.533	564380.743	418400.533	564380.743	Required	<b>So.</b>
MH-S-32	418391.570	564386.546	418391.570	564386.546	Required	0.
MH-S-33	418386.621	564380.753	418386.621	564380.753	Required	X
MH-S-34	418392.082	564413.970	418392.082	564413.970	Required	,
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		@I 90	2-2020 Inno	vyze		

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-35	418386.310	564405.322	418386.310	564405.322	Required	p/
MH-S-36	418380.483	564396.645	418380.483	564396.645	Required	
MH-S-37	418376.535	564398.021	418376.535	564398.021	Required	
MH-S-38	418446.130	564378.270	418446.130	564378.270	Required	4
MH-S-39	418421.568	564395.429	418421.568	564395.429	Required	<b>So.</b>
MH-S-40	418398.528	564411.342	418398.528	564411.342	Required	6
MH-S-41	418389.815	564417.559	418389.815	564417.559	Required	
MH-S-42	418419.965	564428.888	418419.965	564428.888	Required	
MH-S-	418427.558	564416.965			No Entry	

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#### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.000	0	150	MH-S-1	21.304	19.954	1.200	Open Manhole	600
S-1.001	0	150	MH-S-2	19.500	18.150	1.200	Open Manhole	600
S-1.002	0	150	MH-S-3	15.500	14.150	1.200	Open Manhole	600
S-1.003	0	150	MH-S-4	12.500	11.150	1.200	Open Manhole	600
S-1.004	0	225	MH-S-5	11.410	9.985	1.200	Open Manhole	600
S-1.005	0	300	MH-S-6	10.800	9.300	1.200	Open Manhole	1050
S-1.006	0	300	MH-S-7	10.550	8.636	1.614	Open Manhole	1050
S-1.007	0	300	MH-S-8	10.220	8.438	1.482	Open Manhole	1050
S-1.008	0	300	MH-S-9	9.650	8.150	1.200	Open Manhole	1050
S-2.000	0	150	MH-S-10	8.850	7.800	0.900	Open Manhole	600
S-2.001	0	150	MH-S-11	9.100	7.529	1.421	Open Manhole	600

#### <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.000	20.352	11.3	MH-S-2	19.500	18.150	1.200	Open Manhole	600
S-1.001	34.762	8.7	MH-S-3	15.500	14.150	1.200	Open Manhole	600
S-1.002	28.491	9.5	MH-S-4	12.500	11.150	1.200	Open Manhole	600
S-1.003	19.583	18.0	MH-S-5	11.410	10.060	1.200	Open Manhole	600
S-1.004	49.777	81.6	MH-S-6	10.800	9.375	1.200	Open Manhole	1050
S-1.005	54.174	81.6	MH-S-7	10.550	8.636	1.614	Open Manhole	1050
S-1.006	48.192	243.3	MH-S-8	10.220	8.438	1.482	Open Manhole	1050
S-1.007	40.566	140.9	MH-S-9	9.650	8.150	1.200	Open Manhole	1050
S-1.008	21.805	94.8	MH-S-12	9.420	7.920	1.200	Open Manhole	1050
S-2.000	27.388	100.9	MH-S-11	9.100	7.529	1.421	Open Manhole	600
S-2.001	14.825	100.9	MH-S-12	9.420	7.382	1.888	Open Manhole	1050
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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.009	0	300	MH-S-12	9.420	7.232	1.888	Open Manhole	1050
S-3.000 S-3.001	0		MH-S-13 MH-S-14	9.380 9.150	8.630 8.400		Open Manhole Open Manhole	600 600
S-4.000 S-4.001 S-4.002	0	150	MH-S-15 MH-S-16 MH-S-17	9.700 9.450 9.450	8.950 8.700 8.564	0.600	Open Manhole Open Manhole Open Manhole	600 600 600
s-3.002	0	150	MH-S-18	9.400	8.050	1.200	Open Manhole	600

## <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.009	17.653	32.0	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
S-3.000 S-3.001			MH-S-14 MH-S-18	9.150 9.400	8.400 8.050		Open Manhole Open Manhole	
			MH-S-16	9.450	8.700		Open Manhole	600
			MH-S-17 MH-S-18	9.450	8.564 8.050		Open Manhole Open Manhole	
S-3.002	2.971	104.9	MH-S-37	9.400	8.022	1.228	Open Manhole	1050

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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-5.000 S-5.001	0		MH-S-19 MH-S-20	8.450 9.120	7.625 7.260		Open Manhole Open Manhole	600 1050
S-6.000 S-6.001	0		MH-S-21 MH-S-22	9.200 9.200	8.450 8.389		Open Manhole Open Manhole	600 600
S-5.002	0	150	MH-S-23	9.460	7.094	2.216	Open Manhole	1050
S-7.000 S-7.001	0		MH-S-24 MH-S-25	8.900 8.900	8.150 7.982		Open Manhole Open Manhole	600 600
S-8.000	0	150	MH-S-26	8.320	7.570	0.600	Open Manhole	600

## Downstream Manhole

PN	Length (m)	Slope (1:X)		C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
s-5.000	36.875	101.0	MH-S-20	9.120	7.260	1.635	Open Manhole	1050
S-5.001	28.023	169.1	MH-S-23	9.460	7.094	2.141	Open Manhole	1050
S-6.000	6.161	100.9	MH-S-22	9.200	8.389	0.661	Open Manhole	600
S-6.001	12.798	45.9	MH-S-23	9.460	8.110	1.200	Open Manhole	1050
S-5.002	16.414	67.3	MH-S-37	9.400	6.850	2.400	Open Manhole	1050
S-7.000	16.990	100.9	MH-S-25	8.900	7.982	0.768	Open Manhole	600
S-7.001	6.780	100.9	MH-S-36	9.300	7.914	1.236	Open Manhole	1050
S-8.000	3.952	100.9	MH-S-27	8.400	7.531	0.719	Open Manhole	600

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#### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-8.001	0	150	MH-S-27	8.400	7.531	0.719	Open Manhole	600
S-8.002	0	150	MH-S-28	8.700	7.442	1.108	Open Manhole	600
S-8.003	0	150	MH-S-29	9.150	7.156	1.844	Open Manhole	1050
S-9.000	0	150	MH-S-30	8.800	8.050	0.600	Open Manhole	600
S-9.001	0	150	MH-S-31	9.100	7.868	1.082	Open Manhole	600
S-9.002	0	150	MH-S-32	9.340	7.762	1.428	Open Manhole	600
S-8.004	0	225	MH-S-33	9.340	6.960	2.155	Open Manhole	1050
s-10.000	0	150	MH-S-34	9.000	8.250	0.600	Open Manhole	600
S-10.001	0	150	MH-S-35	8.900	7.550	1.200	Open Manhole	600

#### <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)		C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-8.001	8.944	100.9	MH-S-28	8.700	7.442	1.108	Open Manhole	600
S-8.002	28.917	100.9	MH-S-29	9.150	7.156	1.844	Open Manhole	1050
S-8.003	12.175	100.9	MH-S-33	9.340	7.035	2.155	Open Manhole	1050
s-9.000	18.334	100.9	MH-S-31	9.100	7.868	1.082	Open Manhole	600
S-9.001	10.679	100.9	MH-S-32	9.340	7.762	1.428	Open Manhole	600
S-9.002	7.619	100.9	MH-S-33	9.340	7.687	1.503	Open Manhole	1050
S-8.004	18.299	101.1	MH-S-36	9.300	6.779	2.296	Open Manhole	1050
S-10.000	10.397	14.9	MH-S-35	8.900	7.550	1.200	Open Manhole	600
S-10.001	10.452	100.3	MH-S-36	9.300	7.446	1.704	Open Manhole	1050
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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-7.002	0	225	MH-S-36	9.300	6.779	2.296	Open Manhole	1050
S-1.010	0	300	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
S-11.000	0	300	MH-S-38	8.400	7.300	0.800	Open Manhole	1050
S-11.001	0	300	MH-S-39	8.400	7.175	0.925	Open Manhole	1050
S-11.002	0	300	MH-S-40	9.000	7.058	1.642	Open Manhole	1050
S-1.011	0	300	MH-S-41	9.100	5.900	2.900	Open Manhole	1200
S-1.012	0	300	MH-S-42	6.350	4.162	1.888	Open Manhole	1000

## Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH	DIAM., L*	W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection		(mm)	
S-7.002	4.181	174.2	MH-S-37	9.400	6.755	2.420	Open Manhole		105	50
S-1.010	23.624	256.8	MH-S-41	9.100	6.588	2.212	Open Manhole		120	0 (
S-11.000	29.962	239.7	MH-S-39	8.400	7.175	0.925	Open Manhole		105	50
S-11.001	28.002	239.3	MH-S-40	9.000	7.058	1.642	Open Manhole		105	50
S-11.002	10.704	9.2	MH-S-41	9.100	5.900	2.900	Open Manhole		120	0 (
s-1.011	32.208	18.5	MH-S-42	6.350	4.162	1.888	Open Manhole		100	0 (
S-1.012	14.136	362.5	MH-S-	6.500	4.123	2.077	Open Manhole		100	0 (

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#### Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Type	Name	(%)	Area (ha)	Area (ha)	(ha)
1.000	User	_	100	0.011	0.011	0.011
1.001	User	_	100	0.024	0.024	0.024
1.002	User	_	100	0.018	0.018	0.018
1.003	User	_	100	0.015	0.015	0.015
1.004	User	_	100	0.023	0.023	0.023
1.005	User	_	100	0.031	0.031	0.031
1.006	User	_	100	0.029	0.029	0.029
1.007	User	_	100	0.022	0.022	0.022
1.008	User	_	100	0.005	0.005	0.005
2.000	User	_	100	0.005	0.005	0.005
2.001	-	_	100	0.000	0.000	0.000
1.009	_	_	100	0.000	0.000	0.000
3.000	User	_	50	0.012	0.006	0.006
3.001	User	-	50	0.035	0.017	0.017
4.000	User	_	100	0.007	0.007	0.007
	User	-	30	0.011	0.003	0.010
4.001	User	-	100	0.007	0.007	0.007
4.002	User	-	50	0.015	0.007	0.007
	User	-	50	0.003	0.001	0.009
3.002	-	-	100	0.000	0.000	0.000
5.000	User	-	50	0.055	0.027	0.027
5.001	User	-	50	0.046	0.023	0.023
	User	-	30	0.039	0.012	0.035
6.000	User	-	100	0.002	0.002	0.002
	User	_	30	0.004	0.001	0.003
6.001	User	-	100	0.008	0.008	0.008
	User	-	30	0.009	0.003	0.010
5.002	-	-	100	0.000	0.000	0.000
7.000	User	-	100	0.002	0.002	0.002
7.001	User	-	100	0.002	0.002	0.002
8.000	User	-	100	0.002	0.002	0.002
8.001	User	-	100	0.008	0.008	0.008
	User	_	50	0.002	0.001	0.008
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# Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Туре	Name	(%)	Area (ha)	Area (ha)	(ha)
8.002	User	-	100	0.011	0.011	0.011
	User	-	50	0.002	0.001	0.012
	User	-	52	0.002	0.001	0.013
	User	-	100	0.002	0.002	0.015
	User	-	30	0.007	0.002	0.018
8.003	User	-	100	0.010	0.010	0.010
	User	-	100	0.001	0.001	0.011
	User	-	100	0.002	0.002	0.014
	User	-	30	0.002	0.001	0.014
9.000	User	-	100	0.002	0.002	0.002
9.001	User	_	100	0.002	0.002	0.002
	User	-	100	0.001	0.001	0.003
9.002	User	_	100	0.002	0.002	0.002
8.004	User	-	100	0.021	0.021	0.021
	User	_	30	0.003	0.001	0.022
	User	_	30	0.010	0.003	0.025
10.000	User	_	100	0.012	0.012	0.012
	User	_	30	0.004	0.001	0.014
10.001	User	_	100	0.002	0.002	0.002
	User	_	30	0.004	0.001	0.003
7.002	User	_	100	0.002	0.002	0.002
1.010	-	_	100	0.000	0.000	0.000
11.000	User	_	50	0.071	0.035	0.035
11.001	User	-	50	0.060	0.030	0.030
11.002	-	_	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
1.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.684	0.468	0.468

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#### Simulation Criteria for Storm

Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800

Areal Reduction Factor 1.000 Foul Sewage per hectare (1/s) 0.000 Flow per Person per Day (1/per/day) 0.000

Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60

Hot Start Level (mm) 0 MADD Factor \* 10m<sup>3</sup>/ha Storage 0.000 Output Interval (mins) 1

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Return Period (years) 2 Ratio R 0.350 Cv (Winter) 0.840 Region England and Wales Profile Type Summer Storm Duration (mins) 30

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#### Online Controls for Storm

#### Hydro-Brake® Optimum Manhole: MH-S-41, DS/PN: S-1.011, Volume (m³): 5.9

Unit Reference	MD-SHE-0054-2000-2400-2000	Sump Available	Yes
Design Head (m)	2.400	Diameter (mm)	54
Design Flow $(1/s)$	2.0	Invert Level (m) 5.	900
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm) 1	200
Application	Surface		

Control Points	Head (m)	Flow (1/s)	Control Points	Head (m)	Flow (1/s)
Design Point (Calculated)	2.400	2.0	Kick-Flo®	0.488	1.0
Flush-Flo™	0.242	1.2	Mean Flow over Head Range	_	1.4

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 (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)
0.100	1.1	0.600	1.1	1.600	1.7	2.600	2.1	5.000	2.8	7.500	3.4
0.200	1.2	0.800	1.2	1.800	1.8	3.000	2.2	5.500	2.9	8.000	3.5
0.300	1.2	1.000	1.3	2.000	1.8	3.500	2.4	6.000	3.1	8.500	3.6
0.400	1.1	1.200	1.5	2.200	1.9	4.000	2.5	6.500	3.2	9.000	3.7
0.500	1.0	1.400	1.6	2.400	2.0	4.500	2.7	7.000	3.3	9.500	3.8

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## Offline Controls for Storm

Weir Manhole: MH-S-41, DS/PN: S-1.011, Loop to PN: S-1.012

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 8.300

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#### Storage Structures for Storm

### Filter Drain Manhole: MH-S-26, DS/PN: S-8.000

Infiltration Coefficient Base (m/hr	) 0.00000	Trench Width (	(m)	0.7	Slope (1:X)	240.0
Infiltration Coefficient Side (m/hr	) 0.00000	Trench Length (	(m)	4.0	Cap Volume Depth (m)	0.000
Safety Facto	r 2.0	Pipe Diameter (	(m) (	0.150 Cap	Infiltration Depth (m)	0.000
Porosit	y 0.30	Pipe Depth above Invert (	(m) (	0.075		
Invert Level (m	7.570	Number of Pir	ne s	1		

#### Filter Drain Manhole: MH-S-28, DS/PN: S-8.002

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m	n) 0.7	Slope (1:X) 100.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m	n) 29.0	Cap Volume Depth (m) 0.000
Safety Factor	2.0	Pipe Diameter (m	n) 0.150	Cap Infiltration Depth (m) 0.000
Porosity	0.30	Pipe Depth above Invert (m	n) 0.075	
Invert Level (m)	7.442	Number of Pipe	es 1	

#### Filter Drain Manhole: MH-S-39, DS/PN: S-11.001

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width	(m)	0.7	Slope (1:X) 240.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length	(m)	30.0	Cap Volume Depth (m) 0.000
Safety Factor	2.0	Pipe Diameter	(m)	0.300	Cap Infiltration Depth (m) 0.000
Porosity	0.30	Pipe Depth above Invert	(m)	0.075	
Invert Level (m)	7.175	Number of Pip	oes	1	

#### Filter Drain Manhole: MH-S-40, DS/PN: S-11.002

Infiltration Coefficient Base (m/hr	) 0.00000	Trench Width	(m)	0.7	Slope (1:X)	240.0
Infiltration Coefficient Side (m/hr	) 0.00000	Trench Length	(m)	28.0	Cap Volume Depth (m)	0.000
Safety Facto	r 2.0	Pipe Diameter	(m)	0.300 Ca	p Infiltration Depth (m)	0.000
Porosit	y 0.30	Pipe Depth above Invert	(m)	0.075		
Invert Level (n	7.058	Number of Pi	pes	1		

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### Cellular Storage Manhole: MH-S-41, DS/PN: S-1.011

Invert Level (m) 5.900 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²) I	Inf. Area (m²)	Depth (m) A	rea (m²) Inf.	Area (m²)
0.000	144.0	144.0	2.400	144.0	288.0	2.500	0.0	288.0

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#### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m3/ha Storage 0.000 Foul Sewage per hectare (1/s) 0.000 Inlet Coefficient 0.800 Hot Start (mins) 0 Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (1/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Rainfall Model Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

Profile(s) Summer and Winter Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 1 Return Period(s) (years) 45

Climate Change (%)

PN	US/MH Name	Storm			First (X) Surcharge	• •	First (Z) Overflow	Overflow Act.	Water Level (m)				Overflow (1/s)	Half Drain Time (mins)	Flow	Status
S-1.000	MH-S-1	15 Winter	1	+45%					19.973	-0.131	0.000	0.04			2.0	OK
S-1.001	MH-S-2	15 Winter	1	+45%					18.181	-0.119	0.000	0.10			5.7	OK
S-1.002	MH-S-3	15 Winter	1	+45%					14.189	-0.111	0.000	0.15			8.4	OK
S-1.003	MH-S-4	15 Winter	1	+45%					11.203	-0.097	0.000	0.27			10.6	OK
S-1.004	MH-S-5	15 Winter	1	+45%					10.063	-0.147	0.000	0.26			14.3	OK
S-1.005	MH-S-6	15 Winter	1	+45%					9.380	-0.220	0.000	0.16			18.6	OK
S-1.006	MH-S-7	15 Winter	1	+45%					8.758	-0.178	0.000	0.34			22.5	OK
S-1.007	MH-S-8	15 Winter	1	+45%					8.548	-0.190	0.000	0.29			25.2	OK
							@1982-2	020 Inno	VVZE							

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US/MH Level

PN	Name	Exceeded
S-1.000	MH-S-1	
S-1.001	MH-S-2	
S-1.002	MH-S-3	
S-1.003	MH-S-4	
S-1.004	MH-S-5	
S-1.005	MH-S-6	
S-1.006	MH-S-7	
S-1.007	MH-S-8	

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PN	US/MH Name	Storm			First (X) Surcharge	 First (Z) Overflow	Overflow Act.		Surcharged Depth (m)		Flow / Cap.	Overflow (1/s)	Half Drain Time (mins)	Flow	Status
S-1.008	MH-S-9	15 Winter	1	+45%				8.253	-0.197	0.000	0.26			25.7	OK
S-2.000	MH-S-10	15 Winter	1	+45%				7.824	-0.126	0.000	0.06			1.0	OK
S-2.001	MH-S-11	15 Winter	1	+45%				7.552	-0.126	0.000	0.06			1.0	OK
S-1.009	MH-S-12	15 Winter	1	+45%				7.311	-0.221	0.000	0.16			26.5	OK
s-3.000	MH-S-13	15 Winter	1	+45%				8.653	-0.127	0.000	0.06			1.1	OK
S-3.001	MH-S-14	15 Winter	1	+45%				8.443	-0.107	0.000	0.18			3.7	OK
S-4.000	MH-S-15	15 Winter	1	+45%				8.979	-0.121	0.000	0.08			1.8	OK
S-4.001	MH-S-16	15 Winter	1	+45%				8.743	-0.107	0.000	0.18			2.9	OK
S-4.002	MH-S-17	15 Winter	1	+45%				8.597	-0.118	0.000	0.10			4.2	OK
S-3.002	MH-S-18	15 Winter	1	+45%				8.147	-0.053	0.000	0.73			8.0	OK
S-5.000	MH-S-19	15 Winter	1	+45%				7.673	-0.177	0.000	0.10			4.9	OK
S-5.001	MH-S-20	15 Winter	1	+45%				7.341	-0.144	0.000	0.27			10.2	OK
S-6.000	MH-S-21	15 Winter	1	+45%				8.469		0.000	0.04			0.6	OK
S-6.001	MH-S-22	15 Winter	1	+45%				8.419		0.000	0.09			2.1	OK
S-5.002	MH-S-23	15 Winter	1	+45%				7.179		0.000	0.61			12.3	
		15 Winter		+45%				8.162	-0.138	0.000	0.02			0.3	OK
		15 Winter		+45%				8.000		0.000	0.03			0.5	OK
		15 Winter		+45%				7.587		0.000	0.03		5	0.4	
		15 Winter		+45%				7.564		0.000	0.11			1.7	
		15 Winter		+45%				7.494		0.000	0.26		7	4.4	
S-8.003	MH-S-29	15 Winter	1	+45%				7.222	-0.083	0.000	0.41			6.6	OK
S-9.000	MH-S-30	15 Winter	1	+45%				8.065		0.000	0.02			0.3	
		15 Winter		+45%				7.889		0.000	0.05			0.7	
		15 Winter	1	+45%				7.789		0.000	0.07			1.1	
		15 Winter	1	+45%				7.036		0.000	0.25			11.5	
S-10.000	MH-S-34	15 Winter	1	+45%				8.274	-0.126	0.000	0.06			2.5	OK
		15 Winter		+45%				7.594		0.000	0.19			3.0	
		15 Winter		+45%				6.922		0.000	0.52			14.3	
S-1.010	MH-S-37	15 Winter	1	+45%				6.913		0.000	0.96			58.6	OK
S-11.000	MH-S-38	15 Winter	1	+45%				7.363	-0.237	0.000	0.10			6.3	OK
						©1982-20	20 Innov	vze							

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US/MH Level

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PN	Name	Exceeded
S-1.008	MH-S-9	
S-2.000	MH-S-10	
S-2.001	MH-S-11	
S-1.009	MH-S-12	
s-3.000	MH-S-13	
S-3.001	MH-S-14	
S-4.000	MH-S-15	
S-4.001	MH-S-16	
S-4.002	MH-S-17	
S-3.002	MH-S-18	
s-5.000	MH-S-19	
	MH-S-20	
S-6.000	MH-S-21	
S-6.001	MH-S-22	
S-5.002	MH-S-23	
S-7.000	MH-S-24	
S-7.001	MH-S-25	
S-8.000	MH-S-26	
S-8.001	MH-S-27	
	MH-S-28	
	MH-S-29	
S-9.000	MH-S-30	
S-9.001	MH-S-31	
	MH-S-32	
	MH-S-33	
s-10.000		
S-10.001		
S-7.002	MH-S-36	
S-1.010	MH-S-37	
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US/MH Level
PN Name Exceeded

S-11.000 MH-S-38

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									Water	Surcharged	Flooded			Half Drain	Pipe
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(1/s)	(mins)	(1/s)
S-11.001	MH-S-39	15 Winter	1	+45%					7.257	-0.218	0.000	0.17		7	10.7
S-11.002	MH-S-40	15 Winter	1	+45%					7.097	-0.261	0.000	0.04		7	10.8
S-1.011	MH-S-41	960 Winter	1	+45%	1/30 Summer			0	6.723	0.523	0.000	0.01	0.0	944	1.2
S-1.012	MH-S-42	960 Winter	1	+45%					4.196	-0.266	0.000	0.03			1.2

PN	US/MH Name	Status	Level Exceeded
S-11.001	MH-S-39	OK	
S-11.002	MH-S-40	OK	
S-1.011	MH-S-41	SURCHARGED	
S-1.012	MH-S-42	OK	

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#### STORM SEWER DESIGN by the Modified Rational Method

#### Design Criteria for Storm

Pipe Sizes SLS-1 Manhole Sizes 600mm +

FSR Rainfall Model - England and Wales

Return Period (years) 2 Foul Sewage (l/s/ha) 0.000 Maximum Backdrop Height (m) 2.000 M5-60 (mm) 18.900 Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200 Ratio R 0.350 PIMP (%) 100 Min Vel for Auto Design only (m/s) 1.00 Maximum Rainfall (mm/hr) 50 Add Flow / Climate Change (%) 0 Min Slope for Optimisation (1:X) 500 Maximum Time of Concentration (mins) 30 Minimum Backdrop Height (m) 0.500

Designed with Level Soffits

#### Network Design Table for Storm

Length	Fall	Slope	I.Area	T.E.	Ba	ıse	k	HYD	DIA	Section Type	Auto
(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
00 20.352	1.804	11.3	0.011	5.00		0.0	0.600	0	150	Pipe/Conduit	₩
34.762	4.000	8.7	0.024	0.00		0.0	0.600	0	150	Pipe/Conduit	Ď
28.491	3.000	9.5	0.018	0.00		0.0	0.600	0	150	Pipe/Conduit	Ğ
03 19.583	1.090	18.0	0.015	0.00		0.0	0.600	0	150	Pipe/Conduit	ď
(	(m) 00 20.352 01 34.762 02 28.491	(m) (m) 00 20.352 1.804 01 34.762 4.000 02 28.491 3.000	(m) (m) (1:X) 00 20.352 1.804 11.3 01 34.762 4.000 8.7 02 28.491 3.000 9.5	(m) (m) (1:X) (ha) 00 20.352 1.804 11.3 0.011 01 34.762 4.000 8.7 0.024 02 28.491 3.000 9.5 0.018	(m) (m) (1:X) (ha) (mins) 00 20.352 1.804 11.3 0.011 5.00 01 34.762 4.000 8.7 0.024 0.00 02 28.491 3.000 9.5 0.018 0.00	(m) (m) (1:X) (ha) (mins) Flow 00 20.352 1.804 11.3 0.011 5.00 01 34.762 4.000 8.7 0.024 0.00 02 28.491 3.000 9.5 0.018 0.00	(m) (m) (1:X) (ha) (mins) Flow (1/s) 00 20.352 1.804 11.3 0.011 5.00 0.0 01 34.762 4.000 8.7 0.024 0.00 0.0 02 28.491 3.000 9.5 0.018 0.00 0.0	(m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) 00 20.352 1.804 11.3 0.011 5.00 0.0 0.600 01 34.762 4.000 8.7 0.024 0.00 0.0 0.600 02 28.491 3.000 9.5 0.018 0.00 0.0 0.600	(m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT 00 20.352 1.804 11.3 0.011 5.00 0.0 0.600 0 01 34.762 4.000 8.7 0.024 0.00 0.0 0.600 0 02 28.491 3.000 9.5 0.018 0.00 0.0 0.600 0	(m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT (mm)  00 20.352 1.804 11.3 0.011 5.00 0.0 0.600 0 150  01 34.762 4.000 8.7 0.024 0.00 0.0 0.600 0 150  02 28.491 3.000 9.5 0.018 0.00 0.0 0.600 0 150	(m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT (mm)  00 20.352 1.804 11.3 0.011 5.00 0.0 0.600 0 150 Pipe/Conduit 01 34.762 4.000 8.7 0.024 0.00 0.0 0.600 0 150 Pipe/Conduit 02 28.491 3.000 9.5 0.018 0.00 0.0 0.600 0 150 Pipe/Conduit

#### Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	$\Sigma$ Base	Foul	Add Flow	Vel	Cap	Flow
	(mm/hr)	(mins)	(m)	(ha)	Flow (1/s)	(1/s)	(1/s)	(m/s)	(1/s)	(1/s)
S-1.000	50.00	5.11	19.954	0.011	0.0	0.0	0.0	3.02	53.3	1.5
S-1.001	50.00	5.28	18.150	0.035	0.0	0.0	0.0	3.44	60.8	4.7
S-1.002	50.00	5.43	14.150	0.053	0.0	0.0	0.0	3.29	58.1	7.1
s-1.003	50.00	5.56	11.150	0.067	0.0	0.0	0.0	2.39	42.2	9.1

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-1.004 S-1.005			81.6 81.6	0.023 0.031	0.00		0.600	0		Pipe/Conduit Pipe/Conduit	€
S-1.006 S-1.007	40.566	0.288	140.9	0.029 0.022	0.00	0.0	0.600	0	300	Pipe/Conduit Pipe/Conduit	<b>6</b>
S-1.008			94.8	0.005	0.00		0.600	0		Pipe/Conduit	•
S-2.000 S-2.001				0.005	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
S-1.009	17.653	0.552	32.0	0.000	0.00	0.0	0.600	0	300	Pipe/Conduit	•
S-3.000 S-3.001			75.2 66.2	0.006 0.017	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	€

### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-1.004 S-1.005 S-1.006 S-1.007 S-1.008	50.00 50.00 50.00 50.00 49.73		9.300	0.090 0.121 0.150 0.172 0.177	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	1.45 1.74 1.00 1.32 1.62	57.6 123.1 70.9 93.5 114.2	12.2 16.4 20.4 23.3 23.8
S-2.000 S-2.001 S-1.009	50.00 50.00	5.70	7.800 7.529	0.005	0.0	0.0	0.0	1.00	17.7 17.7	0.7
S-3.000 S-3.001	50.00	5.25	8.630 8.400	0.182 0.006 0.023	0.0	0.0	0.0	1.16 1.24	20.5	0.8

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PN	Length	Fall	Slope	I.Area	T.E.	Ba	ıse	k	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-4.000	13.626	0.250	54.5	0.010	5.00		0.0	0.600	0	150	Pipe/Conduit	₫*
S-4.001	13.607	0.136	100.3	0.007	0.00		0.0	0.600	0	150	Pipe/Conduit	<u>-</u>
S-4.002	7.463	0.514	14.5	0.009	0.00		0.0	0.600	0	150	Pipe/Conduit	•
												•
s-3,002	2.971	0.028	104.9	0.000	0.00		0.0	0.600	0	150	Pipe/Conduit	₫*
											1 -,	•
S-5.000	36 875	0 365	101 0	0.027	5.00		0 0	0.600	0	225	Pipe/Conduit	<u> </u>
									-		± '	ð
S-5.001	28.023	0.166	169.1	0.035	0.00		0.0	0.600	0	225	Pipe/Conduit	₩.
S-6.000	6.161	0.061	100.9	0.003	5.00		0.0	0.600	0	150	Pipe/Conduit	₩.
S-6.001	12.798	0.279	45.9	0.010	0.00		0.0	0.600	0	150	Pipe/Conduit	

### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-4.000	50.00	5.17	8.950	0.010	0.0	0.0	0.0	1.37	24.1	1.3
S-4.001	50.00	5.39	8.700	0.017	0.0	0.0	0.0	1.00	17.7	2.3
S-4.002	50.00	5.44	8.564	0.026	0.0	0.0	0.0	2.66	47.0	3.5
S-3.002	50.00	5.61	8.050	0.049	0.0	0.0	0.0	0.98	17.3	6.6
S-5.000	50.00	5.47	7.625	0.027	0.0	0.0	0.0	1.30	51.7	3.7
S-5.001	50.00	5.94	7.260	0.062	0.0	0.0	0.0	1.00	39.9	8.4
S-6.000	50.00	5.10	8.450	0.003	0.0	0.0	0.0	1.00	17.7	0.4
S-6.001	50.00	5.25	8.389	0.013	0.0	0.0	0.0	1.49	26.3	1.8

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-5.002	16.414	0.244	67.3	0.000	0.00	0.0	0.600	0	150	Pipe/Conduit	₫*
S-7.000 S-7.001		0.168 0.067		0.002	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
S-8.000 S-8.001 S-8.002 S-8.003	8.944 28.917		100.9	0.002 0.008 0.018 0.014	5.00 0.00 0.00 0.00	0.0	0.600 0.600 0.600 0.600	0 0 0	150 150	Pipe/Conduit Pipe/Conduit Pipe/Conduit Pipe/Conduit	999
S-9.000 S-9.001 S-9.002	10.679		100.9	0.002 0.003 0.002	5.00 0.00 0.00	0.0	0.600 0.600 0.600	0	150	Pipe/Conduit Pipe/Conduit Pipe/Conduit	99

### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	$\Sigma$ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-5.002	50.00	6.16	7.094	0.075	0.0	0.0	0.0	1.23	21.7	10.2
S-7.000 S-7.001	50.00		8.150 7.982	0.002	0.0	0.0	0.0	1.00	17.7 17.7	0.2
S-8.000 S-8.001 S-8.002 S-8.003	50.00 50.00 50.00 50.00	5.21 5.70	7.570 7.531 7.442 7.156	0.002 0.010 0.028 0.042	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00 1.00	17.7 17.7 17.7 17.7	0.3 1.4 3.8 5.8
S-9.000 S-9.001 S-9.002	50.00 50.00 50.00	5.48	8.050 7.868 7.762	0.002 0.004 0.007	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00	17.7 17.7 17.7	0.2 0.6 0.9

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PN	Length	Fall	STope	1.Area	T.E.	Ba	ase	ĸ	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-8.004	18.299	0.181	101.1	0.025	0.00		0.0	0.600	0	225	Pipe/Conduit	•
s-10.000	10.397	0.700	14.9	0.014	5.00		0.0	0.600	0	150	Pipe/Conduit	€
S-10.001	10.452	0.104	100.3	0.003	0.00		0.0	0.600	0	150	Pipe/Conduit	ď
S-7.002	4.181	0.024	174.2	0.002	0.00		0.0	0.600	0	225	Pipe/Conduit	•
S-1.010	23.624	0.092	256.8	0.000	0.00		0.0	0.600	0	300	Pipe/Conduit	ď
S-11.000 S-11.001 S-11.002	28.002	0.117		0.035 0.030 0.000	5.00 0.00 0.00		0.0	0.600 0.600 0.600	0 0	300	Pipe/Conduit Pipe/Conduit Pipe/Conduit	<del>0</del>

### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-8.004	50.00	6.13	6.960	0.074	0.0	0.0	0.0	1.30	51.7	10.1
S-10.000	50.00	5.07	8.250	0.014	0.0	0.0	0.0	2.63	46.4	1.8
S-10.001	50.00	5.24	7.550	0.017	0.0	0.0	0.0	1.00	17.7	2.3
S-7.002	50.00	6.20	6.779	0.096	0.0	0.0	0.0	0.99	39.3	13.0
S-1.010	48.28	8.70	6.680	0.402	0.0	0.0	0.0	0.98	69.0	52.6
S-11.000	50.00	5.49	7.300	0.035	0.0	0.0	0.0	1.01	71.5	4.8
S-11.001	50.00	5.96	7.175	0.066	0.0	0.0	0.0	1.01	71.5	8.9
S-11.002	50.00	5.99	7.058	0.066	0.0	0.0	0.0	5.20	367.7	8.9
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PN Length Fall Slope I.Area T.E. Base k HYD DIA Section Type Auto (m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT (mm) Design

S-1.011 32.208 1.738 18.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit of S-1.012 14.136 0.039 362.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit

#### Network Results Table

PN Rain T.C. US/IL Σ I.Area Σ Base Foul Add Flow Vel Cap Flow (mm/hr) (mins) (m) (ha) Flow (1/s) (1/s) (1/s) (m/s) (1/s) (1/s)

S-1.011 47.88 8.84 5.900 0.468 0.0 0.0 0.0 3.67 259.4 60.7

10.0 0.0

0.0 0.82 58.0 10.0

S-1.012 50.00 5.29 4.162 0.000

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		Micro
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Micro Drainage	Network 2020.1	'

MH Name	MH CL (		MH Depth (m)	Coni	MH nection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-1	21.3	304	1.350	Open	Manhole	600	S-1.000	19.954	150				
MH-S-2	19.5	500	1.350	Open	Manhole	600	s-1.001	18.150	150	s-1.000	18.150	150	
MH-S-3	15.5	500	1.350	Open	Manhole	600	s-1.002	14.150	150	s-1.001	14.150	150	
MH-S-4	12.5	500	1.350	Open	Manhole	600	s-1.003	11.150	150	s-1.002	11.150	150	
MH-S-5	11.4	10	1.425	Open	Manhole	600	S-1.004	9.985	225	s-1.003	10.060	150	
MH-S-6	10.8	300	1.500	Open	Manhole	1050	s-1.005	9.300	300	s-1.004	9.375	225	
MH-S-7	10.5	550	1.914	Open	Manhole	1050	s-1.006	8.636	300	s-1.005	8.636	300	
MH-S-8	10.2	220	1.782	Open	Manhole	1050	s-1.007	8.438	300	s-1.006	8.438	300	
MH-S-9	9.6	550	1.500	Open	Manhole	1050	S-1.008	8.150	300	s-1.007	8.150	300	
MH-S-10	8.8	350	1.050	Open	Manhole	600	S-2.000	7.800	150				
MH-S-11	9.1	.00	1.571	Open	Manhole	600	s-2.001	7.529	150	s-2.000	7.529	150	
MH-S-12	9.4	20	2.188	Open	Manhole	1050	s-1.009	7.232	300	s-1.008	7.920	300	688
										s-2.001	7.382	150	
MH-S-13	9.3	880	0.750	Open	Manhole	600	s-3.000	8.630	150				
MH-S-14	9.1	.50	0.750	Open	Manhole	600	s-3.001	8.400	150	s-3.000	8.400	150	
MH-S-15	9.7	00	0.750	Open	Manhole	600	S-4.000	8.950	150				
MH-S-16	9.4	150	0.750	Open	Manhole	600	S-4.001	8.700	150	s-4.000	8.700	150	
MH-S-17	9.4	150	0.886	Open	Manhole	600	S-4.002	8.564	150	s-4.001	8.564	150	
MH-S-18	9.4	100	1.350	Open	Manhole	600	s-3.002	8.050	150	s-3.001	8.050	150	
										s-4.002	8.050	150	
MH-S-19	8.4	150	0.825	Open	Manhole	600	s-5.000	7.625	225				
MH-S-20	9.1	.20	1.860	Open	Manhole	1050	s-5.001	7.260	225	s-5.000	7.260	225	
MH-S-21	9.2	200	0.750	Open	Manhole	600	s-6.000	8.450	150				
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MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-22	9.200	0.811	Open Manhol	e 600	s-6.001	8.389	150	s-6.000	8.389	150	
MH-S-23	9.460	2.366	Open Manhol	e 1050	s-5.002	7.094	150	S-5.001	7.094	225	
								S-6.001	8.110	150	1016
MH-S-24	8.900	0.750	Open Manhol	e 600	s-7.000	8.150	150				
MH-S-25	8.900	0.918	Open Manhol	e 600	s-7.001	7.982	150	s-7.000	7.982	150	
MH-S-26	8.320	0.750	Open Manhol	e 600	S-8.000	7.570	150				
MH-S-27	8.400	0.869	Open Manhol	e 600	S-8.001	7.531	150	S-8.000	7.531	150	
MH-S-28	8.700	1.258	Open Manhol	e 600	S-8.002	7.442	150	S-8.001	7.442	150	
MH-S-29	9.150	1.994	Open Manhol	e 1050	S-8.003	7.156	150	S-8.002	7.156	150	
MH-S-30	8.800	0.750	Open Manhol	e 600	s-9.000	8.050	150				
MH-S-31	9.100	1.232	Open Manhol	e 600	s-9.001	7.868	150	S-9.000	7.868	150	
MH-S-32	9.340	1.578	Open Manhol	e 600	S-9.002	7.762	150	S-9.001	7.762	150	
MH-S-33	9.340	2.380	Open Manhol	e 1050	S-8.004	6.960	225	S-8.003	7.035	150	
								S-9.002	7.687	150	652
MH-S-34	9.000	0.750	Open Manhol	e 600	S-10.000	8.250	150				
MH-S-35	8.900	1.350	Open Manhol	e 600	S-10.001	7.550	150	S-10.000	7.550	150	
MH-S-36	9.300	2.521	Open Manhol	e 1050	s-7.002	6.779	225	S-7.001	7.914	150	1060
								S-8.004	6.779	225	
								S-10.001	7.446	150	592
MH-S-37	9.400	2.720	Open Manhol	e 1050	S-1.010	6.680	300	S-1.009	6.680	300	
								S-3.002	8.022	150	1192
								S-5.002	6.850	150	20
								S-7.002	6.755	225	

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MH Name	MH CL (m)	MH Depth (m)	Con	MH nection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-38	8.400	1.100	Open	Manhole	1050	S-11.000	7.300	300				
MH-S-39	8.400	1.225	Open	Manhole	1050	s-11.001	7.175	300	s-11.000	7.175	300	
MH-S-40	9.000	1.942	Open	Manhole	1050	S-11.002	7.058	300	s-11.001	7.058	300	
MH-S-41	9.100	3.200	Open	Manhole	1200	S-1.011	5.900	300	S-1.010	6.588	300	688
									S-11.002	5.900	300	
MH-S-42	6.350	2.188	Open	Manhole	1000	S-1.012	4.162	300	S-1.011	4.162	300	
MH-S-	6.500	2.377	Open	Manhole	1000		OUTFALL		S-1.012	4.123	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-1	418218.177	564656.696	418218.177	564656.696	Required	•
MH-S-2	418217.419	564636.359	418217.419	564636.359	Required	·
MH-S-3	418230.888	564604.312	418230.888	564604.312	Required	
MH-S-4	418242.414	564578.257	418242.414	564578.257	Required	\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-5	418243.918	564558.732	418243.918	564558.732	Required	
MH-S-6	418269.068	564515.776	418269.068	564515.776	Required	
MH-S-7	418294.334	564467.855	418294.334	564467.855	Required	
MH-S-8	418323.940	564429.830	418323.940	564429.830	Required	
MH-S-9	418347.372	564396.716	418347.372	564396.716	Required	
MH-S-10	418370.109	564345.830	418370.109	564345.830	Required	6
MH-S-11	418359.115	564370.915	418359.115	564370.915	Required	4
MH-S-12	418365.344	564384.368	418365.344	564384.368	Required	
MH-S-13	418373.491	564429.297	418373.491	564429.297	Required	, Q
MH-S-14	418387.573	564419.248	418387.573	564419.248	Required	
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MH-S-15 418347.184 564399.604 418347.184 564399.604 Required  MH-S-16 418358.254 564391.659 418358.254 564391.659 Required  MH-S-17 418370.457 564393.844 418370.457 564393.844 Required  MH-S-18 418374.456 564400.144 418374.456 564400.144 Required  MH-S-19 418426.874 564345.131 418426.874 564345.131 Required  MH-S-20 418396.692 564366.318 418396.692 564366.318 Required  MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-17 418370.457 564393.844 418370.457 564393.844 Required  MH-S-18 418374.456 564400.144 418374.456 564400.144 Required  MH-S-19 418426.874 564345.131 418426.874 564345.131 Required  MH-S-20 418396.692 564366.318 418396.692 564366.318 Required  MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-15	418347.184	564399.604	418347.184	564399.604	Required	•
MH-S-18 418374.456 564400.144 418374.456 564400.144 Required  MH-S-19 418426.874 564345.131 418426.874 564345.131 Required  MH-S-20 418396.692 564366.318 418396.692 564366.318 Required  MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-16	418358.254	564391.659	418358.254	564391.659	Required	-
MH-S-19 418426.874 564345.131 418426.874 564345.131 Required  MH-S-20 418396.692 564366.318 418396.692 564366.318 Required  MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-17	418370.457	564393.844	418370.457	564393.844	Required	
MH-S-20 418396.692 564366.318 418396.692 564366.318 Required  MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-18	418374.456	564400.144	418374.456	564400.144	Required	
MH-S-21 418363.851 564369.353 418363.851 564369.353 Required  MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-19	418426.874	564345.131	418426.874	564345.131	Required	<b>\</b>
MH-S-22 418363.851 564375.514 418363.851 564375.514 Required  MH-S-23 418373.407 564381.908 418373.407 564381.908 Required  MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-20	418396.692	564366.318	418396.692	564366.318	Required	0,
MH-S-23 418373.407 564381.908 418373.407 564381.908 Required MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-21	418363.851	564369.353	418363.851	564369.353	Required	
MH-S-24 418395.667 564406.447 418395.667 564406.447 Required	MH-S-22	418363.851	564375.514	418363.851	564375.514	Required	
<i>P</i>	MH-S-23	418373.407	564381.908	418373.407	564381.908	Required	
©1982-2020 Innovvze	MH-S-24	418395.667	564406.447	418395.667	564406.447	Required	,
			©198	2-2020 Inno	vyze		

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-25	418385.888	564392.553	418385.888	564392.553	Required	V
MH-S-26	418431.043	564350.108	418431.043	564350.108	Required	<b>\</b>
MH-S-27	418427.989	564352.616	418427.989	564352.616	Required	0
MH-S-28	418420.465	564357.451	418420.465	564357.451	Required	6
MH-S-29	418396.545	564373.700	418396.545	564373.700	Required	6
MH-S-30	418415.688	564370.425	418415.688	564370.425	Required	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
MH-S-31	418400.533	564380.743	418400.533	564380.743	Required	0.
MH-S-32	418391.570	564386.546	418391.570	564386.546	Required	<b>P.</b>
MH-S-33	418386.621	564380.753	418386.621	564380.753	Required	X
MH-S-34	418392.082	564413.970	418392.082	564413.970	Required	<b>P</b>
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-35	418386.310	564405.322	418386.310	564405.322	Required	p/
MH-S-36	418380.483	564396.645	418380.483	564396.645	Required	
MH-S-37	418376.535	564398.021	418376.535	564398.021	Required	
MH-S-38	418446.130	564378.270	418446.130	564378.270	Required	4
MH-S-39	418421.568	564395.429	418421.568	564395.429	Required	<b>S</b> 0.
MH-S-40	418398.528	564411.342	418398.528	564411.342	Required	6
MH-S-41	418389.815	564417.559	418389.815	564417.559	Required	
MH-S-42	418419.965	564428.888	418419.965	564428.888	Required	
MH-S-	418427.558	564416.965			No Entry	

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### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.000	0	150	MH-S-1	21.304	19.954	1.200	Open Manhole	600
S-1.001	0	150	MH-S-2	19.500	18.150	1.200	Open Manhole	600
S-1.002	0	150	MH-S-3	15.500	14.150	1.200	Open Manhole	600
S-1.003	0	150	MH-S-4	12.500	11.150	1.200	Open Manhole	600
S-1.004	0	225	MH-S-5	11.410	9.985	1.200	Open Manhole	600
S-1.005	0	300	MH-S-6	10.800	9.300	1.200	Open Manhole	1050
S-1.006	0	300	MH-S-7	10.550	8.636	1.614	Open Manhole	1050
S-1.007	0	300	MH-S-8	10.220	8.438	1.482	Open Manhole	1050
S-1.008	0	300	MH-S-9	9.650	8.150	1.200	Open Manhole	1050
S-2.000	0	150	MH-S-10	8.850	7.800	0.900	Open Manhole	600
S-2.001	0	150	MH-S-11	9.100	7.529	1.421	Open Manhole	600

## Downstream Manhole

	PN	Length	-	МН			D.Depth		MH DIAM., L*W	
		(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)	
S	-1.000	20.352	11.3	MH-S-2	19.500	18.150	1.200	Open Manhole	600	
S	-1.001	34.762	8.7	MH-S-3	15.500	14.150	1.200	Open Manhole	600	
S	-1.002	28.491	9.5	MH-S-4	12.500	11.150	1.200	Open Manhole	600	
S	-1.003	19.583	18.0	MH-S-5	11.410	10.060	1.200	Open Manhole	600	
S	-1.004	49.777	81.6	MH-S-6	10.800	9.375	1.200	Open Manhole	1050	
S	-1.005	54.174	81.6	MH-S-7	10.550	8.636	1.614	Open Manhole	1050	
S	-1.006	48.192	243.3	MH-S-8	10.220	8.438	1.482	Open Manhole	1050	
S	-1.007	40.566	140.9	MH-S-9	9.650	8.150	1.200	Open Manhole	1050	
S	-1.008	21.805	94.8	MH-S-12	9.420	7.920	1.200	Open Manhole	1050	
S	-2.000	27.388	100.9	MH-S-11	9.100	7.529	1.421	Open Manhole	600	
S	-2.001	14.825	100.9	MH-S-12	9.420	7.382	1.888	Open Manhole	1050	
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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.009	0	300	MH-S-12	9.420	7.232	1.888	Open Manhole	1050
s-3.000 s-3.001	0		MH-S-13 MH-S-14	9.380 9.150	8.630 8.400		Open Manhole Open Manhole	600 600
S-4.000 S-4.001 S-4.002	0 0	150	MH-S-15 MH-S-16 MH-S-17	9.700 9.450 9.450	8.950 8.700 8.564	0.600	Open Manhole Open Manhole Open Manhole	600 600 600
S-3.002	0	150	MH-S-18	9.400	8.050	1.200	Open Manhole	600

## 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)
S-1.009	17.653	32.0	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
S-3.000 S-3.001			MH-S-14 MH-S-18	9.150 9.400	8.400 8.050		Open Manhole Open Manhole	600 600
S-4.000 S-4.001 S-4.002	13.607	100.3	MH-S-16 MH-S-17 MH-S-18	9.450 9.450 9.400	8.700 8.564 8.050	0.736	Open Manhole Open Manhole Open Manhole	600 600 600
S-3.002	2.971	104.9	MH-S-37	9.400	8.022	1.228	Open Manhole	1050

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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
s-5.000 s-5.001	0		MH-S-19 MH-S-20	8.450 9.120	7.625 7.260		Open Manhole Open Manhole	600 1050
S-6.000 S-6.001	0		MH-S-21 MH-S-22	9.200 9.200	8.450 8.389		Open Manhole Open Manhole	600 600
S-5.002 S-7.000	0	150	MH-S-24	9.460	7.094 8.150	0.600	Open Manhole Open Manhole	1050
s-7.001 s-8.000	0		MH-S-26	8.900 8.320	7.982 7.570		Open Manhole Open Manhole	600

## Downstream Manhole

PN	Length (m)	Slope (1:X)		C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
			MH-S-20 MH-S-23	9.120 9.460	7.260 7.094		Open Manhole Open Manhole	
			MH-S-22 MH-S-23	9.200 9.460	8.389 8.110		Open Manhole Open Manhole	600 1050
S-5.002	16.414	67.3	MH-S-37	9.400	6.850	2.400	Open Manhole	1050
			MH-S-25 MH-S-36		7.982 7.914		Open Manhole Open Manhole	600 1050
s-8.000	3.952	100.9	MH-S-27	8.400	7.531	0.719	Open Manhole	600

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### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-8.001	0	150	MH-S-27	8.400	7.531	0.719	Open Manhole	600
S-8.002	0	150	MH-S-28	8.700	7.442	1.108	Open Manhole	600
S-8.003	0	150	MH-S-29	9.150	7.156	1.844	Open Manhole	1050
S-9.000	0	150	MH-S-30	8.800	8.050	0.600	Open Manhole	600
S-9.001	0	150	MH-S-31	9.100	7.868	1.082	Open Manhole	600
S-9.002	0	150	MH-S-32	9.340	7.762	1.428	Open Manhole	600
S-8.004	0	225	MH-S-33	9.340	6.960	2.155	Open Manhole	1050
S-10.000	0	150	MH-S-34	9.000	8.250	0.600	Open Manhole	600
S-10.001	0	150	MH-S-35	8.900	7.550	1.200	Open Manhole	600

## Downstream Manhole

	PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH D	IAM., (mm)	L*W
	S-8.001	8.944	100.9	MH-S-28	8.700	7.442	1.108	Open Manhole			600
	S-8.002	28.917	100.9	MH-S-29	9.150	7.156	1.844	Open Manhole			1050
	S-8.003	12.175	100.9	MH-S-33	9.340	7.035	2.155	Open Manhole		:	1050
				MH-S-31	9.100	7.868		Open Manhole			600
	S-9.001	10.679	100.9	MH-S-32	9.340	7.762	1.428	Open Manhole			600
	S-9.002	7.619	100.9	MH-S-33	9.340	7.687	1.503	Open Manhole		:	1050
	S-8.004	18.299	101.1	MH-S-36	9.300	6.779	2.296	Open Manhole		:	1050
:	s-10.000	10.397	14.9	MH-S-35	8.900	7.550	1.200	Open Manhole			600
	S-10.001	10.452	100.3			7.446		Open Manhole		-	1050
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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-7.002	0	225	MH-S-36	9.300	6.779	2.296	Open Manhole	1050
S-1.010	0	300	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
s-11.000	0	300	MH-S-38	8.400	7.300	0.800	Open Manhole	1050
S-11.001	0	300	MH-S-39	8.400	7.175	0.925	Open Manhole	1050
S-11.002	0	300	MH-S-40	9.000	7.058	1.642	Open Manhole	1050
S-1.011	0	300	MH-S-41	9.100	5.900	2.900	Open Manhole	1200
S-1.012	0	300	MH-S-42	6.350	4.162	1.888	Open Manhole	1000

## Downstream Manhole

Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
4.181	174.2	MH-S-37	9.400	6.755	2.420	Open Manhole	1050
23.624	256.8	MH-S-41	9.100	6.588	2.212	Open Manhole	1200
29.962	239.7	MH-S-39	8.400	7.175	0.925	Open Manhole	1050
28.002	239.3	MH-S-40	9.000	7.058	1.642	Open Manhole	1050
10.704	9.2	MH-S-41	9.100	5.900	2.900	Open Manhole	1200
32.208	18.5	MH-S-42	6.350	4.162	1.888	Open Manhole	1000
14.136	362.5	MH-S-	6.500	4.123	2.077	Open Manhole	1000
						_	
	(m) 4.181 23.624 29.962 28.002 10.704 32.208	(m) (1:x)  4.181 174.2  23.624 256.8  29.962 239.7  28.002 239.3  10.704 9.2  32.208 18.5	(m) (1:X) Name  4.181 174.2 MH-S-37  23.624 256.8 MH-S-41  29.962 239.7 MH-S-39 28.002 239.3 MH-S-40 10.704 9.2 MH-S-41  32.208 18.5 MH-S-42	(m) (1:X) Name (m)  4.181 174.2 MH-S-37 9.400  23.624 256.8 MH-S-41 9.100  29.962 239.7 MH-S-39 8.400 28.002 239.3 MH-S-40 9.000 10.704 9.2 MH-S-41 9.100  32.208 18.5 MH-S-42 6.350	(m) (1:X) Name (m) (m)  4.181 174.2 MH-S-37 9.400 6.755  23.624 256.8 MH-S-41 9.100 6.588  29.962 239.7 MH-S-39 8.400 7.175 28.002 239.3 MH-S-40 9.000 7.058 10.704 9.2 MH-S-41 9.100 5.900  32.208 18.5 MH-S-42 6.350 4.162	(m)     (1:X)     Name     (m)     (m)       4.181     174.2     MH-S-37     9.400     6.755     2.420       23.624     256.8     MH-S-41     9.100     6.588     2.212       29.962     239.7     MH-S-39     8.400     7.175     0.925       28.002     239.3     MH-S-40     9.000     7.058     1.642       10.704     9.2     MH-S-41     9.100     5.900     2.900       32.208     18.5     MH-S-42     6.350     4.162     1.888	(m)         (1:X)         Name         (m)         (m)         (m)         Connection           4.181         174.2         MH-S-37         9.400         6.755         2.420         Open Manhole           23.624         256.8         MH-S-41         9.100         6.588         2.212         Open Manhole           29.962         239.7         MH-S-39         8.400         7.175         0.925         Open Manhole           28.002         239.3         MH-S-40         9.000         7.058         1.642         Open Manhole           10.704         9.2         MH-S-41         9.100         5.900         2.900         Open Manhole           32.208         18.5         MH-S-42         6.350         4.162         1.888         Open Manhole

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### Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Туре	Name	(%)	Area (ha)	Area (ha)	(ha)
1.000	User	_	100	0.011	0.011	0.011
1.001	User	_	100	0.024	0.024	0.024
1.002	User	_	100	0.018	0.018	0.018
1.003	User	_	100	0.015	0.015	0.015
1.004	User	_	100	0.023	0.023	0.023
1.005	User	_	100	0.031	0.031	0.031
1.006	User	_	100	0.029	0.029	0.029
1.007	User	_	100	0.022	0.022	0.022
1.008	User	_	100	0.005	0.005	0.005
2.000	User	_	100	0.005	0.005	0.005
2.001	_	-	100	0.000	0.000	0.000
1.009	_	-	100	0.000	0.000	0.000
3.000	User	_	50	0.012	0.006	0.006
3.001	User	_	50	0.035	0.017	0.017
4.000	User	_	100	0.007	0.007	0.007
	User	-	30	0.011	0.003	0.010
4.001	User	-	100	0.007	0.007	0.007
4.002	User	-	50	0.015	0.007	0.007
	User	_	50	0.003	0.001	0.009
3.002	_	-	100	0.000	0.000	0.000
5.000	User	_	50	0.055	0.027	0.027
5.001	User	_	50	0.046	0.023	0.023
	User	_	30	0.039	0.012	0.035
6.000	User	_	100	0.002	0.002	0.002
	User	-	30	0.004	0.001	0.003
6.001	User	-	100	0.008	0.008	0.008
	User	-	30	0.009	0.003	0.010
5.002	-	-	100	0.000	0.000	0.000
7.000	User	-	100	0.002	0.002	0.002
7.001	User	_	100	0.002	0.002	0.002
8.000	User	_	100	0.002	0.002	0.002
8.001	User	_	100	0.008	0.008	0.008
	User		50	0.002	0.001	0.008
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# Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Туре	Name	(%)	Area (ha)	Area (ha)	(ha)
8.002	User	_	100	0.011	0.011	0.011
	User	-	50	0.002	0.001	0.012
	User	-	52	0.002	0.001	0.013
	User	-	100	0.002	0.002	0.015
	User	-	30	0.007	0.002	0.018
8.003	User	-	100	0.010	0.010	0.010
	User	-	100	0.001	0.001	0.011
	User	-	100	0.002	0.002	0.014
	User	-	30	0.002	0.001	0.014
9.000	User	-	100	0.002	0.002	0.002
9.001	User	-	100	0.002	0.002	0.002
	User	-	100	0.001	0.001	0.003
9.002	User	-	100	0.002	0.002	0.002
8.004	User	-	100	0.021	0.021	0.021
	User	-	30	0.003	0.001	0.022
	User	-	30	0.010	0.003	0.025
10.000	User	-	100	0.012	0.012	0.012
	User	-	30	0.004	0.001	0.014
10.001	User	-	100	0.002	0.002	0.002
	User	-	30	0.004	0.001	0.003
7.002	User	-	100	0.002	0.002	0.002
1.010	-	-	100	0.000	0.000	0.000
11.000	User	-	50	0.071	0.035	0.035
11.001	User	-	50	0.060	0.030	0.030
11.002	-	-	100	0.000	0.000	0.000
1.011	_	-	100	0.000	0.000	0.000
1.012	_	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.684	0.468	0.468

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#### Simulation Criteria for Storm

Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800

Areal Reduction Factor 1.000 Foul Sewage per hectare (1/s) 0.000 Flow per Person per Day (1/per/day) 0.000

Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60

Hot Start Level (mm) 0 MADD Factor \* 10m<sup>3</sup>/ha Storage 0.000 Output Interval (mins) 1

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Return Period (years) 2 Ratio R 0.350 Cv (Winter) 0.840 Region England and Wales Profile Type Summer Storm Duration (mins) 30

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#### Online Controls for Storm

### Hydro-Brake® Optimum Manhole: MH-S-41, DS/PN: S-1.011, Volume (m³): 5.9

Unit Reference	MD-SHE-0054-2000-2400-2000	Sump Available	Yes
Design Head (m)	2.400	Diameter (mm)	54
Design Flow $(1/s)$	2.0	Invert Level (m) 5.	900
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm) 1	200
Application	Surface		

Control Points	Head (m)	Flow (1/s)	Control Points	Head (m)	Flow (1/s)
Design Point (Calculated)	2.400	2.0	Kick-Flo®	0.488	1.0
Flush-Flo™	0.242	1.2	Mean Flow over Head Range	_	1.4

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 (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)
0.100	1.1	0.600	1.1	1.600	1.7	2.600	2.1	5.000	2.8	7.500	3.4
0.200	1.2	0.800	1.2	1.800	1.8	3.000	2.2	5.500	2.9	8.000	3.5
0.300	1.2	1.000	1.3	2.000	1.8	3.500	2.4	6.000	3.1	8.500	3.6
0.400	1.1	1.200	1.5	2.200	1.9	4.000	2.5	6.500	3.2	9.000	3.7
0.500	1.0	1.400	1.6	2.400	2.0	4.500	2.7	7.000	3.3	9.500	3.8

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## Offline Controls for Storm

Weir Manhole: MH-S-41, DS/PN: S-1.011, Loop to PN: S-1.012

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 8.300

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#### Storage Structures for Storm

### Filter Drain Manhole: MH-S-26, DS/PN: S-8.000

Infiltration Coefficient Base (m/hr	0.00000	Trench Width	(m)	0.7	Slope (1:X) 24	40.0
Infiltration Coefficient Side (m/hr	) 0.00000	Trench Length	(m)	4.0	Cap Volume Depth (m) 0.	.000
Safety Facto	r 2.0	Pipe Diameter	(m)	0.150	Cap Infiltration Depth (m) 0.	.000
Porosit	y 0.30	Pipe Depth above Invert	(m)	0.075		
Invert Level (m	7.570	Number of Pi	nes	1		

#### Filter Drain Manhole: MH-S-28, DS/PN: S-8.002

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (	(m) 0	0.7	Slope (1	:X)	100.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (	(m) 29	9.0 Ca	p Volume Depth	(m)	0.000
Safety Factor	2.0	Pipe Diameter (	(m) 0.1	150 Cap Infi	ltration Depth	(m)	0.000
Porosity	0.30	Pipe Depth above Invert (	(m) 0.0	075			
Invert Level (m)	7.442	Number of Pip	es	1			

#### Filter Drain Manhole: MH-S-39, DS/PN: S-11.001

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width	(m)	0.7	Slope (1:X) 240.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length	(m)	30.0	Cap Volume Depth (m) 0.000
Safety Factor	2.0	Pipe Diameter (	(m)	0.300	Cap Infiltration Depth (m) 0.000
Porosity	0.30	Pipe Depth above Invert	(m)	0.075	
Invert Level (m)	7.175	Number of Pip	oes	1	

#### Filter Drain Manhole: MH-S-40, DS/PN: S-11.002

Infiltration Coefficient Base (m/hr	) 0.00000	Trench Width	(m)	0.7	Slope (1:X)	240.0
Infiltration Coefficient Side (m/hr	) 0.00000	Trench Length	(m)	28.0	Cap Volume Depth (m)	0.000
Safety Facto	r 2.0	Pipe Diameter	(m)	0.300 Ca	p Infiltration Depth (m)	0.000
Porosit	y 0.30	Pipe Depth above Invert	(m)	0.075		
Invert Level (n	7.058	Number of Pi	pes	1		

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### Cellular Storage Manhole: MH-S-41, DS/PN: S-1.011

Invert Level (m) 5.900 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	144.0	144.0	2.400	144.0	288.0	2.500	0.0	288.0

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#### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (1/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (1/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

Climate Change (%)

									Water	Surcharged	Flooded			Half Drain	Pipe	
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow	
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(1/s)	(mins)	(1/s)	Status
S-1.000	MH-S-1	15 Winter	30	+45%					19.985	-0.119	0.000	0.10			4.8	OK
S-1.001	MH-S-2	15 Winter	30	+45%					18.204	-0.096	0.000	0.28			16.2	OK
S-1.002	MH-S-3	15 Winter	30	+45%					14.220	-0.080	0.000	0.44			24.7	OK
S-1.003	MH-S-4	15 Winter	30	+45%					11.252	-0.048	0.000	0.80			31.7	OK
S-1.004	MH-S-5	15 Winter	30	+45%					10.134	-0.076	0.000	0.75			41.4	OK
S-1.005	MH-S-6	15 Winter	30	+45%					9.448	-0.152	0.000	0.47			54.9	OK
S-1.006	MH-S-7	15 Winter	30	+45%					8.887	-0.049	0.000	0.97			64.8	OK
s-1.007	MH-S-8	15 Winter	30	+45%					8.650	-0.088	0.000	0.83			71.8	OK
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US/MH Level

PN	Name	Exceeded
s-1.000	MH-S-1	
S-1.001	MH-S-2	
S-1.002	MH-S-3	
S-1.003	MH-S-4	
S-1.004	MH-S-5	
S-1.005	MH-S-6	
S-1.006	MH-S-7	
S-1.007	MH-S-8	

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PN	US/MH Name	Storm		Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)		Flow / Cap.	Overflow (1/s)	Half Drain Time (mins)	Pipe Flow (1/s)
s-1.008	MH-S-9	15 Winter	30	+45%					8.341	-0.109	0.000	0.72			72.6
S-2.000	MH-S-10	15 Winter	30	+45%					7.838	-0.112	0.000	0.14			2.4
S-2.001	MH-S-11	1440 Winter	30	+45%	30/720 Winter				7.715	0.037	0.000	0.01			0.1
S-1.009	MH-S-12	1440 Winter	30	+45%	30/360 Winter				7.715	0.184	0.000	0.03			4.4
s-3.000	MH-S-13	15 Winter	30	+45%					8.667	-0.113	0.000	0.14			2.6
S-3.001	MH-S-14	15 Winter	30	+45%					8.477	-0.073	0.000	0.52			10.8
S-4.000	MH-S-15	15 Winter	30	+45%					8.996	-0.104	0.000	0.20			4.4
	MH-S-16	15 Winter	30	+45%					8.773	-0.077	0.000	0.47			7.7
	MH-S-17	15 Winter	30	+45%					8.620	-0.094	0.000	0.29			11.8
	MH-S-18	15 Winter	30	+45%	30/15 Summer				8.297	0.097	0.000	2.05			22.3
S-5.000	MH-S-19	15 Winter	30	+45%					7.784	-0.066	0.000	0.24			11.9
	MH-S-20	15 Winter	30	+45%	30/15 Summer				7.758	0.273	0.000	0.62			23.1
	MH-S-21	15 Winter	30	+45%					8.481		0.000	0.09			1.4
	MH-S-22	15 Winter	30	+45%					8.441		0.000	0.26			6.3
		1440 Winter	30	+45%	30/15 Summer				7.716		0.000	0.09			1.8
	MH-S-24	15 Winter	30	+45%					8.170	-0.130	0.000	0.04			0.7
	MH-S-25	15 Winter	30	+45%					8.012	-0.119	0.000	0.09			1.4
		1440 Winter	30	+45%					7.716		0.000	0.00		168	0.1
		1440 Winter	30		30/960 Winter				7.716	0.036	0.000	0.02			0.3
		1440 Winter	30	+45%					7.717		0.000	0.04		216	0.7
		1440 Winter	30	+45%	30/15 Summer				7.716	0.410	0.000	0.06			1.0
	MH-S-30		30	+45%					8.071	-0.129	0.000	0.05			0.8
	MH-S-31	15 Winter	30	+45%					7.904	-0.114	0.000	0.13			2.1
	MH-S-32		30	+45%					7.809	-0.103	0.000	0.21			3.2
		1440 Winter	30	+45%	30/15 Summer				7.715	0.530	0.000	0.04			1.8
	MH-S-34		30	+45%					8.288	-0.112	0.000	0.15			6.1
		1440 Winter	30		30/960 Winter				7.715	0.015	0.000	0.03			0.4
		1440 Winter	30	+45%	,				7.715	0.711	0.000	0.08			2.2
		600 Winter	30	+45%					7.723	0.743	0.000	0.30			18.3
S-11.000	MH-S-38	1440 Winter	30	+45%	30/480 Winter				7.713	0.113	0.000	0.01			0.9
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		US/MH		Level
	PN	Name	Status	Exceede
	S-1.008	MH-S-9	OK	
	S-2.000	MH-S-10	OK	
	S-2.001	MH-S-11	SURCHARGED	
	S-1.009	MH-S-12	SURCHARGED	
	S-3.000	MH-S-13	OK	
	S-3.001	MH-S-14	OK	
	S-4.000	MH-S-15	OK	
	S-4.001	MH-S-16	OK	
	S-4.002	MH-S-17	OK	
	S-3.002	MH-S-18	SURCHARGED	
	S-5.000	MH-S-19	OK	
	S-5.001	MH-S-20	SURCHARGED	
	S-6.000	MH-S-21	OK	
	S-6.001	MH-S-22	OK	
	S-5.002	MH-S-23	SURCHARGED	
	S-7.000	MH-S-24	OK	
	S-7.001	MH-S-25	OK	
	S-8.000	MH-S-26	OK	
	S-8.001	MH-S-27	SURCHARGED	
	S-8.002	MH-S-28	SURCHARGED	
	S-8.003	MH-S-29	SURCHARGED	
	S-9.000	MH-S-30	OK	
	S-9.001	MH-S-31	OK	
	S-9.002	MH-S-32	OK	
	S-8.004	MH-S-33	SURCHARGED	
Š	3-10.000	MH-S-34	OK	
Š	5-10.001	MH-S-35	SURCHARGED	
	S-7.002	MH-S-36	SURCHARGED	
	S-1.010	MH-S-37	SURCHARGED	
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US/MH Level
PN Name Status Exceeded

S-11.000 MH-S-38 SURCHARGED

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									Water	Surcharged	Flooded			Half Drain	Pipe
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(1/s)	(mins)	(1/s)
S-11.001	MH-S-39	1440 Winter	30	+45%	30/360 Winter				7.713	0.238	0.000	0.02		552	1.6
S-11.002	MH-S-40	1440 Winter	30	+45%	30/180 Winter				7.713	0.355	0.000	0.01		744	1.6
S-1.011	MH-S-41	1440 Winter	30	+45%	30/15 Summer			0	7.713	1.513	0.000	0.01	0.0	1728	1.8
S-1.012	MH-S-42	1440 Winter	30	+45%					4.200	-0.262	0.000	0.04			1.8

	US/MH		Level
PN	Name	Status	Exceeded

S-11.001 MH-S-39 SURCHARGED S-11.002 MH-S-40 SURCHARGED S-1.011 MH-S-41 SURCHARGED S-1.012 MH-S-42 OK

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#### STORM SEWER DESIGN by the Modified Rational Method

#### Design Criteria for Storm

Pipe Sizes SLS-1 Manhole Sizes 600mm +

FSR Rainfall Model - England and Wales

Return Period (years) 2 Foul Sewage (l/s/ha) 0.000 Maximum Backdrop Height (m) 2.000 M5-60 (mm) 18.900 Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200 Ratio R 0.350 PIMP (%) 100 Min Vel for Auto Design only (m/s) 1.00 Maximum Rainfall (mm/hr) 50 Add Flow / Climate Change (%) 0 Min Slope for Optimisation (1:X) 500 Maximum Time of Concentration (mins) 30 Minimum Backdrop Height (m) 0.500

Designed with Level Soffits

#### Network Design Table for Storm

PN	Length	Fall	Slope	I.Area	T.E.	Ba	ise	k	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
s-1.000	20.352	1.804	11.3	0.011	5.00		0.0	0.600	0	150	Pipe/Conduit	€
S-1.001	34.762	4.000	8.7	0.024	0.00		0.0	0.600	0	150	Pipe/Conduit	₽
S-1.002	28.491	3.000	9.5	0.018	0.00		0.0	0.600	0	150	Pipe/Conduit	<u>-</u>
s-1.003	19.583	1.090	18.0	0.015	0.00		0.0	0.600	0	150	Pipe/Conduit	ď

#### Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	$\Sigma$ Base	Foul	Add Flow	Vel	Cap	Flow
	(mm/hr)	(mins)	(m)	(ha)	Flow (1/s)	(1/s)	(1/s)	(m/s)	(1/s)	(1/s)
S-1.000	50.00	5.11	19.954	0.011	0.0	0.0	0.0	3.02	53.3	1.5
S-1.001	50.00	5.28	18.150	0.035	0.0	0.0	0.0	3.44	60.8	4.7
S-1.002	50.00	5.43	14.150	0.053	0.0	0.0	0.0	3.29	58.1	7.1
s-1.003	50.00	5.56	11.150	0.067	0.0	0.0	0.0	2.39	42.2	9.1

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)		Base Flow (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-1.004 S-1.005			81.6 81.6	0.023 0.031	0.00		0.600	0		Pipe/Conduit Pipe/Conduit	€
S-1.006 S-1.007	40.566	0.288	140.9	0.029 0.022	0.00	0.0	0.600	0	300	Pipe/Conduit Pipe/Conduit	<b>6</b>
S-1.008			94.8	0.005	0.00		0.600	0		Pipe/Conduit	•
S-2.000 S-2.001				0.005	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
S-1.009	17.653	0.552	32.0	0.000	0.00	0.0	0.600	0	300	Pipe/Conduit	•
S-3.000 S-3.001			75.2 66.2	0.006 0.017	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	€

### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-1.004 S-1.005 S-1.006 S-1.007 S-1.008	50.00 50.00 50.00 50.00 49.73	6.65 7.45 7.96	9.985 9.300 8.636 8.438 8.150	0.090 0.121 0.150 0.172	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0 0.0	1.45 1.74 1.00 1.32	57.6 123.1 70.9 93.5 114.2	12.2 16.4 20.4 23.3 23.8
S-2.000 S-2.001	50.00 50.00	5.46	7.800 7.529	0.177 0.005 0.005	0.0	0.0	0.0	1.00	17.7 17.7	0.7
S-1.009 S-3.000 S-3.001	49.42 50.00 50.00	5.25	7.232 8.630 8.400	0.182 0.006 0.023	0.0	0.0	0.0	2.79 1.16 1.24	197.2 20.5 21.9	24.4 0.8 3.1

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PN	Length	Fall	Slope	I.Area	T.E.	Ba	ıse	k	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-4.000	13.626	0.250	54.5	0.010	5.00		0.0	0.600	0	150	Pipe/Conduit	₫*
S-4.001	13.607	0.136	100.3	0.007	0.00		0.0	0.600	0	150	Pipe/Conduit	<u>-</u>
S-4.002	7.463	0.514	14.5	0.009	0.00		0.0	0.600	0	150	Pipe/Conduit	•
												•
s-3,002	2.971	0.028	104.9	0.000	0.00		0.0	0.600	0	150	Pipe/Conduit	₫*
											1 -,	•
S-5.000	36 875	0 365	101 0	0.027	5.00		0 0	0.600	0	225	Pipe/Conduit	<u> </u>
									-		± '	ð
S-5.001	28.023	0.166	169.1	0.035	0.00		0.0	0.600	0	225	Pipe/Conduit	₩.
S-6.000	6.161	0.061	100.9	0.003	5.00		0.0	0.600	0	150	Pipe/Conduit	₩.
S-6.001	12.798	0.279	45.9	0.010	0.00		0.0	0.600	0	150	Pipe/Conduit	

### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-4.000	50.00		8.950	0.010	0.0	0.0	0.0	1.37	24.1	1.3
S-4.001 S-4.002	50.00		8.700 8.564	0.017	0.0	0.0	0.0	1.00	17.7 47.0	2.3
S-3.002	50.00	5.61	8.050	0.049	0.0	0.0	0.0	0.98	17.3	6.6
S-5.000 S-5.001	50.00		7.625 7.260	0.027 0.062	0.0	0.0	0.0	1.30 1.00	51.7 39.9	3.7 8.4
S-6.000 S-6.001	50.00	5.10 5.25	8.450 8.389	0.003 0.013	0.0	0.0	0.0	1.00	17.7 26.3	0.4

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PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	ase (1/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-5.002	16.414	0.244	67.3	0.000	0.00	0.0	0.600	0	150	Pipe/Conduit	•
S-7.000 S-7.001		0.168 0.067		0.002	5.00		0.600	0		Pipe/Conduit Pipe/Conduit	•
			100.9	0.002 0.008 0.018 0.014	5.00 0.00 0.00 0.00	0.0	0.600 0.600 0.600 0.600	0 0 0	150 150	Pipe/Conduit Pipe/Conduit Pipe/Conduit Pipe/Conduit	999
S-9.000 S-9.001 S-9.002	10.679		100.9	0.002 0.003 0.002	5.00 0.00 0.00	0.0	0.600 0.600 0.600	0 0	150	Pipe/Conduit Pipe/Conduit Pipe/Conduit	9 6

### Network Results Table

PN	Rain (mm/hr)	T.C.	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-5.002	50.00	6.16	7.094	0.075	0.0	0.0	0.0	1.23	21.7	10.2
S-7.000 S-7.001	50.00 50.00		8.150 7.982	0.002	0.0	0.0	0.0	1.00	17.7 17.7	0.2
S-8.000 S-8.001 S-8.002 S-8.003	50.00 50.00 50.00 50.00	5.21 5.70	7.570 7.531 7.442 7.156	0.002 0.010 0.028 0.042	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00 1.00	17.7 17.7 17.7	0.3 1.4 3.8 5.8
S-9.000 S-9.001 S-9.002	50.00 50.00 50.00	5.48	8.050 7.868 7.762	0.002 0.004 0.007	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.00 1.00 1.00	17.7 17.7 17.7	0.2 0.6 0.9
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PN	Length	Fall	STope	1.Area	T.E.	Ba	ase	ĸ	HYD	DIA	Section Type	Auto
	(m)	(m)	(1:X)	(ha)	(mins)	Flow	(1/s)	(mm)	SECT	(mm)		Design
S-8.004	18.299	0.181	101.1	0.025	0.00		0.0	0.600	0	225	Pipe/Conduit	•
s-10.000	10.397	0.700	14.9	0.014	5.00		0.0	0.600	0	150	Pipe/Conduit	€
S-10.001	10.452	0.104	100.3	0.003	0.00		0.0	0.600	0	150	Pipe/Conduit	ď
s-7.002	4.181	0.024	174.2	0.002	0.00		0.0	0.600	0	225	Pipe/Conduit	•
S-1.010	23.624	0.092	256.8	0.000	0.00		0.0	0.600	0	300	Pipe/Conduit	ď
S-11.000 S-11.001 S-11.002	28.002	0.117		0.035 0.030 0.000	5.00 0.00 0.00		0.0	0.600 0.600 0.600	0 0	300	Pipe/Conduit Pipe/Conduit Pipe/Conduit	<del>0</del>

### Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL E	I.Area (ha)	Σ Base Flow (1/s)		Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
S-8.004	50.00	6.13	6.960	0.074	0.0	0.0	0.0	1.30	51.7	10.1
S-10.000 S-10.001	50.00 50.00		8.250 7.550	0.014	0.0	0.0	0.0	2.63	46.4 17.7	1.8
S-7.002	50.00	6.20	6.779	0.096	0.0	0.0	0.0	0.99	39.3	13.0
S-1.010	48.28	8.70	6.680	0.402	0.0	0.0	0.0	0.98	69.0	52.6
S-11.000 S-11.001 S-11.002	50.00 50.00 50.00	5.96	7.300 7.175 7.058	0.035 0.066 0.066	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	1.01 1.01 5.20	71.5 71.5 367.7	4.8 8.9 8.9
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PN Length Fall Slope I.Area T.E. Base k HYD DIA Section Type Auto (m) (m) (1:X) (ha) (mins) Flow (1/s) (mm) SECT (mm) Design

S-1.011 32.208 1.738 18.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit of S-1.012 14.136 0.039 362.5 0.000 0.00 0.0 0.600 o 300 Pipe/Conduit

#### Network Results Table

PN Rain T.C. US/IL E I.Area E Base Foul Add Flow Vel Cap Flow (mm/hr) (mins) (m) (ha) Flow (l/s) (l/s) (1/s) (m/s) (1/s) 
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MH Name	MH CL (		MH Depth (m)	Coni	MH nection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-1	21.3	304	1.350	Open	Manhole	600	S-1.000	19.954	150				
MH-S-2	19.5	500	1.350	Open	Manhole	600	s-1.001	18.150	150	s-1.000	18.150	150	
MH-S-3	15.5	500	1.350	Open	Manhole	600	s-1.002	14.150	150	s-1.001	14.150	150	
MH-S-4	12.5	500	1.350	Open	Manhole	600	s-1.003	11.150	150	s-1.002	11.150	150	
MH-S-5	11.4	10	1.425	Open	Manhole	600	S-1.004	9.985	225	s-1.003	10.060	150	
MH-S-6	10.8	300	1.500	Open	Manhole	1050	s-1.005	9.300	300	s-1.004	9.375	225	
MH-S-7	10.5	550	1.914	Open	Manhole	1050	s-1.006	8.636	300	s-1.005	8.636	300	
MH-S-8	10.2	220	1.782	Open	Manhole	1050	s-1.007	8.438	300	s-1.006	8.438	300	
MH-S-9	9.6	550	1.500	Open	Manhole	1050	S-1.008	8.150	300	s-1.007	8.150	300	
MH-S-10	8.8	350	1.050	Open	Manhole	600	S-2.000	7.800	150				
MH-S-11	9.1	.00	1.571	Open	Manhole	600	s-2.001	7.529	150	s-2.000	7.529	150	
MH-S-12	9.4	20	2.188	Open	Manhole	1050	s-1.009	7.232	300	s-1.008	7.920	300	688
										s-2.001	7.382	150	
MH-S-13	9.3	880	0.750	Open	Manhole	600	s-3.000	8.630	150				
MH-S-14	9.1	.50	0.750	Open	Manhole	600	s-3.001	8.400	150	s-3.000	8.400	150	
MH-S-15	9.7	00	0.750	Open	Manhole	600	S-4.000	8.950	150				
MH-S-16	9.4	150	0.750	Open	Manhole	600	S-4.001	8.700	150	s-4.000	8.700	150	
MH-S-17	9.4	150	0.886	Open	Manhole	600	S-4.002	8.564	150	s-4.001	8.564	150	
MH-S-18	9.4	100	1.350	Open	Manhole	600	s-3.002	8.050	150	s-3.001	8.050	150	
										s-4.002	8.050	150	
MH-S-19	8.4	150	0.825	Open	Manhole	600	s-5.000	7.625	225				
MH-S-20	9.1	.20	1.860	Open	Manhole	1050	s-5.001	7.260	225	s-5.000	7.260	225	
MH-S-21	9.2	200	0.750	Open	Manhole	600	s-6.000	8.450	150				
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MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-22	9.200	0.811	Open Manhol	e 600	s-6.001	8.389	150	s-6.000	8.389	150	
MH-S-23	9.460	2.366	Open Manhol	e 1050	s-5.002	7.094	150	S-5.001	7.094	225	
								S-6.001	8.110	150	1016
MH-S-24	8.900	0.750	Open Manhol	e 600	s-7.000	8.150	150				
MH-S-25	8.900	0.918	Open Manhol	e 600	s-7.001	7.982	150	s-7.000	7.982	150	
MH-S-26	8.320	0.750	Open Manhol	e 600	S-8.000	7.570	150				
MH-S-27	8.400	0.869	Open Manhol	e 600	S-8.001	7.531	150	S-8.000	7.531	150	
MH-S-28	8.700	1.258	Open Manhol	e 600	S-8.002	7.442	150	S-8.001	7.442	150	
MH-S-29	9.150	1.994	Open Manhol	e 1050	S-8.003	7.156	150	S-8.002	7.156	150	
MH-S-30	8.800	0.750	Open Manhol	e 600	s-9.000	8.050	150				
MH-S-31	9.100	1.232	Open Manhol	e 600	s-9.001	7.868	150	S-9.000	7.868	150	
MH-S-32	9.340	1.578	Open Manhol	e 600	S-9.002	7.762	150	S-9.001	7.762	150	
MH-S-33	9.340	2.380	Open Manhol	e 1050	S-8.004	6.960	225	S-8.003	7.035	150	
								S-9.002	7.687	150	652
MH-S-34	9.000	0.750	Open Manhol	e 600	S-10.000	8.250	150				
MH-S-35	8.900	1.350	Open Manhol	e 600	S-10.001	7.550	150	S-10.000	7.550	150	
MH-S-36	9.300	2.521	Open Manhol	e 1050	s-7.002	6.779	225	S-7.001	7.914	150	1060
								S-8.004	6.779	225	
								S-10.001	7.446	150	592
MH-S-37	9.400	2.720	Open Manhol	e 1050	S-1.010	6.680	300	S-1.009	6.680	300	
								S-3.002	8.022	150	1192
								S-5.002	6.850	150	20
								S-7.002	6.755	225	

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MH Name	MH CL (m)	MH Depth (m)		MH ection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MH-S-38	8.400	1.100	Open M	Manhole	1050	s-11.000	7.300	300				
MH-S-39	8.400	1.225	Open M	Manhole	1050	S-11.001	7.175	300	s-11.000	7.175	300	
MH-S-40	9.000	1.942	Open M	Manhole	1050	S-11.002	7.058	300	s-11.001	7.058	300	
MH-S-41	9.100	3.200	Open M	Manhole	1200	S-1.011	5.900	300	S-1.010	6.588	300	688
									s-11.002	5.900	300	
MH-S-42	6.350	2.188	Open M	Manhole	1000	S-1.012	4.162	300	S-1.011	4.162	300	
MH-S-	6.500	2.377	Open M	Manhole	1000		OUTFALL		S-1.012	4.123	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-1	418218.177	564656.696	418218.177	564656.696	Required	•
MH-S-2	418217.419	564636.359	418217.419	564636.359	Required	
MH-S-3	418230.888	564604.312	418230.888	564604.312	Required	
MH-S-4	418242.414	564578.257	418242.414	564578.257	Required	1

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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-5	418243.918	564558.732	418243.918	564558.732	Required	
MH-S-6	418269.068	564515.776	418269.068	564515.776	Required	
MH-S-7	418294.334	564467.855	418294.334	564467.855	Required	
MH-S-8	418323.940	564429.830	418323.940	564429.830	Required	
MH-S-9	418347.372	564396.716	418347.372	564396.716	Required	
MH-S-10	418370.109	564345.830	418370.109	564345.830	Required	6
MH-S-11	418359.115	564370.915	418359.115	564370.915	Required	4
MH-S-12	418365.344	564384.368	418365.344	564384.368	Required	
MH-S-13	418373.491	564429.297	418373.491	564429.297	Required	
MH-S-14	418387.573	564419.248	418387.573	564419.248	Required	
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-15	418347.184	564399.604	418347.184	564399.604	Required	•
MH-S-16	418358.254	564391.659	418358.254	564391.659	Required	1
MH-S-17	418370.457	564393.844	418370.457	564393.844	Required	
MH-S-18	418374.456	564400.144	418374.456	564400.144	Required	
MH-S-19	418426.874	564345.131	418426.874	564345.131	Required	
MH-S-20	418396.692	564366.318	418396.692	564366.318	Required	<b>So.</b>
MH-S-21	418363.851	564369.353	418363.851	564369.353	Required	Ţ
MH-S-22	418363.851	564375.514	418363.851	564375.514	Required	
MH-S-23	418373.407	564381.908	418373.407	564381.908	Required	
MH-S-24	418395.667	564406.447	418395.667	564406.447	Required	,
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-25	418385.888	564392.553	418385.888	564392.553	Required	V
MH-S-26	418431.043	564350.108	418431.043	564350.108	Required	<b>\</b>
MH-S-27	418427.989	564352.616	418427.989	564352.616	Required	0
MH-S-28	418420.465	564357.451	418420.465	564357.451	Required	6
MH-S-29	418396.545	564373.700	418396.545	564373.700	Required	6
MH-S-30	418415.688	564370.425	418415.688	564370.425	Required	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
MH-S-31	418400.533	564380.743	418400.533	564380.743	Required	0.
MH-S-32	418391.570	564386.546	418391.570	564386.546	Required	<b>P.</b>
MH-S-33	418386.621	564380.753	418386.621	564380.753	Required	X
MH-S-34	418392.082	564413.970	418392.082	564413.970	Required	<b>P</b>
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MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MH-S-35	418386.310	564405.322	418386.310	564405.322	Required	1
MH-S-36	418380.483	564396.645	418380.483	564396.645	Required	
MH-S-37	418376.535	564398.021	418376.535	564398.021	Required	
MH-S-38	418446.130	564378.270	418446.130	564378.270	Required	<i>A</i> =
MH-S-39	418421.568	564395.429	418421.568	564395.429	Required	0.
MH-S-40	418398.528	564411.342	418398.528	564411.342	Required	6
MH-S-41	418389.815	564417.559	418389.815	564417.559	Required	
MH-S-42	418419.965	564428.888	418419.965	564428.888	Required	
MH-S-	418427.558	564416.965			No Entry	

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### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.000	0	150	MH-S-1	21.304	19.954	1.200	Open Manhole	600
S-1.001	0	150	MH-S-2	19.500	18.150	1.200	Open Manhole	600
S-1.002	0	150	MH-S-3	15.500	14.150	1.200	Open Manhole	600
S-1.003	0	150	MH-S-4	12.500	11.150	1.200	Open Manhole	600
S-1.004	0	225	MH-S-5	11.410	9.985	1.200	Open Manhole	600
S-1.005	0	300	MH-S-6	10.800	9.300	1.200	Open Manhole	1050
S-1.006	0	300	MH-S-7	10.550	8.636	1.614	Open Manhole	1050
S-1.007	0	300	MH-S-8	10.220	8.438	1.482	Open Manhole	1050
S-1.008	0	300	MH-S-9	9.650	8.150	1.200	Open Manhole	1050
S-2.000	0	150	MH-S-10	8.850	7.800	0.900	Open Manhole	600
S-2.001	0	150	MH-S-11	9.100	7.529	1.421	Open Manhole	600

### <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.000	20.352	11.3	MH-S-2	19.500	18.150	1.200	Open Manhole	600
S-1.001	34.762	8.7	MH-S-3	15.500	14.150	1.200	Open Manhole	600
S-1.002	28.491	9.5	MH-S-4	12.500	11.150	1.200	Open Manhole	600
S-1.003	19.583	18.0	MH-S-5	11.410	10.060	1.200	Open Manhole	600
S-1.004	49.777	81.6	MH-S-6	10.800	9.375	1.200	Open Manhole	1050
S-1.005	54.174	81.6	MH-S-7	10.550	8.636	1.614	Open Manhole	1050
S-1.006	48.192	243.3	MH-S-8	10.220	8.438	1.482	Open Manhole	1050
S-1.007	40.566	140.9	MH-S-9	9.650	8.150	1.200	Open Manhole	1050
S-1.008	21.805	94.8	MH-S-12	9.420	7.920	1.200	Open Manhole	1050
			MH-S-11	9.100	7.529		Open Manhole	
S-2.001	14.825	100.9	MH-S-12	9.420	7.382	1.888	Open Manhole	1050
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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W
	sect	(111111)	Name	(111)	(111)	(111)	Connection	(mm)
S-1.009	0	300	MH-S-12	9.420	7.232	1.888	Open Manhole	1050
s-3.000	0	150	MH-S-13	9.380	8.630	0.600	Open Manhole	600
S-3.001	0	150	MH-S-14	9.150	8.400	0.600	Open Manhole	600
S-4.000	0	150	MH-S-15	9.700	8.950	0.600	Open Manhole	600
S-4.001	0	150	MH-S-16	9.450	8.700	0.600	Open Manhole	600
S-4.002	0	150	MH-S-17	9.450	8.564	0.736	Open Manhole	600
s-3.002	0	150	MH-S-18	9.400	8.050	1.200	Open Manhole	600

## <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-1.009	17.653	32.0	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
S-3.000 S-3.001			MH-S-14 MH-S-18	9.150 9.400	8.400 8.050		Open Manhole Open Manhole	
S-4.001	13.607	100.3	MH-S-16 MH-S-17 MH-S-18	9.450 9.450 9.400	8.700 8.564 8.050	0.736	Open Manhole Open Manhole Open Manhole	600 600 600
S-3.002	2.971	104.9	MH-S-37	9.400	8.022	1.228	Open Manhole	1050

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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-5.000	0	225	MH-S-19	8.450	7.625	0.600	Open Manhole	600
S-5.001	0	225	MH-S-20	9.120	7.260	1.635	Open Manhole	1050
S-6.000	0	150	MH-S-21	9.200	8.450	0.600	Open Manhole	600
S-6.001	0	150	MH-S-22	9.200	8.389	0.661	Open Manhole	600
S-5.002	0	150	MH-S-23	9.460	7.094	2.216	Open Manhole	1050
s-7.000	0	150	MH-S-24	8.900	8.150	0.600	Open Manhole	600
s-7.001	0	150	MH-S-25	8.900	7.982	0.768	Open Manhole	600
S-8.000	0	150	MH-S-26	8.320	7.570	0.600	Open Manhole	600

## Downstream Manhole

PN	Length (m)	Slope (1:X)		C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
			MH-S-20 MH-S-23	9.120 9.460	7.260 7.094		Open Manhole Open Manhole	
			MH-S-22 MH-S-23	9.200 9.460	8.389 8.110		Open Manhole Open Manhole	600 1050
S-5.002	16.414	67.3	MH-S-37	9.400	6.850	2.400	Open Manhole	1050
			MH-S-25 MH-S-36		7.982 7.914		Open Manhole Open Manhole	600 1050
s-8.000	3.952	100.9	MH-S-27	8.400	7.531	0.719	Open Manhole	600

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### <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-8.001	0	150	MH-S-27	8.400	7.531	0.719	Open Manhole	600
S-8.002	0	150	MH-S-28	8.700	7.442	1.108	Open Manhole	600
S-8.003	0	150	MH-S-29	9.150	7.156	1.844	Open Manhole	1050
S-9.000	0	150	MH-S-30	8.800	8.050	0.600	Open Manhole	600
s-9.001	0	150	MH-S-31	9.100	7.868	1.082	Open Manhole	600
S-9.002	0	150	MH-S-32	9.340	7.762	1.428	Open Manhole	600
S-8.004	0	225	MH-S-33	9.340	6.960	2.155	Open Manhole	1050
S-10.000	0	150	MH-S-34	9.000	8.250	0.600	Open Manhole	600
S-10.001	0	150	MH-S-35	8.900	7.550	1.200	Open Manhole	600

### <u>Downstream Manhole</u>

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-8.001	8.944	100.9	MH-S-28	8.700	7.442	1.108	Open Manhole	600
S-8.002	28.917	100.9	MH-S-29	9.150	7.156	1.844	Open Manhole	1050
S-8.003	12.175	100.9	MH-S-33	9.340	7.035	2.155	Open Manhole	1050
s-9.000	18.334	100.9	MH-S-31	9.100	7.868	1.082	Open Manhole	600
S-9.001	10.679	100.9	MH-S-32	9.340	7.762	1.428	Open Manhole	600
S-9.002	7.619	100.9	MH-S-33	9.340	7.687	1.503	Open Manhole	1050
S-8.004	18.299	101.1	MH-S-36	9.300	6.779	2.296	Open Manhole	1050
S-10.000	10.397	14.9	MH-S-35	8.900	7.550	1.200	Open Manhole	600
S-10.001	10.452	100.3	MH-S-36	9.300	7.446	1.704	Open Manhole	1050
			C	1002 20	120 Tmm			

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## <u>Upstream Manhole</u>

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S-7.002	0	225	MH-S-36	9.300	6.779	2.296	Open Manhole	1050
S-1.010	0	300	MH-S-37	9.400	6.680	2.420	Open Manhole	1050
S-11.000	0	300	MH-S-38	8.400	7.300	0.800	Open Manhole	1050
S-11.001	0	300	MH-S-39	8.400	7.175	0.925	Open Manhole	1050
S-11.002	0	300	MH-S-40	9.000	7.058	1.642	Open Manhole	1050
S-1.011	0	300	MH-S-41	9.100	5.900	2.900	Open Manhole	1200
S-1.012	0	300	MH-S-42	6.350	4.162	1.888	Open Manhole	1000

## 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)
S-7.002	4.181	174.2	MH-S-37	9.400	6.755	2.420	Open Manhole	1050
S-1.010	23.624	256.8	MH-S-41	9.100	6.588	2.212	Open Manhole	1200
S-11.000 S-11.001 S-11.002	28.002	239.3	MH-S-40		7.175 7.058 5.900	1.642	Open Manhole Open Manhole Open Manhole	
S-1.011 S-1.012			MH-S-42 MH-S-	6.350 6.500	4.162 4.123		Open Manhole Open Manhole	1000 1000

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### Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Туре	Name	(%)	Area (ha)	Area (ha)	(ha)
1.000	User	_	100	0.011	0.011	0.011
1.001	User	_	100	0.024	0.024	0.024
1.002	User	_	100	0.018	0.018	0.018
1.003	User	_	100	0.015	0.015	0.015
1.004	User	_	100	0.023	0.023	0.023
1.005	User	_	100	0.031	0.031	0.031
1.006	User	_	100	0.029	0.029	0.029
1.007	User	_	100	0.022	0.022	0.022
1.008	User	_	100	0.005	0.005	0.005
2.000	User	_	100	0.005	0.005	0.005
2.001	_	-	100	0.000	0.000	0.000
1.009	_	_	100	0.000	0.000	0.000
3.000	User	_	50	0.012	0.006	0.006
3.001	User	_	50	0.035	0.017	0.017
4.000	User	_	100	0.007	0.007	0.007
	User	-	30	0.011	0.003	0.010
4.001	User	_	100	0.007	0.007	0.007
4.002	User	-	50	0.015	0.007	0.007
	User	-	50	0.003	0.001	0.009
3.002	-	-	100	0.000	0.000	0.000
5.000	User	-	50	0.055	0.027	0.027
5.001	User	_	50	0.046	0.023	0.023
	User	_	30	0.039	0.012	0.035
6.000	User	_	100	0.002	0.002	0.002
	User	_	30	0.004	0.001	0.003
6.001	User	-	100	0.008	0.008	0.008
F 000	User	-	30	0.009	0.003	0.010
5.002	_	-	100	0.000	0.000	0.000
7.000	User	-	100	0.002	0.002	0.002
7.001	User	-	100	0.002	0.002	0.002
8.000	User	-	100	0.002	0.002	0.002
8.001	User	-	100	0.008	0.008	0.008
	User	-	50	0.002	0.001	0.008
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# Area Summary for Storm

Pipe	PIMP	PIMP	PIMP	Gross	Imp.	Pipe Total
Number	Туре	Name	(%)	Area (ha)	Area (ha)	(ha)
8.002	User	_	100	0.011	0.011	0.011
	User	-	50	0.002	0.001	0.012
	User	-	52	0.002	0.001	0.013
	User	-	100	0.002	0.002	0.015
	User	-	30	0.007	0.002	0.018
8.003	User	-	100	0.010	0.010	0.010
	User	-	100	0.001	0.001	0.011
	User	-	100	0.002	0.002	0.014
	User	-	30	0.002	0.001	0.014
9.000	User	-	100	0.002	0.002	0.002
9.001	User	-	100	0.002	0.002	0.002
	User	-	100	0.001	0.001	0.003
9.002	User	-	100	0.002	0.002	0.002
8.004	User	-	100	0.021	0.021	0.021
	User	-	30	0.003	0.001	0.022
	User	-	30	0.010	0.003	0.025
10.000	User	-	100	0.012	0.012	0.012
	User	-	30	0.004	0.001	0.014
10.001	User	-	100	0.002	0.002	0.002
	User	-	30	0.004	0.001	0.003
7.002	User	-	100	0.002	0.002	0.002
1.010	-	-	100	0.000	0.000	0.000
11.000	User	-	50	0.071	0.035	0.035
11.001	User	-	50	0.060	0.030	0.030
11.002	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
1.012	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.684	0.468	0.468

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#### Simulation Criteria for Storm

Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800

Areal Reduction Factor 1.000 Foul Sewage per hectare (1/s) 0.000 Flow per Person per Day (1/per/day) 0.000

Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60

Hot Start Level (mm) 0 MADD Factor \* 10m<sup>3</sup>/ha Storage 0.000 Output Interval (mins) 1

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Return Period (years) 2 Ratio R 0.350 Cv (Winter) 0.840 Region England and Wales Profile Type Summer Storm Duration (mins) 30

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#### Online Controls for Storm

### Hydro-Brake® Optimum Manhole: MH-S-41, DS/PN: S-1.011, Volume (m³): 5.9

Unit Reference	MD-SHE-0054-2000-2400-2000	Sump Available	Yes
Design Head (m)	2.400	Diameter (mm)	54
Design Flow $(1/s)$	2.0	Invert Level (m) 5.	900
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm) 1	200
Application	Surface		

Control Points	Head (m) Fl	ow (1/s)	Control Points	Head (m)	Flow (1/s)
Design Point (Calculated)	2.400	2.0	Kick-Flo®	0.488	1.0
Flush-Flo™	0.242	1.2 N	Mean Flow over Head Range	_	1.4

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 (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)	Depth (m)	Flow (1/s)
0.100	1.1	0.600	1.1	1.600	1.7	2.600	2.1	5.000	2.8	7.500	3.4
0.200	1.2	0.800	1.2	1.800	1.8	3.000	2.2	5.500	2.9	8.000	3.5
0.300	1.2	1.000	1.3	2.000	1.8	3.500	2.4	6.000	3.1	8.500	3.6
0.400	1.1	1.200	1.5	2.200	1.9	4.000	2.5	6.500	3.2	9.000	3.7
0.500	1.0	1.400	1.6	2.400	2.0	4.500	2.7	7.000	3.3	9.500	3.8

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## Offline Controls for Storm

Weir Manhole: MH-S-41, DS/PN: S-1.011, Loop to PN: S-1.012

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 8.300

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#### Storage Structures for Storm

### Filter Drain Manhole: MH-S-26, DS/PN: S-8.000

Infiltration Coefficient Base (m/hr	) 0.00000	Trench Width (	(m)	0.7	Slope (1:X)	240.0
Infiltration Coefficient Side (m/hr	) 0.00000	Trench Length (	(m)	4.0	Cap Volume Depth (m)	0.000
Safety Facto	r 2.0	Pipe Diameter (	(m) (	0.150 Cap	Infiltration Depth (m)	0.000
Porosit	y 0.30	Pipe Depth above Invert (	(m) (	0.075		
Invert Level (m	7.570	Number of Pir	ne s	1		

#### Filter Drain Manhole: MH-S-28, DS/PN: S-8.002

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m	n) 0.7	Slope (1:X) 100.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m	n) 29.0	Cap Volume Depth (m) 0.000
Safety Factor	2.0	Pipe Diameter (m	n) 0.150	Cap Infiltration Depth (m) 0.000
Porosity	0.30	Pipe Depth above Invert (m	n) 0.075	
Invert Level (m)	7.442	Number of Pipe	es 1	

#### Filter Drain Manhole: MH-S-39, DS/PN: S-11.001

Infiltration Coefficient Base (	(m/hr) 0.000	)0 Tre	ench Width (m)	0.7	S	lope (1:X)	240.0
Infiltration Coefficient Side (	(m/hr) 0.000	00 Tren	nch Length (m)	30.0	Cap Volume	Depth (m)	0.000
Safety F	Tactor 2	.0 Pipe	e Diameter (m'	0.300	Cap Infiltration	Depth (m)	0.000
Por	cosity 0.	30 Pipe Depth abo	ove Invert (m	0.075			
Invert Leve	el (m) 7.1	75 Ni	umber of Pipes	s 1			

#### Filter Drain Manhole: MH-S-40, DS/PN: S-11.002

Infiltration Coefficient Base (m	m/hr) 0.00000	Trench Width	(m)	0.7	Slope (1:	X) 240.0
Infiltration Coefficient Side (m	m/hr) 0.00000	Trench Length	(m)	28.0	Cap Volume Depth (	(m) 0.000
Safety Fa	actor 2.0	Pipe Diameter	(m)	0.300	Cap Infiltration Depth (	(m) 0.000
Porc	osity 0.30	Pipe Depth above Invert	(m)	0.075		
Invert Level	1 (m) 7.058	Number of Pi	pes	1		

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### Cellular Storage Manhole: MH-S-41, DS/PN: S-1.011

Invert Level (m) 5.900 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth	(m) A	rea (m²)	Inf. Area	(m²)	Depth	(m)	Area	(m²)	Inf.	Area	(m²)	Depth	(m)	Area	(m²)	Inf.	Area	(m²	)
0.	000	144.0	1	44.0	2.	400	1	44.0		2	288.0	2.	500		0.0		2	288.0	0

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#### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor \* 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (1/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (1/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 5 Number of Real Time Controls 0

#### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.900 Cv (Summer) 0.750 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

Profile(s)

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

Climate Change (%)

									Water	Surcharged	Flooded			Half Drain	Pipe	
	US/MH		Return	${\tt Climate}$	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow	
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(1/s)	(mins)	(1/s)	
S-1.000	MH-S-1	15 Winter	100	+45%					19.989	-0.115	0.000	0.12			6.3	
S-1.001	MH-S-2	15 Winter	100	+45%					18.212	-0.088	0.000	0.36			20.9	
S-1.002	MH-S-3	15 Winter	100	+45%					14.232	-0.068	0.000	0.57			32.0	
S-1.003	MH-S-4	15 Winter	100	+45%	100/15 Summer				11.377	0.077	0.000	1.03			40.7	
S-1.004	MH-S-5	15 Winter	100	+45%					10.165	-0.045	0.000	0.96			53.1	
S-1.005	MH-S-6	15 Winter	100	+45%					9.473	-0.127	0.000	0.61			70.8	
S-1.006	MH-S-7	15 Winter	100	+45%	100/15 Summer				9.047	0.111	0.000	1.24			82.6	
S-1.007	MH-S-8	15 Winter	100	+45%					8.709	-0.029	0.000	1.00			86.8	
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	US/MH		Level
PN	Name	Status	Exceeded
s-1.000	MH-S-1	OK	
S-1.001	MH-S-2	OK	
s-1.002	MH-S-3	OK	
S-1.003	MH-S-4	SURCHARGED	
S-1.004	MH-S-5	OK	
s-1.005	MH-S-6	OK	
S-1.006	MH-S-7	SURCHARGED	
S-1.007	MH-S-8	OK	

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PN	US/MH Name	Storm		Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.		Surcharged Depth (m)		Flow /	Overflow (1/s)	Half Drain Time (mins)	Pipe Flow (1/s)
S-1.008	MH-S-9	15 Winter	100	+45%					8.368	-0.082	0.000	0.88			88.1
S-2.000	MH-S-10	1440 Winter	100	+45%	100/360 Winter				8.238	0.288	0.000	0.01			0.2
S-2.001	MH-S-11	1440 Winter	100	+45%	100/15 Summer				8.238	0.560	0.000	0.01			0.2
S-1.009	MH-S-12	1440 Winter	100	+45%	100/15 Summer				8.238	0.707	0.000	0.03			5.6
s-3.000	MH-S-13	15 Winter	100	+45%					8.672	-0.108	0.000	0.18			3.4
S-3.001	MH-S-14	15 Winter	100	+45%					8.530	-0.020	0.000	0.65			13.5
S-4.000	MH-S-15	15 Winter	100	+45%					9.002	-0.098	0.000	0.26			5.7
	MH-S-16	15 Winter	100	+45%					8.785	-0.065	0.000	0.61			9.9
	MH-S-17	15 Winter	100	+45%					8.628	-0.086	0.000	0.38			15.2
	MH-S-18	15 Winter	100	+45%	100/15 Summer				8.377	0.177	0.000	2.63			28.5
	MH-S-19		100	+45%	100/15 Summer				8.361	0.511	0.000	0.28			13.7
	MH-S-20	15 Winter	100	+45%	100/15 Summer				8.326	0.841	0.000	0.72			26.7
	MH-S-21	15 Winter	100	+45%					8.485	-0.115	0.000	0.12			1.8
	MH-S-22		100	+45%					8.449	-0.090	0.000	0.34			8.1
	MH-S-23			+45%	100/15 Summer				8.243	0.999	0.000	1.57			31.7
		1440 Winter	100	+45%					8.237	-0.063	0.000	0.00			0.0
		1440 Winter			100/600 Winter				8.237	0.106	0.000	0.01			0.1
		1440 Winter		+45%	100/15 Summer				8.240	0.520	0.000	0.01		624	0.1
		1440 Winter		+45%	100/15 Summer				8.240	0.559	0.000	0.02			0.3
		1440 Winter		+45%	100/15 Summer				8.240	0.648	0.000	0.05		624	0.9
		1440 Winter		+45%	100/15 Summer				8.239	0.933	0.000	0.08			1.3
		1440 Winter			100/960 Winter				8.239	0.039	0.000	0.00			0.1
		1440 Winter	100		100/480 Winter				8.239	0.220	0.000	0.01			0.1
		1440 Winter	100		100/360 Winter				8.238	0.326	0.000	0.02			0.3
		1440 Winter	100		100/15 Summer				8.238	1.053	0.000	0.04			2.1
	MH-S-34		100	+45%	400/45				8.294	-0.106	0.000	0.19			7.9
		1440 Winter	100	+45%					8.237	0.537	0.000	0.03			0.5
		1440 Winter		+45%					8.237	1.233	0.000	0.10			2.6
		1440 Winter		+45%					8.237	1.257	0.000	0.19			11.4
S-11.000	MH-S-38	1440 Winter	100	+45%	100/120 Winter				8.236	0.636	0.000	0.02			1.1
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	US/MH		Level				
PN	Name	Status	Exceede				
S-1.008	MH-S-9	OK					
S-2.000	MH-S-10	SURCHARGED					
S-2.001	MH-S-11	SURCHARGED					
S-1.009	MH-S-12	SURCHARGED					
S-3.000	MH-S-13	OK					
S-3.001	MH-S-14	OK					
S-4.000	MH-S-15	OK					
S-4.001	MH-S-16	OK					
S-4.002	MH-S-17	OK					
S-3.002	MH-S-18	SURCHARGED					
S-5.000	MH-S-19	FLOOD RISK					
S-5.001	MH-S-20	SURCHARGED					
S-6.000	MH-S-21	OK					
S-6.001	MH-S-22	OK					
S-5.002	MH-S-23	SURCHARGED					
S-7.000	MH-S-24	OK					
S-7.001	MH-S-25	SURCHARGED					
S-8.000	MH-S-26	FLOOD RISK					
S-8.001	MH-S-27	FLOOD RISK					
S-8.002	MH-S-28	SURCHARGED					
S-8.003	MH-S-29	SURCHARGED					
S-9.000	MH-S-30	SURCHARGED					
S-9.001	MH-S-31	SURCHARGED					
S-9.002	MH-S-32	SURCHARGED					
S-8.004	MH-S-33	SURCHARGED					
S-10.000	MH-S-34	OK					
S-10.001	MH-S-35	SURCHARGED					
S-7.002	MH-S-36	SURCHARGED					
S-1.010	MH-S-37	SURCHARGED					
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US/MH Level
PN Name Status Exceeded

S-11.000 MH-S-38 FLOOD RISK

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PN	US/MH Name	Storm		Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.		Surcharged Depth (m)	Flooded Volume (m³)		Overflow (1/s)	Half Drain Time (mins)	Pipe Flow (1/s)
S-11.001	MH-S-39	1440 Winter	100	+45%	100/120 Winter				8.236	0.761	0.000	0.03		1176	2.0
S-11.002	MH-S-40	1440 Winter	100	+45%	100/120 Summer				8.236	0.878	0.000	0.01		1344	1.9
S-1.011	MH-S-41	1440 Winter	100	+45%	100/15 Summer			0	8.236	2.036	0.000	0.01	0.0	2088	2.0
S-1.012	MH-S-42	1440 Winter	100	+45%					4.203	-0.259	0.000	0.05			2.0

	US/MH		rever
PN	Name	Status	Exceeded

S-11.001 MH-S-39 FLOOD RISK S-11.002 MH-S-40 SURCHARGED S-1.011 MH-S-41 SURCHARGED S-1.012 MH-S-42 OK

