Hydrock

Proposed Development

Rail Central, Northamptonshire

Flood Risk Assessment, Hydraulic Modelling and Drainage Strategy Report (Part 1: Main SRFI Site)

Final Report

Ashfield Land Management Ltd

February 2018

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1.0 INTRODUCTION

This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our client Ashfield Land Management Ltd in support of an application for Development Consent under the Planning Act 2008, to be submitted to the Examining Authority, for the proposed development of 'Rail Central', a Strategic Rail Freight Interchange (SRFI) in Northamptonshire.

This report forms an appendix to the PEIR for the proposed development (**Appendix 14.1**).

The proposed development of the main site (the 'Main SRFI Site') is located within the administrative area of South Northamptonshire. Proposed highways works are situated at locations within South Northamptonshire and Northampton Borough, and are needed in order to mitigate relevant significant effects on the highway network arising for the development of the Main SRFI Site.

The Flood Risk Section of the National Networks National Policy Statement (NN NPS) has been reviewed and addressed within this report.

Local Planning Authorities are advised by the Government's *National Planning Policy Framework (NPPF)* to consult the Environment Agency (EA) on development proposals in areas at risk of flooding and/or for sites greater than 1ha in area.

This report has been prepared to satisfy any potential concerns the EA may have with the proposed development and to meet the requirements of NN NPS and NPPF through:

- Providing an assessment of whether the site is likely to be affected by flooding; and,
- Detailing the measures necessary to mitigate any flood risk identified, to ensure that the proposed development and end use would be safe, and that flood risk would not be increased elsewhere.

The report considers the requirements for undertaking a FRA as stipulated in NN NPS and NPPF. Only those requirements that are appropriate to a development of this nature have been considered in the compilation of this report.

This report has been prepared in accordance with current EA Policy and the requirements of the LLFA.

The Proposed Development can be considered as comprising the following main groupings of elements. FRA reports have been/will be provided for each element

- FRA Part 1 - the 'Main SFRI Site' on which the SRFI will be delivered (including A43 access and all rail infrastructure);
- FRA Part 2 - J.15a works including summary of Other Minor Highways works

2.0 SITE INFORMATION

2.1 Existing Situation (Main SRFI Site)

2.1.1 Location

Table.1: Site Referencing Information

Site Address	Rail Central, Northamptonshire
Grid Reference	472641, 254048 SP726540

2.1.2 Existing Land Use

The site is currently undeveloped and in agricultural use. The only built form within the site are farm storage buildings and gravelled access routes.

The site is located to the north of Blisworth and south of Milton Malsor with Northampton being beyond Milton Malsor to the north.

The overall site area is bordered by existing railway lines to the east and south, and by the A43 road to the west. To the north, and beyond the railway lines and A43 road is a mixture of undeveloped agricultural land with a number of small residential villages.

Two watercourses have been identified within the Main SFRI Site and these are the Milton Malsor Brook and the Unnamed Watercourse. The Unnamed Watercourse has its source on the southern site boundary and flows in a north westerly direction, under the Towcester Road, and into the Milton Malsor Brook. The Milton Malsor Brook is located within the western limit of the site and flows in a northerly direction.

2.2 Proposed Development

The Proposed Development is for a Strategic Rail Freight Interchange (SFRI) with associated highways works and ancillary development on land within the proposed 'Order Limits' in Northamptonshire in the East Midlands region of England, approximately 20km northwest of Milton Keynes and approximately 6km south of Northampton.

An application for Development Consent is required because the proposal is considered to comprise a Nationally Significant Infrastructure Project (NSIP) under the terms of subsections 26(3) to (7) of the PA2008.

The proposed development comprises the following key elements:

- A Road to Rail intermodal facility, including connections to the Northampton Loop Line, new rail sidings, gantry cranes, a container storage area, a train maintenance depot and facilities to transfer containers to Heavy Goods Vehicles (HGV);

- An Express Freight Terminal, including connections to the West Coast Main Line, a freight platform with associated loading and unloading facilities;

- Up to 740,000 sq.ft. (GIA)) of rail served logistics development;
- A new grade separated access point on the A43;
- Improvements to J15a of the M1;
- Other off site highways works;
- A lorry park;
- Control building/centre;
- Strategic open space and landscaping;
- Infrastructure to serve the development, including roads, an underpass, bus terminal and utilities infrastructure.

The Proposed Development can be considered as comprising the following main groupings of elements:

- The 'Main SFRI Site' on which the SRFI will be delivered (including A43 access and all rail infrastructure);
- J.15a works
- Other minor highways works

This part of the FRA (Part 1) considers the Main SRFI Site including the A43 access and all rail infrastructure. The key features of the proposed development of the Main SRFI Site are as follows:

- Demolition of existing buildings and structures;
- An intermodal freight terminal with direct connections to the Northampton Loop Line, capable of accommodating trains of up to 775m long, including up to 3 gantry cranes, container storage, a train maintenance depot and facilities to transfer containers to Heavy Goods Vehicles (HGV);
- An express freight terminal with direct connections to the West Coast Main Line, capable of accommodating trains of up to 240m long, a freight platform with associated loading and unloading facilities;
- Up to 702, 097 sq m (Gross External Area) of rail connected and rail served warehousing and ancillary service buildings including a lorry park, terminal control building and bus terminal;
- New road infrastructure including a new separated access point on the A34 (T), an internal site underpass (under Northampton Road) and necessary utilities infrastructure; and

- Strategic landscaping and open space including alterations to public rights of way, the creation of new ecological enhancement areas and publicly accessible open areas, flood attenuation, and the partial diversion of the Milton Malsor brook.

The extent of the Proposed Development for which consent is being sought is defined by a series of parameters. A masterplan has also been prepared which illustrates how the Proposed Development could be delivered within those parameters.

Construction of the Proposed Development will be phased over a number of years. Within the framework of the parameters, flexibility is required to enable floorspace to be delivered that meets specific occupier requirements that will only be known after Development Consent has been granted.

In order to effectively meet the demand which has been identified, it is necessary that that the DCO provides enough flexibility for the Applicant to accommodate changing occupier requirements and to give certainty to occupiers that they will be able to operate competitively without undue constraints imposed by the DCO during occupation.

The assessment work in this FRA has been undertaken to assess the reasonable worst-case on the basis of the fixed parameters which set out the location, extent and scale of the Proposed Development for which consent is sought.

3.0 ASSESSMENT OF FLOOD RISK

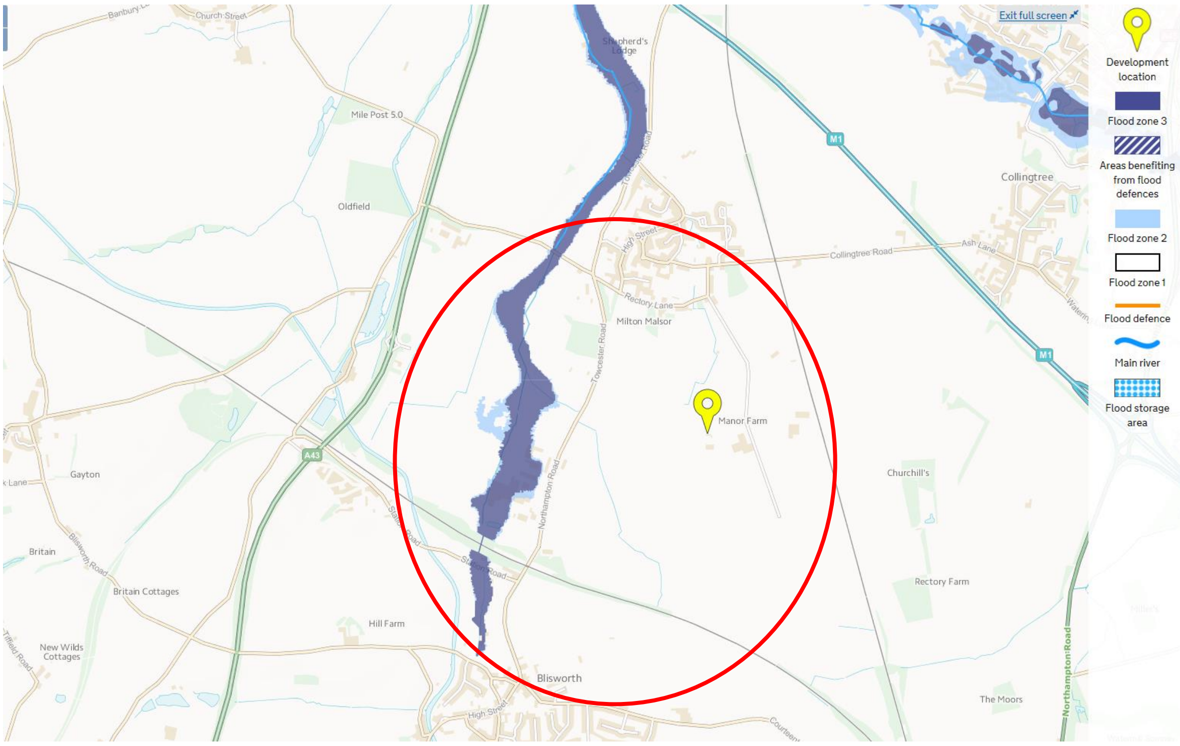
3.1 Fluvial and Tidal Flooding

The Main SFRI is shown by the EA's Flood Zone Mapping to be predominantly within Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%)). However, small areas of the Site immediately adjacent to the Milton Malsor Brook and the Unnamed Watercourse are shown to be at a potentially increased risk of flooding with some land categorised as being at medium and high risk. High risk is Flood Zone 3, which is considered to have a greater than 1 in 100 annual probability of river flooding (>1%) in any year. Medium risk is Flood Zone 2 which is land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

A plan locating both watercourses, along with other key features has been included within Appendix A.

Following discussions with the EA, modelling to produce the current Flood Zone mapping (Figure 1 below) was confirmed as having been produced using JFLOW modelling. The original JFLOW modelling used relatively coarse spatial data and considers flood risk over a wide area with a low resolution and as such is typically not suitable for determining site specific flood risk.

Figure 1: EA Flood Zone Mapping (approximate site location shown)



Two watercourses flow through the site. The largest is the Milton Malsor Brook which flows in a northerly direction through the western parcel of the site. There is also an Unnamed Watercourse that has its source within the approximate centre of the southern boundary and flows in a north westerly direction under Towcester Road before flowing into the Milton Malsor Brook a short distance beyond.

Both watercourses are rural and are crossed/ within culverts in a number of places. The Unnamed Watercourse is crossed by Towcester Road and a farm access culvert whilst the only formal structure on the Milton Malsor Brook is where it flows under Rectory Lane.

The EA have confirmed that they hold no information relating to historic flood events on the site. In addition, Northamptonshire County Council's (the LLFA) Strategic Flood Risk Assessment also makes no reference to any recorded historic incidents of fluvial flooding within the general Main SFRI site or immediately surrounding area.

However, anecdotal records provided by local residents indicate that the Main SFRI Site has previously experienced localised flooding and evidence has been provided in the form of photographs. These photographs confirm that flooding has occurred on the site is areas limited to lower lying areas that immediately border the watercourses. The information provided supports EA flood outlines in terms of general extents and mechanisms (i.e. location of out of bank flows and general flow routes).

Based on the current EA Flood Zone mapping, the majority of the site is shown to be within Flood Zone 1 and at low risk from fluvial flooding. However, the lower elevated sections of the site immediately adjacent to Milton Malsor Brook are currently within Flood Zone 3 and at high risk.

The northern section of the site is shown to be within Flood Zone 3 and potentially at high risk of fluvial flooding. The more elevated sections of the site to the south are shown to be at low risk and within Flood Zone 1. Following discussions with the EA it has been confirmed that site specific modelling is required to reliably assess existing levels of flood risk. This is detailed further in section 4.0.

Owing to the location of the site relative to tidally influenced areas the risk from this source is considered negligible and as such no further assessment will be required. The watercourses within the Study Area drain into the River Nene. The River Nene is not shown as being tidally influenced until around 65km north east of the downstream limit of the study area.

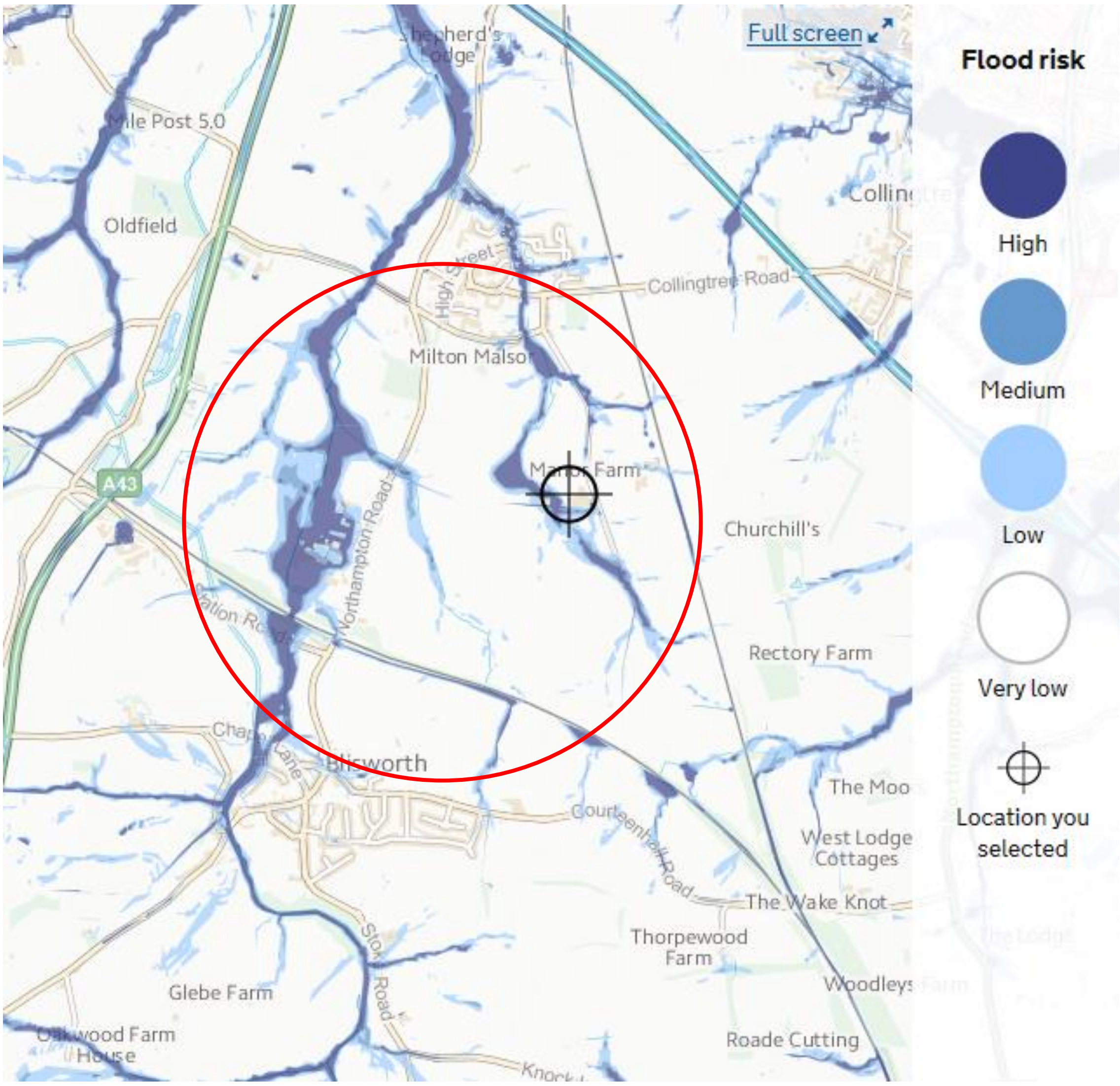
3.2 Surface Water Flooding

The Local Authority Strategic Flood risk Assessment (SFRA) identifies surface water flooding occurs as a result of overland flow from adjacent land and intense rainfall that is unable to soak into the ground (in the event that soil storage capacity is exceeded) or enter watercourses or engineered drainage systems. Any generated overland flows either drain into existing land drainage features or follow the general topography which can increase the potential of localised flooding in lower lying areas. The SFRA does not make reference to any known incidents of surface water flooding at the site or wider Milton Malsor area.

However, anecdotal records provided by local residents indicate that the site has previously experienced localised flooding and evidence has been provided in the form of photographs. These photographs confirm that historic flooding through the site has occurred but that it has not been extensive and, from the information provided, has been limited to lower lying areas of the Study Area.

Whilst the SFRA does not highlight any previously recorded surface water flooding within the site, the EA's Flooding from Surface Water mapping predicts areas at potential risk from this source through the western section of the site that closely match, but extended further, than the EA's fluvial flood map. Two additional flow routes through the eastern sections of the site are also shown. The first is from the high section of land to the west with potential surface flows in an easterly direction towards the Milton Malsor Brook. The second route is within the east of the site where flows are predicted to be directed by the topography in a northerly direction away from the site.

Figure 2: EA Flooding from Surface Water Mapping (approximate site location shown)



Whilst localised areas within the site are shown to be potentially at risk from surface water flooding, it is recognised that this mapping does not take account of existing sewer networks and/or land drainage ditches. The topographical survey has identified a number of small field ditches (width <2m) through the Study Area and as such these are considered likely to intercept a significant volume of potential surface water overland flows. Therefore, the outlines included in the EA's mapping are considered as being 'worst case' and to represent the event of a complete failure of the existing sewer and drainage network.

The topography of the site is such that any surface water flows generated within the site will flow in a generally northerly direction and drain away from the site.

It is therefore concluded that the site is at a lower risk of surface water flooding than is currently indicated by the EA's mapping owing to the presence of an existing field ditch network that will intercept and convey flows. However, the localised low points and valleys through the site will be at risk from surface water flooding in the event of blockage to this network.

3.3 Groundwater Flooding

Groundwater flooding is described by the SFRA as when water levels below ground rise above surface levels. This can be as a result of the water table rising after unusuallyprolonged rainfall. Flooding is most likely to occur in low lying areas underlain by permeable rocks (aquifers).

The British Geological Survey mapping, and a separate detailed Site Investigation Report (Report Ref: R/151171/001), indicates that the Site is predominantly underlain by the Dyrham Formation and the Whitby Mudstone formation and these are both considered as being low in permeability. As such, and given the Milton Malsor Brook and Unnamed Watercourse flow through the site, it is considered that groundwater levels would be in hydraulic connectivity with normal channel water levels but not to vary significantly over time. In order to adopt a conservative approach, the 1 in 1000 year fluvial outline from the modelling study is considered as being representative of the 'worst case' groundwater flooding scenario. The lower elevated sections of the Site that immediately border the watercourse are therefore considered to be at an increased risk from this source.

3.4 Infrastructure Failure Flooding

The SFRA does not make reference to any previously recorded incidents of infrastructure flooding within the site or surrounding area.

The site consists of mainly arable farmland with some smaller scale pastoral fields. As such, it is considered that there is only a limited engineered sewer network serving, or running through the site.

From the review of sewer records it is concluded that in the event of a failure (as a result of a blockage or collapse of the sewer) any generated overland flows would follow the existing topography and drain towards the two watercourse or other land drainage features within the site (i.e. field ditches) and drain towards the north. Any flooding as a result of an infrastructure failure would increase the flood risk but it is expected that this would only affect lower areas of the site before draining into existing land drainage features or watercourses. As such, and given that this is only considered to be a risk during exceedance event.

3.5 Flooding from Artificial Sources

The EA's Flooding from Reservoir Mapping shows that the Main SFRI Site is not within an area considered as being within the maximum extent of predicted flooding from artificial sources.

The Grand Union Canal abuts the site to the west and is shown by Ordnance Survey contour mapping to be a level above sections of the site and therefore there is the potential for inundation of the Main SFRI Site in the event of a failure or breach of the Grand Union Canal embankment. The risk of such a failure is considered to be low owing to the level of ongoing inspections and maintenance undertaken by the Canal & River Trust. The risk for this source is therefore considered as minimal and residual only.

3.6 Summary

The existing EA flood risk data shows that the lower lying areas within the western section of the site and those areas immediately adjacent to the Milton Malsor Brook to be at an increased risk of fluvial flooding and Flood Zone 3. The remainder of the site is shown as being within Flood Zone 1. The EA have also confirmed that the Flood Zone map is based on relatively coarse modelling and this requires confirmation in order to assess site specific flood risk.

Much of the site has been shown by the EA's Surface Water flood risk mapping as being at high risk from this source. However, the mapping to determine the predicted surface water extents is unlikely to make an allowance for drainage ditches and as such is considered to be a 'worst case' prediction. Nevertheless, these areas of the site are considered to remain at risk for surface water in localised areas particularly in the event of a failure of the local drainage network.

The area in the western parcel of the site is also considered to be at risk of flooding from infrastructure failure and also the 'worst case' groundwater flooding extent. The remainder of the site is concluded to be at low risk from all assessed sources.

4.0 HYDROLOGICAL & HYDRAULIC ASSESSMENT (BASELINE)

4.1 Background

The existing flood mapping within the Milton Malsor area is based on JFLOW modelling. This identifies a potential fluvial flood risk from the Milton Malsor Brook which is the main watercourse that flows in a northerly direction through the Study Area and between Blisworth to the south and Milton Malsor to the north. From a review, and from provided historical flooding information, it is considered that the flooding mechanisms/extents may differ from those currently shown on the EA's mapping. A second Unnamed watercourse flows in a north westerly direction through the Study Area and is a tributary of the Milton Malsor Brook.

The Environment Agency (EA) have raised concerns that the existing flood mapping does not suitably represent the mechanisms and therefore the type of flooding events, such as the anecdotal information, and it has been agreed that a more detailed 1D/2D modelling study be undertaken to assess the existing fluvial flood risk to the site and its immediate environs. The aim of this more detailed modelling will be to better represent the range of potential flooding mechanisms to the site and wider area, allow comparison to known flood events, and to provide a clearer understanding of the potential future flood risk to the site and wider area for given design events. The second watercourse through the site has not currently been modelled and, as such, there is a requirement to include this within the assessment.

The design fluvial events considered are:

- 1 in 20 year,
- 1 in 100 year,
- 1 in 100year plus 35% allowance for climate change.
- 1 in 200 year.
- The 1 in 1000 year event

These fluvial flows consider the 1 in 20 year fluvial event as it is commonly used to define the functional floodplain (Flood Zone 3b), the 100 and 1000 year events as these are used to define the Zone 3a (High Risk) and Zone 1 (Medium Risk) limits respectively, and an allowance for a 35% increase in the 100 year flows to take account of the potential impact of climate change on fluvial flows based on the Higher Central value for a design life of 100 years for less vulnerable development in accordance with current guidance. In addition the 1 in 200 year event it to be assessed to meet the local requirement of Northamptonshire County Council.

In addition to assessing the existing 'baseline' risks to the site for fluvial this modelling study also considers the post-development conditions to assess the potential impact of the proposed mitigation measures on local and wider area flood risk. These measures include the realignment and redesigning of both watercourses to accommodate the proposed development. The modelling of the post- development conditions are to ensure that the proposed works have no detrimental impact on flood risk either at the site or to properties elsewhere, and to identify any potential factors detrimentally impacting on flood risk within the wider area. Any mitigation measures identified have been modelled to investigate if they have any detrimental impact elsewhere.

The area of study has been discussed with the Environment Agency and has been defined so as to include the whole area that has the potential to impact on the site along with an area extending downstream sufficiently to demonstrate no detrimental impact elsewhere or boundary effects. The modelling includes two separate watercourses;

- the Milton Malsor Brook, and;
- the Unnamed Watercourse.

The Milton Malsor Brook is defined as a ‘Main River’ and flows in a predominantly northerly direction through the west section of the Study Area and ultimately drains into the River Nene.

The Unnamed Watercourse is an ‘Ordinary Watercourse’ and drains only a small catchment. This watercourse flows in a generally north westerly direction through the Study Area before joining the Milton Malsor Brook as it flows through the western section of the site.

4.2 Hydrological Modelling

The software used to assess return period flows is considered industry standard and, at the time of writing, is the most up-to-date version available. The software and versions used are detailed below:

- FEH CD-ROM Version 3 – Using the 2013 Rainfall Data
- WINFAP FEH Version 3.0.003 referencing HiFlows databased version 5 (to include years up to 2015)
- ReFH2 Version 2.2.

4.2.1.1 Milton Malsor Brook

The Flood Estimation Handbook (FEH) (2013) approach has been used to obtain the relevent descriptors for the Milton Malsor catchment. This has been defined to a point at the downstream limit of the site. The catchment area to this point has been confirmed as 12.04km^2 (grid reference 472073, 253393). From a review of LiDAR Data and comparison with the FEH catchment outline, it was evident that the FEH data omits an area beyond the Grand Union Canal which would in fact drain into the Milton Malsor Brook. As such, the catchment area was increased to make an allowance for this area and this results in a revised area of 12.55km^2.

A manual check of the SPR and BFIHOST values has also been undertaken using the methodology suggested within the EA’s Flood Estimation Guidance (Document Number 197_08). This involved overlaying the site-specific catchment (including the additional area) onto the soils map and determining the percentage of each HOST Class within the additional area added to the original FEH Catchment area.

The soil maps show that the additional area is underlain by HOST CLASS 18 (Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils). The HOST Class was taken from

Table 5.1 within Volume 5 of the Flood Estimation Handbook which provided associated SPR and BFI values for this HOST class of 30.8 and 0.589 respectively. Both of these values are less conservative (SPR is lower and BFI is higher) than those taken from the FEH Catchment Descriptors and included within Table 1 below. As such, it is considered that the SPR and BFI values originally generated are more conservative and these are therefore left unchanged.

The Catchment Descriptors generated are shown in Table 2 below.

Table 2: FEH (2013) The Milton Malsor Brook Catchment Descriptors

Descriptor	Value	Descriptor	Value	Descriptor	Value
AREA	12.55	RMED-2D	38.8	C(1 km)	-0.026
ALTBAR	113	SAAR	625	D1(1 km)	0.333
ASPBAR	41	SAAR4170	648	D2(1 km)	0.303
ASPVAR	0.39	SPRHOST	30.8	D3(1 km)	0.241
BFIHOST	0.589	URBCONC1990	-99999	E(1 km)	0.302
DPLBAR	3.42	URBEXT1990	0.0047	F(1 km)	2.498
DPSBAR	34.9	URBLOC1990	-99999		
FARL	1	D1	-0.02488		
LDP	6.54	D2	0.31202		
PROPWET	0.3	D3	0.30353		
RMED-1H	11.8	E	0.29991		
RMED-1D	29	F	2.51872		
PROPWET	0.52	C	-0.2585		

In line with best practice for a catchment of this nature, and noting that gauged data is not available for the watercourse itself, a Statistical analysis approach has been adopted, utilising WINFAP-FEH.

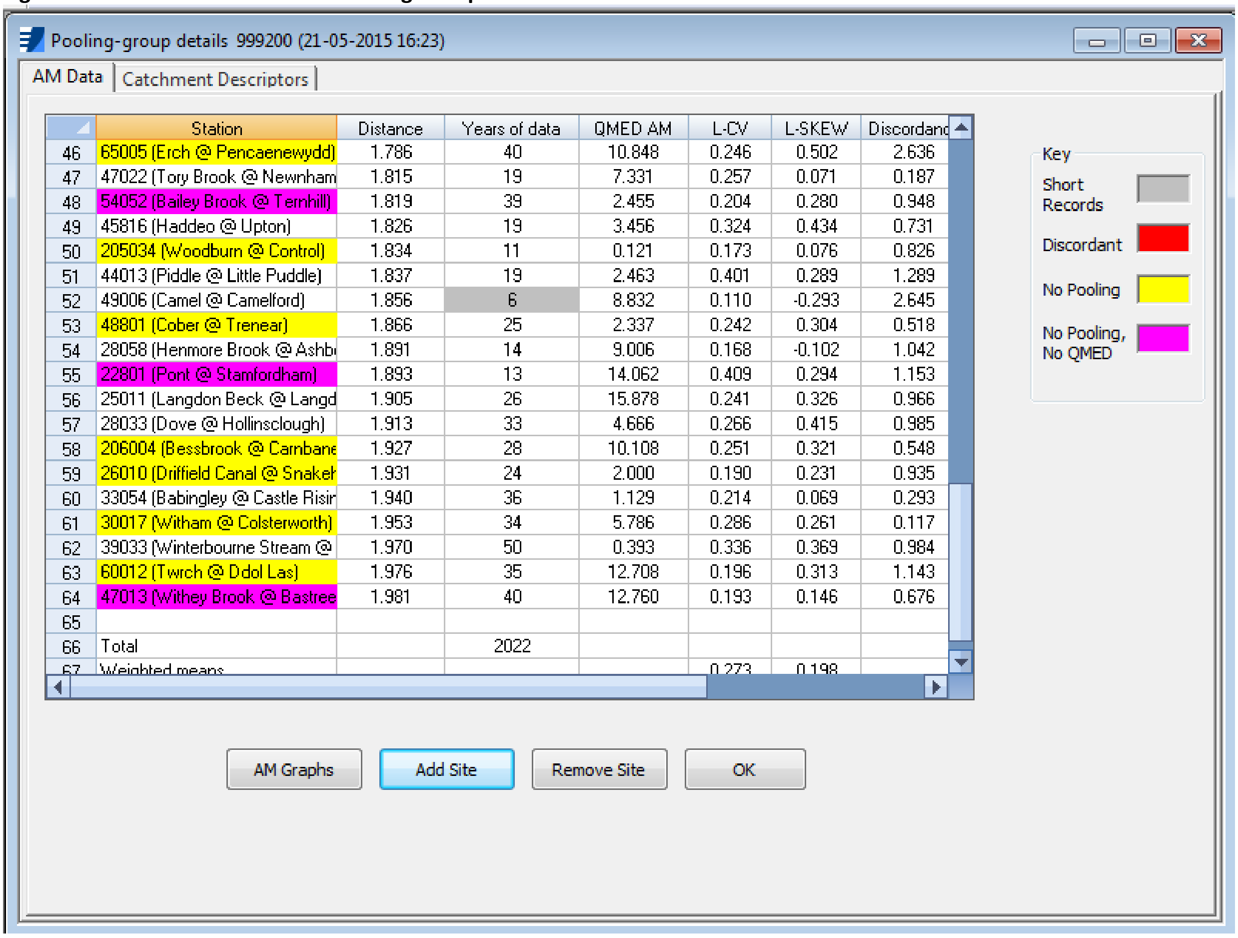
A pooling group has been compiled, comprising 554 years of data, with those stations indicated as being unsuitable for pooling removed, along with those with high discordancy values. Stations that were shown as having significantly different values for key attributes (AREA, SAAR, BFIHOST, URBEXT, and FARL) have also been removed in line with guidance within the WINFAP manual. Using this approach, a further seven donor stations were indicated as being unacceptable and were therefore removed from the pooling group. The seven stations removed have been listed below.

- Station 25011 – Langdon Beck @ Langdon– Removed as SAAR = 1463 (compared to 625 for study catchment). Also removed as BFI < 0.25 (compared to 0.589 for study catchment)

- Station 49006 – Camel @ Camelford– Removed as SAAR = 1418 (compared to 625 for study catchment)
- Station 47022 – Tory Brook @ Newnham Park – Removed as SAAR = 1403 (compared to 625 for study catchment)
- Station 28033 – Dove @ Hollinsclough – Removed as SAAR = 1346 (compared to 625 for study catchment)
- Station 26803 – Water Forlornes @ Driffield – Removed as BFI >0.8 (compared to 0.589 for study catchment)
- Station 33054 – Babingley @ Castle Rising – Removed as BFI >0.8 (compared to 0.589 for study catchment) and removed as FARL <0.95 (compared to 1 for study catchment)
- Station 47022 – Tory Brook @ Newnham Park – Removed as FARL < 0.95 (compared to 1 for study catchment)

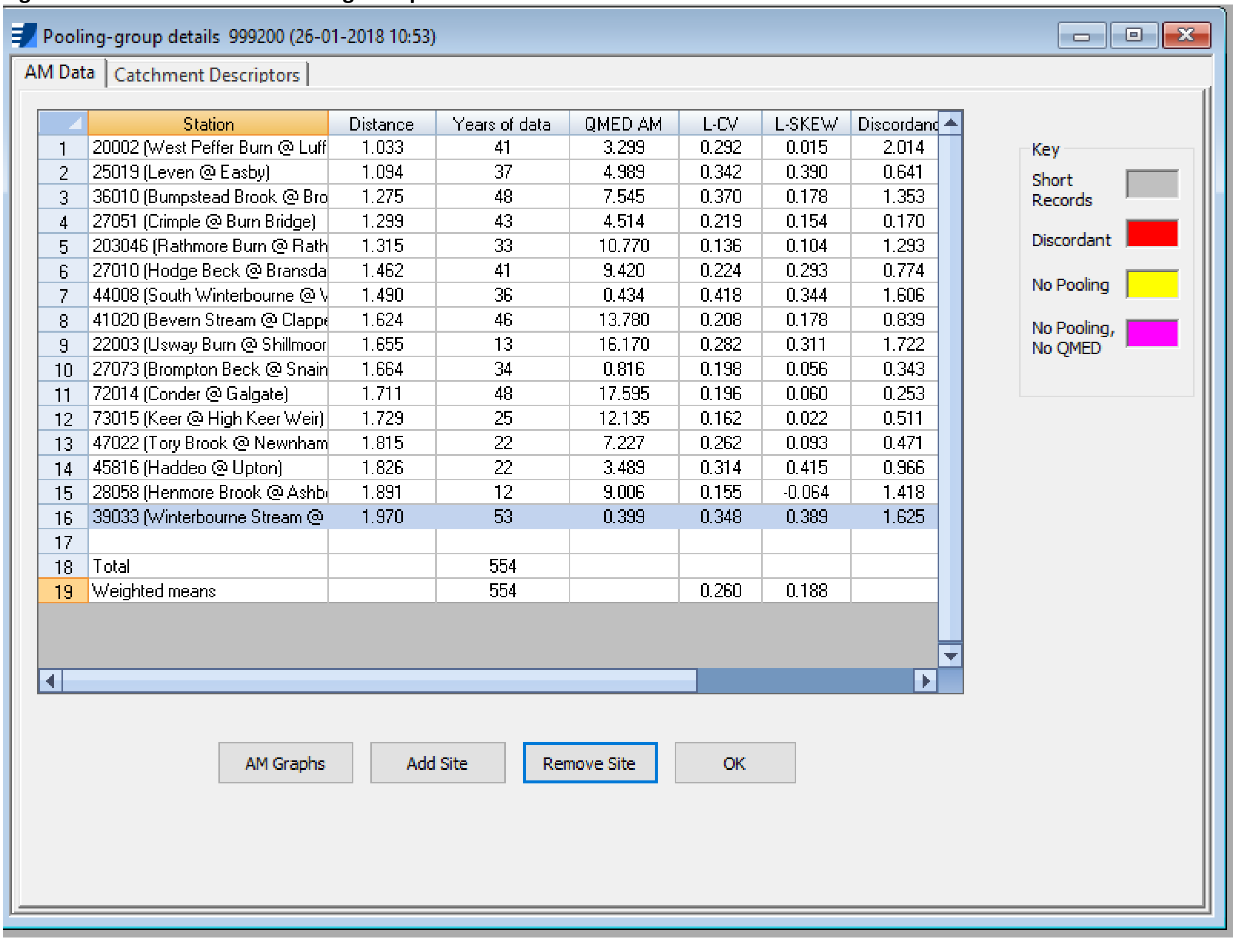
A copy of the initial WINFAP-FEH generated, and the final amended pooling groups are shown in Figures 3 and 4 below respectively.

Figure 3: WINFAP-FEH Generated Pooling Group



	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
46	65005 (Erch @ Pencaenewydd)	1.786	40	10.848	0.246	0.502	2.636
47	47022 (Tory Brook @ Newnham	1.815	19	7.331	0.257	0.071	0.187
48	54052 (Bailey Brook @ Ternhill)	1.819	39	2.455	0.204	0.280	0.948
49	45816 (Haddeo @ Upton)	1.826	19	3.456	0.324	0.434	0.731
50	205034 (Woodburn @ Control)	1.834	11	0.121	0.173	0.076	0.826
51	44013 (Piddle @ Little Puddle)	1.837	19	2.463	0.401	0.289	1.289
52	49006 (Camel @ Camelford)	1.856	6	8.832	0.110	-0.293	2.645
53	48801 (Cober @ Trenear)	1.866	25	2.337	0.242	0.304	0.518
54	28058 (Henmore Brook @ Ashb	1.891	14	9.006	0.168	-0.102	1.042
55	22801 (Pont @ Stamfordham)	1.893	13	14.062	0.409	0.294	1.153
56	25011 (Langdon Beck @ Langd	1.905	26	15.878	0.241	0.326	0.966
57	28033 (Dove @ Hollinsclough)	1.913	33	4.666	0.266	0.415	0.985
58	206004 (Bessbrook @ Carnbane	1.927	28	10.108	0.251	0.321	0.548
59	26010 (Driffield Canal @ Snaket	1.931	24	2.000	0.190	0.231	0.935
60	33054 (Babingley @ Castle Risir	1.940	36	1.129	0.214	0.069	0.293
61	30017 (Witham @ Colsterworth)	1.953	34	5.786	0.286	0.261	0.117
62	39033 (Winterbourne Stream @	1.970	50	0.393	0.336	0.369	0.984
63	60012 (Twrch @ Ddol Las)	1.976	35	12.708	0.196	0.313	1.143
64	47013 (Withey Brook @ Bastree	1.981	40	12.760	0.193	0.146	0.676
65							
66	Total		2022				
67	Weighted means				0.273	0.198	

Figure 4: WINFAP-FEH Final Pooling Group



Pooling-group details 999200 (26-01-2018 10:53)

AM Data | Catchment Descriptors

	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	20002 (West Peffer Burn @ Luff	1.033	41	3.299	0.292	0.015	2.014
2	25019 (Leven @ Easby)	1.094	37	4.989	0.342	0.390	0.641
3	36010 (Bumpstead Brook @ Bro	1.275	48	7.545	0.370	0.178	1.353
4	27051 (Crimple @ Burn Bridge)	1.299	43	4.514	0.219	0.154	0.170
5	203046 (Rathmore Burn @ Rath	1.315	33	10.770	0.136	0.104	1.293
6	27010 (Hodge Beck @ Bransda	1.462	41	9.420	0.224	0.293	0.774
7	44008 (South Winterbourne @ V	1.490	36	0.434	0.418	0.344	1.606
8	41020 (Bevern Stream @ Clappe	1.624	46	13.780	0.208	0.178	0.839
9	22003 (Usway Burn @ Shillmoor	1.655	13	16.170	0.282	0.311	1.722
10	27073 (Brompton Beck @ Snain	1.664	34	0.816	0.198	0.056	0.343
11	72014 (Conder @ Galgate)	1.711	48	17.595	0.196	0.060	0.253
12	73015 (Keer @ High Keer Weir)	1.729	25	12.135	0.162	0.022	0.511
13	47022 (Tory Brook @ Newnham	1.815	22	7.227	0.262	0.093	0.471
14	45816 (Haddeo @ Upton)	1.826	22	3.489	0.314	0.415	0.966
15	28058 (Henmore Brook @ Ashb	1.891	12	9.006	0.155	-0.064	1.418
16	39033 (Winterbourne Stream @	1.970	53	0.399	0.348	0.389	1.625
17							
18	Total		554				
19	Weighted means		554		0.260	0.188	

The Generalised Logistic and Generalised Extreme Value distribution are both shown to offer an acceptable growth curve and have been applied accordingly.

QMED has been estimated based on donor station 32029– Flore at Experimental Catchment. This donor station has been selected based on having the closest 'centroid distance' to the study catchment, whilst being classified as suitable for QMED estimation and having a catchment area most similar to the study catchment. The QMED donor value (1.528m^3/s) calculated was greater than the QMED value (1.226m^3/s)obtained by using for the catchment descriptor method.

The impact of climate change on flows has been calculated based on a 35% increase in the 1 in 100 year flow event in line with current guidance.

A manual check of the Urban Adjustment Factor has also been undertaken. Whilst this is an automated process within WINFAP this manual check applies the equations detailed with the EA's Flood Estimation Guidelines (Report no. 197_08) to ensure that an appropriate Urban Adjustment factor is used. This manual check provided an UAF value that was only marginally greater than calculated using the automated process. The manually updated UAF value obtained was 1.03 as compared to the automated value of 1.01. The higher value has therefore been used in the assessment.

The resulting flows, with a summary of their method of derivation are included in Table 3 below.

Table 3: Flow Calculations

Flood Event (Year)	WINFAP-FEH (m^3/s)
1 in 100	4.499[1]
1 in 100 + 35%	6.074[2]
1 in 200%	4.987[1]
1 in 1,000	7.290[1]

[1] WINFAP-FEH calculated flows.

[2] 1 in 100 year WINFAP-FEH calculated flow multiplied by 1.35.

In line with standard guidance, and as requested by the EA, a check of the calculated flows has been undertaken using ReFH2 to allow a comparison of flows to ensure that, where appropriate, a conservative approach has been adopted and the highest calculated flows used within the model. Using the updated catchment descriptors (area increased to 12.55km^2) ReFH2 provided flows that were similar to those using WINFAP. As such, and given that WINFAP was using recorded values from a donor station, it was considered that these were the most appropriate.

4.2.1.2 Unnamed Watercourse

As for the Milton Malsor Brook, the Flood Estimation Handbook (FEH) (2013) has been used to derive the descriptors for the Unnamed Watercourse catchment. This has been defined to a point at the confluence with the Milton Malsor Brook. The catchment area to this point is 0.92km^2 (at grid reference 472850, 255050). A check of available ordnance survey contour mapping and LiDAR data confirms that no significant additional areas drain into this catchment and, as such, the generated catchment descriptors are deemed appropriate. These are summarise in Table 4 below.

Table 4: FEH (2013) The Unnamed Watercourses Catchment Descriptors

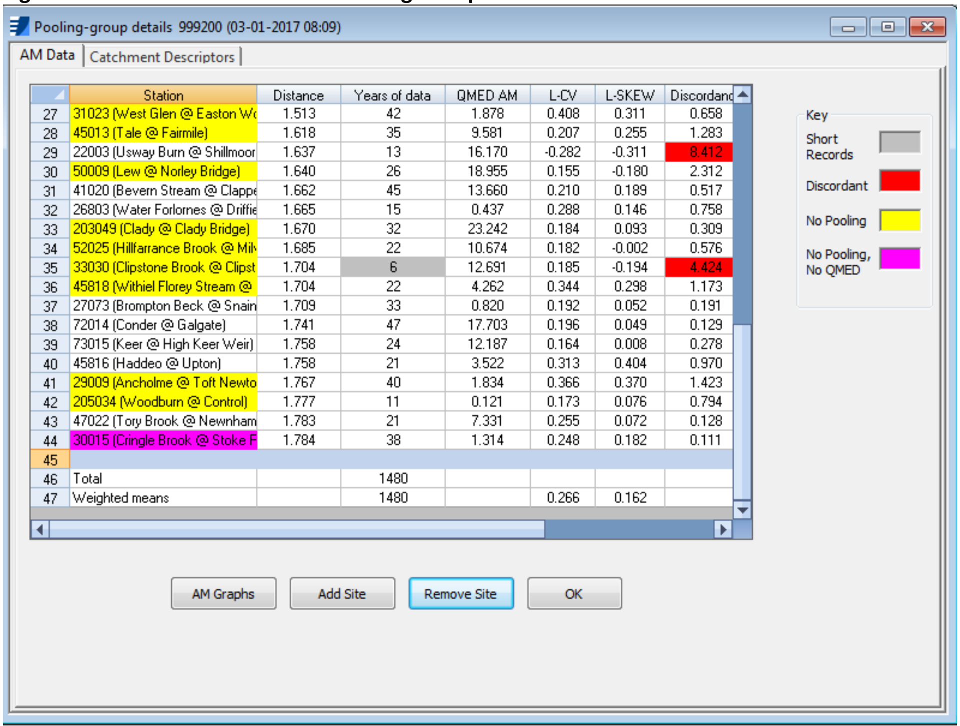
Descriptor	Value	Descriptor	Value	Descriptor	Value
AREA	0.92	RMED-1H	11.5	D1	0..31909
ALTBAR	95	RMED-1D	28.7	D2	0.3011
ASPBAR	338	RMED-2D	38.4	D3	0.24061
ASPVAR	0.59	SAAR	614	E	0.30125
BFIHOST	0.465	SAAR4170	641	F	2.49763
DPLBAR	1.31	SPRHOST	38.18	C(1 km)	-0.025
DPSBAR	24.1	URBCONC1990	-99999	D1(1 km)	0.319
FARL	1	URBEXT1990	0.0041	D2(1 km)	0.308
FPEXT	0.1359	URBLOC1990	-99999	D3(1 km)	0.23
FPDBAR	0.584	URBCONC2000	-99999	E(1 km)	0.3
FPLOC	0.607	URBEXT2000	0	F(1 km)	2.506

LDP	2.57	URBLOC2000	-99999
PROPWET	0.3	C	-0.02539

In line with best practice for a catchment of this nature, and noting that gauged data is not available for the watercourse itself, a Statistical analysis approach has been adopted, utilising WINFAP-FEH.

A pooling group has been compiled, comprising 508 years of data, with those stations indicated as being unsuitable for pooling removed, along with those with high discordancy values. The initial WINFAP-FEH generated data set and the final pooling group used are shown in Figures 5 and 6 below respectively.

Figure 5: WINFAP-FEH Generated Pooling Group

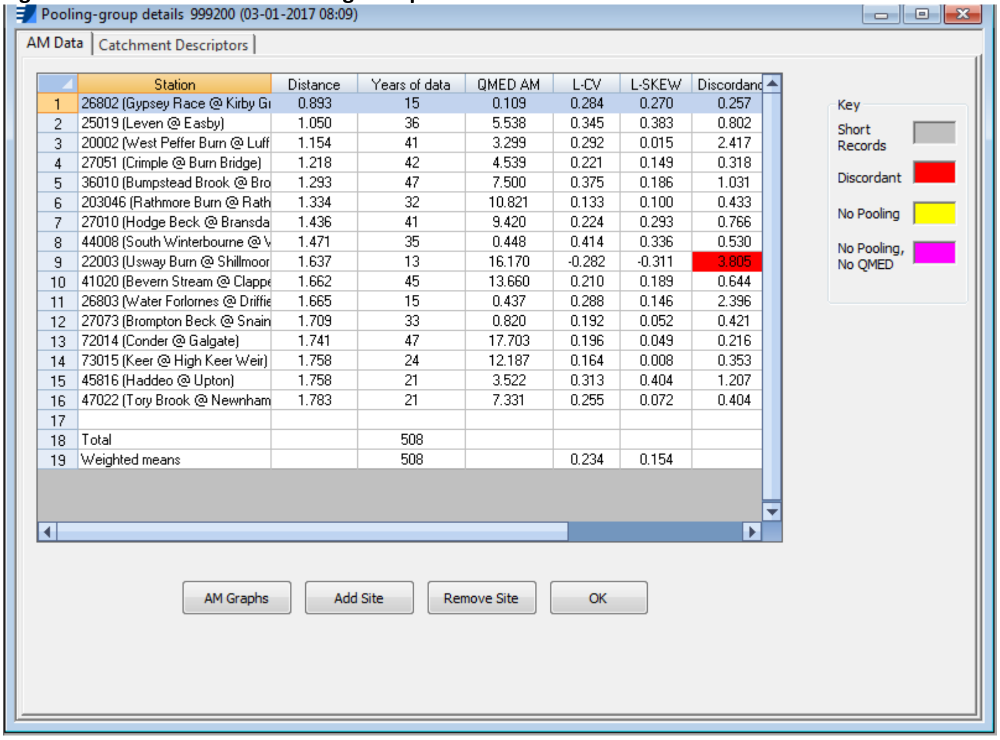


Pooling-group details 999200 (03-01-2017 08:09)

AM Data | Catchment Descriptors

	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
27	31023 (West Glen @ Easton Wc	1.513	42	1.878	0.408	0.311	0.658
28	45013 (Tale @ Fairmile)	1.618	35	9.581	0.207	0.255	1.283
29	22003 (Usway Burn @ Shillmoor	1.637	13	16.170	-0.282	-0.311	8.412
30	50009 (Lew @ Norley Bridge)	1.640	26	18.955	0.155	-0.180	2.312
31	41020 (Bevern Stream @ Clappe	1.662	45	13.660	0.210	0.189	0.517
32	26803 (Water Forlornes @ Driffie	1.665	15	0.437	0.288	0.146	0.758
33	203049 (Clady @ Clady Bridge)	1.670	32	23.242	0.184	0.093	0.309
34	52025 (Hillfarrance Brook @ Mil	1.685	22	10.674	0.182	-0.002	0.576
35	33030 (Clipstone Brook @ Clipst	1.704	6	12.691	0.185	-0.194	4.424
36	45818 (Withiel Florey Stream @	1.704	22	4.262	0.344	0.298	1.173
37	27073 (Brompton Beck @ Snain	1.709	33	0.820	0.192	0.052	0.191
38	72014 (Conder @ Galgate)	1.741	47	17.703	0.196	0.049	0.129
39	73015 (Keer @ High Keer Weir)	1.758	24	12.187	0.164	0.008	0.278
40	45816 (Haddeo @ Upton)	1.758	21	3.522	0.313	0.404	0.970
41	29009 (Ancholme @ Toft Newto	1.767	40	1.834	0.366	0.370	1.423
42	205034 (Woodburn @ Control)	1.777	11	0.121	0.173	0.076	0.794
43	47022 (Tory Brook @ Newnham	1.783	21	7.331	0.255	0.072	0.128
44	30015 (Cringle Brook @ Stoke F	1.784	38	1.314	0.248	0.182	0.111
45							
46	Total		1480				
47	Weighted means		1480		0.266	0.162	

Figure 6: WINFAP-FEH Final Pooling Group



	Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordanc
1	26802 (Gypsey Race @ Kirby Gi	0.893	15	0.109	0.284	0.270	0.257
2	25019 (Leven @ Easby)	1.050	36	5.538	0.345	0.383	0.802
3	20002 (West Peffer Burn @ Luff	1.154	41	3.299	0.292	0.015	2.417
4	27051 (Crimple @ Burn Bridge)	1.218	42	4.539	0.221	0.149	0.318
5	36010 (Bumpstead Brook @ Bro	1.293	47	7.500	0.375	0.186	1.031
6	203046 (Rathmore Burn @ Rath	1.334	32	10.821	0.133	0.100	0.433
7	27010 (Hodge Beck @ Bransda	1.436	41	9.420	0.224	0.293	0.766
8	44008 (South Winterbourne @ V	1.471	35	0.448	0.414	0.336	0.530
9	22003 (Usway Burn @ Shillmoor	1.637	13	16.170	-0.282	-0.311	3.805
10	41020 (Bevern Stream @ Clappe	1.662	45	13.660	0.210	0.189	0.644
11	26803 (Water Forlornes @ Driffie	1.665	15	0.437	0.288	0.146	2.396
12	27073 (Brompton Beck @ Snain	1.709	33	0.820	0.192	0.052	0.421
13	72014 (Conder @ Galgate)	1.741	47	17.703	0.196	0.049	0.216
14	73015 (Keer @ High Keer Weir)	1.758	24	12.187	0.164	0.008	0.353
15	45816 (Haddeo @ Upton)	1.758	21	3.522	0.313	0.404	1.207
16	47022 (Tory Brook @ Newnham	1.783	21	7.331	0.255	0.072	0.404
17							
18	Total		508				
19	Weighted means		508		0.234	0.154	

The Generalised Logistic distribution is shown to offer an acceptable growth curve and has therefore been applied accordingly.

QMED has been estimated based on donor station 33018 – Tove at Cappenham Bridge. This donor station has been selected based on having the closest 'centroid distance' to the study catchment, whilst being classified as suitable for QMED estimation and having a catchment area most similar to the study catchment.

The impact of climate change on flows has been calculated by multiplying the 1 in 100 year calculated flow by 1.35 to take account of the 35% revised allowance on flows in line with current guidance.

The initial pooling group included sites that were discordant. Whilst this is not reason enough to remove a station the impact of both including and removing the identified discordant stations has been assessed. Including the discordant station returned high flower estimates. To maintain a conservative assessment, approach including discordant stations was chosen as the preferred method for calculating the flows for the Unnamed Watercourse.

A manual check of the Urban Adjustment Factor has been undertaken. This provided a UAF value the same as that calculated using the automated process so no adjustment was required.

The resulting flows, with a summary of their method of derivation, are included in Table 5 below.

Table 5: Flow Calculations

Flood Event (Year)	WINFAP-FEH (m^3/s)

1 in 100	0.83[1]
1 in 100 + 35%	1.13[2]
1 in 200	0.99[1]
1 in 1,000	1.44[1]

[1] WINFAP-FEH calculated flows.

[2] 1 in 100 year WINFAP-FEH calculated flow multiplied by 1.35.

4.3 Hydraulic Assessment

4.3.1 Model Type

Based on discussions with the EA, and the identified need to consider overland flow routes, a linked 1D-2D model has been developed using Flood Modeller Pro 4.2.605.22474 and TUFLOW v2013-12-AB-w64.

4.3.2 1D Model

The 1D model developed includes the two watercourses described. These watercourse are linked by junctions. All river sections and structures are defined using information derived through the site specific topographical survey, with interpolates used between the surveyed sections where appropriate. For each river cross section those parts of each section beyond bank tops were deactivated (i.e. 1D model of the channel only) so as to provide the link to TUFLOW with consistent channel widths throughout each watercourse. A summary of the model nodes used is included in Table 6.

Table 6 1D Summary

	Milton Malsor Brook	Unnamed Watercourse
Upstream Node	MMW1157	MME0773
Downstream Node	MMWM050	MME0000D
Cross Section Spacing (based on Samuels, 1989)	Varies but typically 80m	-
River Sections	14	11
Interpolates	0	3
Structures	1x Rectangular Conduit	2 x Circular Conduit

4.4 2D – TUFLOW Model

4.4.1 Baseline Model

The 2D model is based on LiDAR data at a 1m horizontal resolution. This data was captured in 2010 and there is no more recent LiDAR data available. However, it is considered that little is likely to have changed within the site boundary or general Study Area since this data was obtained and therefore it remains a suitably accurate representation of the wider area topography and site levels. A Hillshade model of the LiDAR surface model was produced to enable easy comparison with Ordnance Survey mapping and a review of both data sets confirms no significant changes in developed area has taken place since the LiDAR was flown.

The LiDAR height data was used to define the watersheds in the area and using this information the 2D domain area was defined. The domain followed the line of higher ground to both the west, east, and south of the site. No obvious higher ground was identified at the southern and downstream limit of the modelling study – which is around 200m downstream of the eastern site boundary. The model domain was therefore extended a significant distance downstream of the site to limit the potential for any backwater effects from the downstream boundary impacting on the modelled fluvial regime in the area of the site.

4.4.2 Boundary Conditions

The 1D model includes two upstream boundaries and one downstream boundary.

All upstream boundaries were modelled using ReFH units scaled to the peak flows as outlined in section 2.0.

The downstream boundary condition was assumed normal depth based on the average gradient through the downstream sections of modelled watercourse. All of these are significantly downstream of the downstream limit of the study area at Rectory Lane to avoid any impact on flood levels at the site. The gradient has been based on measurements taken from the LiDAR data and applied within the 'normal depth'.

4.4.3 Roughness Coefficients

Manning's n roughness coefficients used in the 1D Cross Sections and TUFLOW materials file are given in Table 7. Assigning Manning's values is subjective, but those used are considered appropriate for each of the identified land uses observed in the area during the survey, walkover, and review of available aerial photographs.

Table 7 Manning's n roughness coefficients (Open-Channel Hydraulics, Chow 1959).

Feature	Manning's n
Concrete	0.020
Roads	0.022
Gravel channel bed	0.035
Grass	0.040
Vegetation	0.065
Light woodland	0.070
Dense woodland	0.085

Reference V.T. Chow 'Open Channel Hydraulics'.

4.4.4 Structures

All details of the structures included in the 1D model are outlined in Table 8. The dimensions of each are based on measurements taken during the river channel survey specifically for this purpose.

Table 8 Structures- Summary of structure details used in the model

Model Node(s)	Type	Comment	Key Parameters
MMW0000	Rectangular Culvert	Box Culvert under Rectory Lane	Width – 1m Height – 2.8m
MME0451CU	Circular Culvert	Farm Access Culvert	Diameter – 0.45m
MME0363	Circular Culvert	Towcester Road culvert crossing	Diameter – 0.9m

7.1 Results

The baseline modelling results confirm that the current EA Flood Zone overestimates flood extents within the site with a significantly reduced outline predicted by the detailed linked 1D/2D model of both watercourses. Within this section the 1 in 1,000 year results are those that have been reviewed for both the pre and post development conditions in order to review the 'worst case' scenario. This approach was discussed with the EA as adopting a conservative approach given that this event has the highest predicted peak flows and is recognised as the extreme event. Whilst the extent of the modelling is reduced through the modelled reach there are consistencies with the EA's modelling and these are detailed below:

- Within the southern limits of the Study Area the watercourse is perched above the base on the valley. As such, and as demonstrated by the modelling, any out of bank flows would flow to the west and into the currently lower elevated areas and result in a significant area of flooding. The modelled results show that predicted depths within these sections of the site at a lower elevation than the watercourse would be around 0.1m with some isolated areas reaching maximum depths of 0.4m.

- Both the EA mapping and the modelled results suggest that the culverts under Rectory Lane have insufficient capacity for the 1 in 1,000 year event resulting in flows backing up behind the culverts and locally increasing the risk of flooding. The level of the road limits the extent and depth of flooding immediately upstream of each structure as once reached flows overtop. The baseline results predict maximum depths within the site of up to a maximum depth of 1.5m upstream of Rectory Lane. Whilst the mechanisms is consistent with current mapping, then extend of flooding upstream is significantly reduced when compared to the EA's mapping.

Whilst there are the above similarities between the two modelling approaches, differences have also been observed and these are explained below:

- The EA's current wider area modelling focusses only on the Milton Malsor Brook due to this being a 'Main River' and does not appear to make any allowance for the Unnamed Watercourse. As such, the EA's mapping does not show that the culvert under Towcester Road and the farm access culvert. The detailed modelling confirms that these are undersized for the predicted peak flows and would restrict flows and result in an increased risk with out of bank flows predicted to extend around 120m upstream of the culvert and reach depths of up to 0.7m.

- The detailed modelling also predicts out of bank flows at the point of the confluence of the Unnamed Watercourse and Milton Malsor Brook. Whilst the EA mapping shows an area of increased risk at this location, it isn't based on detailed modelling of the two watercourses. The detailed modelling shows that these flow extend from the confluence upstream to Towcester Road with depths reaching a maximum of around 0.17m.

In general the detailed modelling shows that a significantly reduced area of the site is at risk from the 1 in 1,000 year event when compared to the existing EA Flood Zone map. The baseline modelling therefore confirms that a the majority of the site is within Flood Zone 1 with only localised areas at either a lower elevation to or immediately bordering the watercourse as being at an increased risk and within Flood Zone 2 and 3.

In terms of off-site flooding the modelled outlines are shown to be fairly consistent with the provided EA floodplain extents with only the immediate river corridor shown to be at an increased risk and within Flood Zones 2 and 3.

Whilst the modelling has confirmed that the level of risk to the site is reduced when compared to the EA's mapping, the proposed development requires either the culverting of sections or the realignment of both watercourses owing to the location of buildings and proposed post development ground levels. Given the potential future issues in relation to culverts blocking/collapsing, and from discussions with the EA, the diverting of the watercourses was preferred with any culverting being kept to an absolute minimum – i.e. only for roads crossings. The diverting of the watercourses also allows for the redesigning of the channels to ensure that the channel ties into the proposed ground levels whilst also providing appropriate capacity and suitably agreeable easements through the site.

The realigned watercourses will comprise a two staged channel with all flows up to and including the 1 in 100year event being contained within the 'first stage' channel. This channel will have a 1m wide channel base with bank slopes typically of 1 in 3 and 1 in 4. The second stage channel, which has been designed to provide capacity for the more extreme events such as the locally required 1 in 200 year and the 1 in 1,000year events.

The second stage channel will extend from the first stage channel by 8m from top of each bank for the Milton Malsor Brook and 5m from top of bank for the Unnamed Watercourse. This area will be level before then tying back into post development ground levels with these banks also being at a gradient of between 1 in 3 and 1 in 4. Sloping banks are only considered as not being possible through one section of the realigned watercourse and this is towards the north of the site. At this location it is considered that a retaining wall will be required. These lengths would provide the required easements for both Main River and Ordinary Watercourses to facilitate ongoing management and maintenance.

Based on the bank gradients and channel widths detailed above, the river corridor for both watercourses does not exceed 20m. A typical cross section of the diverted and redesigned watercourse has been included within Appendix C.

The proposals include new road crossings with one over the Milton Malsor Brook and one over the Unnamed Watercourse through the construction of an internal site access road. In addition to the construction of two new crossings the existing farm access culvert on the Unnamed Watercourse is to be removed. As the culverts under Towcester Road and Rectory Lane are outside of the site boundary there is no option for the upsizing of these culverts and proposals have had to accommodate the upstream flood risk as a result of these being undersized. However, the new culvert crossings have been sized appropriately to ensure these provide suitable capacity for all events up to an including the 1 in 1,000 year event and have been modelled as 1.8m high and 3m wide rectangular culverts.

In order to assess the potential impact on flood risk a further modelling scenario was run based on the proposed post development conditions. This included 'stamping' the proposed building slab levels, proposed internal access roads (including proposed culverts), post development ground levels, and details (location, width) of the diverted and redesigned watercourses onto the baseline LiDAR for use as the 2D domain. In order to assess the impact of the revised channel dimensions (two-staged channel) a new 1D model was developed to include all channel dimensions and the proposed new road crossings.

The modelling results for the post development scenario shows the two staged channel provides sufficient capacity for all events with no out of bank flows being predicted through these sections. The two staged channel is also shown to provide sufficient capacity to contain flows upstream of the restriction caused by the Towcester Road and therefore predicts no out of bank flows upstream of this culvert. The modelling confirms that the post development scenario results in all units and proposals being at low risk of flooding and within Flood Zone 1 and a signicant betterment when compared to the baseline scenario.

Whilst all of the development is shown to be within Flood Zone 1 with the relocation and construction of the new two staged channels, the culvert under Rectory Lane remains as not providing suitably capacity and would continue to provide a restriction with out of bank flows predicted to extend into the north western limit of the site. From the layout plans the area affected by these out of bank flows is proposed as being soft landscaping and, as such, no further mitigation is required.

In addition to the proposed development being shown to be at acceptable risk following the modelling of the post development conditions, the modelling has also confirmed that the proposed two staged diverted channel results in no detrimental impact to third party land.

Relevant outputs from the modelling study for both the pre and post development conditions are included within Appendix B.

8.0 *NN NPS & NPPF* REQUIREMENTS

8.1 Sequential Test

The NN NPS Flood Risk Section provided guidance that mirrors that of the NPPF but is extended to include specific guidance on climate change. Both of these documents have been reviewed and used to inform this section of the report.

The modelling study undertaken has confirmed that the fluvial flood risk to the site is less than is currently shown on the EA's Flood Zone Map. The proposed ditch diversion and construction of a two staged channel results in all development being within Flood Zone 1 and at low risk. Whilst the modelled risk to the site is lower, a small area to the north of the western parcel remain as being at risk and is affected during the modelled 1 in 1,000 year event.

However, the proposed land reprofiling and ditch diversion works is shown to ensure of the built form (proposed slabs, working yards, access roads and buildings) being elevated outside the floodplain and located within Flood Zone 1. Based on the proposed post development ground levels and proposed two-stage channel, the site effectively adopts a Sequential approach to development with only areas of soft landscaping being located within areas designated as being within Flood Zone 3 based on the post development modelling scenarios. All of the access routes from each unit have been confirmed as being within Flood Zone 1.

The allocation of proposed uses to appropriate Flood Zones is considered to meet the requirements of the Sequential Test advocated within the *NPPF*. However, it is recommended that such an approach be confirmed to be acceptable by the EA and Local Authority in meeting the requirements of the Sequential Test.

It should be noted that further elements of site selection are detailed within the separate Alternative Site Assessment Report.

8.2 Exception Test

Whilst an Exception Test is not explicitly required under the NPPF, assuming the site is accepted to pass the Sequential Test, the following section details any measures necessary to mitigate any residual flood risks, to ensure that the proposed development and occupants will be safe and that flood risk will not be increased elsewhere, akin to the requirements of second requirement of the Exception Test.

8.2.1 Resistance and Resilience of Site

Whilst all development has been confirmed as being located within the post development Flood Zone 1, it would be recommended for regular inspection and maintenance to be carried out of the proposed two stage channel and all crossings of each watercourse.

A number of surface water flow routes are predicted through the site based on the EA's mapping. Given that these are all shown to be generated within the site (i.e. no flow routes from off-site) it is considered that the surface water drainage strategy detailed within Section 9 will intercept and safely convey these flow through the site and manage any discharge to ensure that there is no detrimental impact to third party land and also reduce the potential risks to the site from this source. Given the importance of this system it would be recommended for a management and maintenance schedule to be provided.

8.2.2 Access and Egress

Based on the proposed road levels, dry access (in a 1 in 1,000 year fluvial flood event) is shown to be feasible, based on site specific modelling, from the site onto the adjacent highway network.

9.0 SURFACE WATER MANAGEMENT

9.1 Pre-Development

The area is currently undeveloped and served by a number of watercourses which cross the site, including the Milton Malsor Brook, which is classed as 'Main River' by the Environment Agency. Rain falling on the land will naturally infiltrate the ground until the capacity of the underlying soils is reached, after which runoff will shed off into the local ditches and watercourses.

The watercourses generally flow from south to north through the site with various culverts located in order to allow field access.

A number of culverts discharge into the watercourses along the southern boundary of the site conveying flows from the upstream catchments under the railway line and the canal. These flows will need to be maintained through the site.

The topographic survey indicates a number of piped drainage systems, generally around the perimeter of the site. These can be summarised as follows;

- A 450mm diameter pipe in the western part of the site which appears to be coming from the disused petrol filling station adjacent to the A43. The drain is shown discharging to one of the internal ditches within the site boundary.

- A 2225mm diameter pipe to the north-west quadrant of the site. This appears to link one of the internal ditches to the Malsor Brook.

- A 450mm diameter drain on the extreme northern boundary of the site, to the west of the Malsor Brook and immediately adjacent to the Gayton Road. Although not proven it is likely that this drain serves the Milton Business Park to the west.

- 3 no. 100mm diameter drains on the northern and western boundaries of Willow Lodge and the plant hire depot on the eastern side of Northampton Road. All of these drains flow into the ditch surrounding this area. There are no obvious sources for the drainage and therefore it is assumed that given the small sizes of the pipes that this is part of a land drainage system.

- A 600mm diameter drain entering the site in the north-east corner of the site via a vehicle tunnel under the railway line. This drain discharges into a ditch on the northern boundary of the site. There is no obvious source for any flows in this pipe but they must be considered to be of a reasonable quantity given the size of the pipe.

- In the south-east quadrant of the site there is a 225mm dimeter pipe linking two internal ditches.

- Also in the south-east quadrant, the topographic survey notes that 'local knowledge' indicates a drain running from a culvert under the railway line on the southern boundary flowing north into one of the internal ditches. This drain, if present, will need to be accommodated within the future development.

In all of the above cases, it will be necessary for the post-development proposals to maintain existing flows across the site in order to ensure that no upstream or downstream third party areas are affected.

Drawing no. C151171-C005 showing the locations of existing sewers and drains is included in Appendix C.

Drawing no. C151171-C006 showing the locations of existing watercourses and ditches and is included in Appendix C.

9.2 Post-Development

The proposed development of the site will inevitably lead to an increase in surface water runoff rates and volumes due to the provision of buildings, highways and other hardstanding areas. This increase in generated water will be managed within the proposed development infrastructure drainage systems such that there will be no detrimental impact to third parties downstream of the site.

In line with the NPPF, and other relevant guidance, initial consideration has been given to the use of Sustainable Drainage System (SUDS) methods of surface water disposal. The preferred hierarchy for dealing with surface water run-off is:

- Infiltration to ground via soakaways.
- Discharge to a watercourse.
- Discharge to a public surface water sewer.

Soil investigations have shown that there is no meaningful ability to infiltrate surface water runoff to ground and therefore the proposed drainage will be via positive systems which will ultimately discharge to the existing ditches and watercourses.

An initial assessment has been undertaken to determine the magnitude of surface water storage volumes that will be required in order to limit post-development runoff rates to values that are no greater than the existing greenfield situation.

The greenfield QBAR value has been calculated using the ICP SuDS Method within the industry standard Micro Drainage software. This indicates an undeveloped QBAR value of 4.1 litres/ha/sec which will be applied to the post-development impermeable areas in order to derive a maximum allowable discharge rate from the site.

At this stage of the design process it is assumed that, generally, each building unit and its associated hardstanding areas will contain storage features which will deal with their own attenuation requirements with restricted discharge rates. In the majority of cases, because of the land use, the storage is likely to be provided in underground tanks beneath car park areas and other hardstandings.

A petrol interceptor will be located downstream of each flow control prior to water being discharged from each parcel and being discharged to the relevant ditch or sewer.

In a number of locations there should be the opportunity to include attenuation ponds/basins which will be able to provide additional storage and deliver the ability to improve water quality before discharging to the existing watercourses within the site. At present these features are located to the west of Unit 2 and the north of Unit 9.

It is also intended to include swales, ditches or similar features as conveyance systems and to provide water treatment benefits where there are areas within the layout that will permit.

It is proposed that any discharge from the site be restricted to mimic the existing greenfield QBAR runoff rate, as described above, with attenuation being provided to cater for the 1 in 200 year plus 40% allowance for climate change storm event. This ensures that the proposal meets the criteria set out by Northamptonshire County Council in their role as the Lead Local Flood Authority.

The storage volumes required for each unit have been calculated in accordance with the criteria set out above and the calculations for each unit are included in Appendix C.

The locations of the storage features and their respective sizes together with the overall proposed surface water drainage layout are shown on drawing nos. C151171-C007, C008, C009 and C010 contained in Appendix C.

Due to the scale of the development, a number of watercourses will need to be diverted. The proposed scheme will include the rerouting of such watercourses in order to maintain the current flows from one side of the site to the other.

These proposals will also include the provision of culverts to accommodate road crossings and landscape features.

The Malsor Brook is classed as 'Main River' and therefore the diversion of this feature requires the approval of the Environment Agency (EA). Discussions have been held with the EA to agree the form of the proposed works and ensure that the flood plain requirements can be met within the proposed layout.

The proposals for diversion, removal and retention of existing watercourses/ditches, and the creation of new watercourses, are summarized on drawing no. C151171-C004.

The main infrastructure highway swill be served by a traditional gulley and pipe conveyance system. The runoff from the highways will be restricted to the equivalent greenfield QBAR rate via a flow control and discharged to the nearest appropriate watercourse/ditch/swale.

A petrol interceptor will be located immediately downstream of the flow control and prior the outfall to an open drainage feature.

10.0 FOUL WATER MANAGEMENT

10.1 Pre-Development

As the existing site is undeveloped, it is unlikely that there are any foul drainage systems directly serving the land to be developed. However, it is known that there is an existing 300mm dimeter foul public sewer, owned by Anglian Water, running in a south to north direction immediately parallel to the Milton Malsor Brook.

Copies of the Anglian Water sewer record plans have been obtained and compared with the manholes shown on the topographic survey. This has enabled an accurate check of the route of the public sewer to be established.

There are no recorded or known connections within the site boundary into the main foul sewer.

The layout of the proposed development will impinge upon the route of the existing foul sewer and therefore the sewer will be need to be diverted in a number of locations. This will require a Section 185 application to be made to Anglian Water in due course. The principle of diverting the sewer has been discussed with Anglian Water who have confirmed that they currently have no objections to the proposals.

A plan showing the proposed diversion route is shown on drawing no. C151171-C003 in Appendix C.

10.2 Post-Development

The provision of the development will generate new foul flows and it is proposed to discharge these flows to the existing public sewer. Due to the topography of the site it will be necessary to pump from a number of points around the site.

At the time of the preparation of this report, the exact population across the proposed development is not known. An estimate has therefore been made assuming an average figure of 95m^2 per employee for a national distribution centre, as advised by the Planning Consultant. The total floor area is currently 696,772m^2 and therefore the predicted total population is 7,334.

Reference has been made to the British Water publications, ‘Flows and Loads – 4’, which recommends an allowance of 50 litres/person/day as a dry weather flow. For a population of 7,334 this equates to a flow rate of 10.2 l/s.

Standard practice for commercial developments is to apply a peaking factor of x3 thus giving a peak flow rate of 30.6 l/s.

As an approximate check, reference has also been made to the recommendations in Sewers for Adoption 7th Edition which recommends a design flow for ‘normal’ industry of 0.5 l/s/ha. This results in a peak flow rate of 34.8 l/s and is a reasonable approximation to the Flows and Loads method.

Anglian Water has been consulted about the connection of additional flows to the existing foul sewer and a Pre-Development Enquiry has been submitted to the Company. The resulting report indicated that there is likely to be insufficient capacity in the system to cater for the new development and that upgrading works may be required. Following this, Anglian Water was requested to carry out a Drainage Impact Assessment to determine the potential works required. This assessment recommended that additional offline storage of 102m^3 be provided to the north of Unit 9 as a mitigation strategy. This proposal has been included in the final drainage strategy design.

Copies of both the Pre-Planning Assessment and the Drainage Impact Assessment are included in Appendix C.

A schematic layout of the main foul drainage required to serve the site has been prepared, showing connections to the existing Anglian Water public foul sewer at appropriate locations. A copy of drawing no. C151171-C002 is included in Appendix C.

11.0 CONCLUSIONS

This report has considered the flood risk posed to the proposal site from a variety of sources of flooding, as defined by the *NPPF*.

Current EA data shows that the low lying areas in the western section of the site that immediately border the Milton Malsor Brook are at high risk of flooding and within Flood Zone 3. The remainder of the site is shown as being more elevated and located within Flood Zone 1. The EA have confirmed that the Flood Zone map is based on coarse data at a low resolution and is therefore not suitable for accurately determining site specific flood risk.

The EA's Flooding from Surface Water mapping predicts outlines through the western section of the site that closely match, but extended further, the EA's fluvial flood map. Two additional flow routes through the eastern sections of the site are also shown. The first is from the high section of land to the west with potential surface flows in an easterly direction towards the Milton Malsor Brook. The second route is within the east of the site where flows are predicted to be directed by the topography in a northerly direction away from the site. It should be noted that the EA's surface water mapping does not make an allowance for any existing drainage network or small drainage ditches and, as such, is considered as being representative of the 'worst case' scenario.

The areas identified as being at increased risk from surface water flooding have also been assessed as being at an increased risk from infrastructure failure flooding. Channel levels are considered to be representative of groundwater levels and as such the lower lying areas within the western section of the site are also considered to be at risk during a 'worst case' groundwater flood scenario.

Following discussions with the EA, a site specific detailed linked 1D/2D modelling study has been developed for the site. This demonstrates that whilst the northern and northeastern sections of the site remain in Flood Zone 3, the depths and extents are less than those shown on the EA's mapping and therefore more of the site can be concluded to be at low risk from fluvial flooding.

In addition to assessing the existing fluvial flood risk to the site, the modelling study has been extended to assess the impacts of the post development conditions (construction and diversion of a two staged channel, post development ground levels etc.). This modelling has demonstrated that the proposed two stage channel provides adequate capacity and results in all of the proposed buildings, access routes, working yards being set at a level above the 1 in 1,000 year flood level and therefore within 'Post Development Flood Zone 1'. The proposed ground works and watercourse works results in no worsening of flood risk at the site or to third party land.

Based on the post development modelling, it is shown that all of the proposed units are set at an elevation that ensures they are within Flood Zone 1. The only areas of the site that are within a Flood Zone 2 or 3 are areas of soft landscaping on the northern site boundary and within the western section of the site. As such, based on the proposed use and locations of the buildings, the proposed development is considered to meet the requirements of, and pass the Sequential Test.

In order to ensure that the proposed realigned watercourse, new culvert structures, and surface water drainage system operate efficiently, it is strongly recommended that a detailed management and maintainance plan is prepared to ensure regular clearance works and, if required, maintenance is undertaken to limit the risk of any blockages or failure of any of the proposed system.

This report therefore demonstrates that, provided an approved SUDS is employed, the proposed scheme will:

- Be safe and resilient to flooding in the critical design flood event with an acceptable level of residual risk.
- Not increase flood risk through loss of floodplain storage, impedance of flood flows or increase in surface water run-off.

As such, the proposed development is concluded to meet the flood risk requirements of the *NNNPS* and the *NPPF*.

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APPENDIX A – KEY FEATURES PLAN

Drawing No.	Title
Drawing Ref: C151171-C101	Key Features Plan

NOTES

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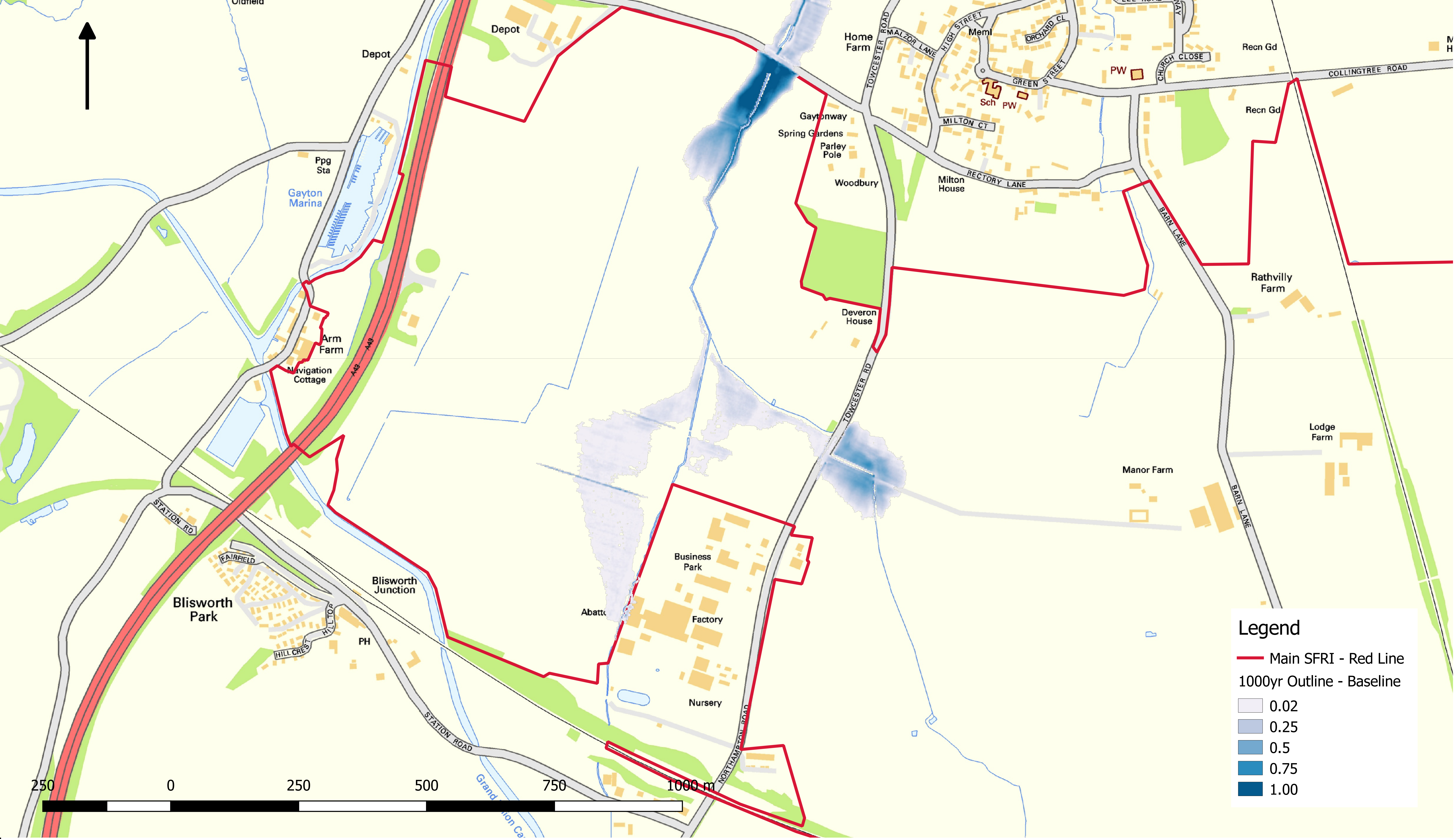
Project	RAIL CENTRAL
Client	ASHFIELD LAND MANAGEMENT LIMITED
Title	Key Feature Plan
Project No.	C151171
Drawn	SDM
Checked	DL
Scale at A3	1:15,000
Drawn Date	18 06 2017
First Issue	18 07 2017
Drawing Status	INFORMATION
Drawing Ref.	C151171-101
Revision	-

APPENDIX B – HYDRAULIC MODELLING RESULTS

Drawing No.	Title
Drawing Ref: C151171-C102	Baseline 1 in 1,000 year Outline
Drawing Ref: C151171-C103	Post Development 1 in 1,000 year Outline



NOTES

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Project
RAIL CENTRAL

Client
ASHFIELD LAND MANAGEMENT LIMITED

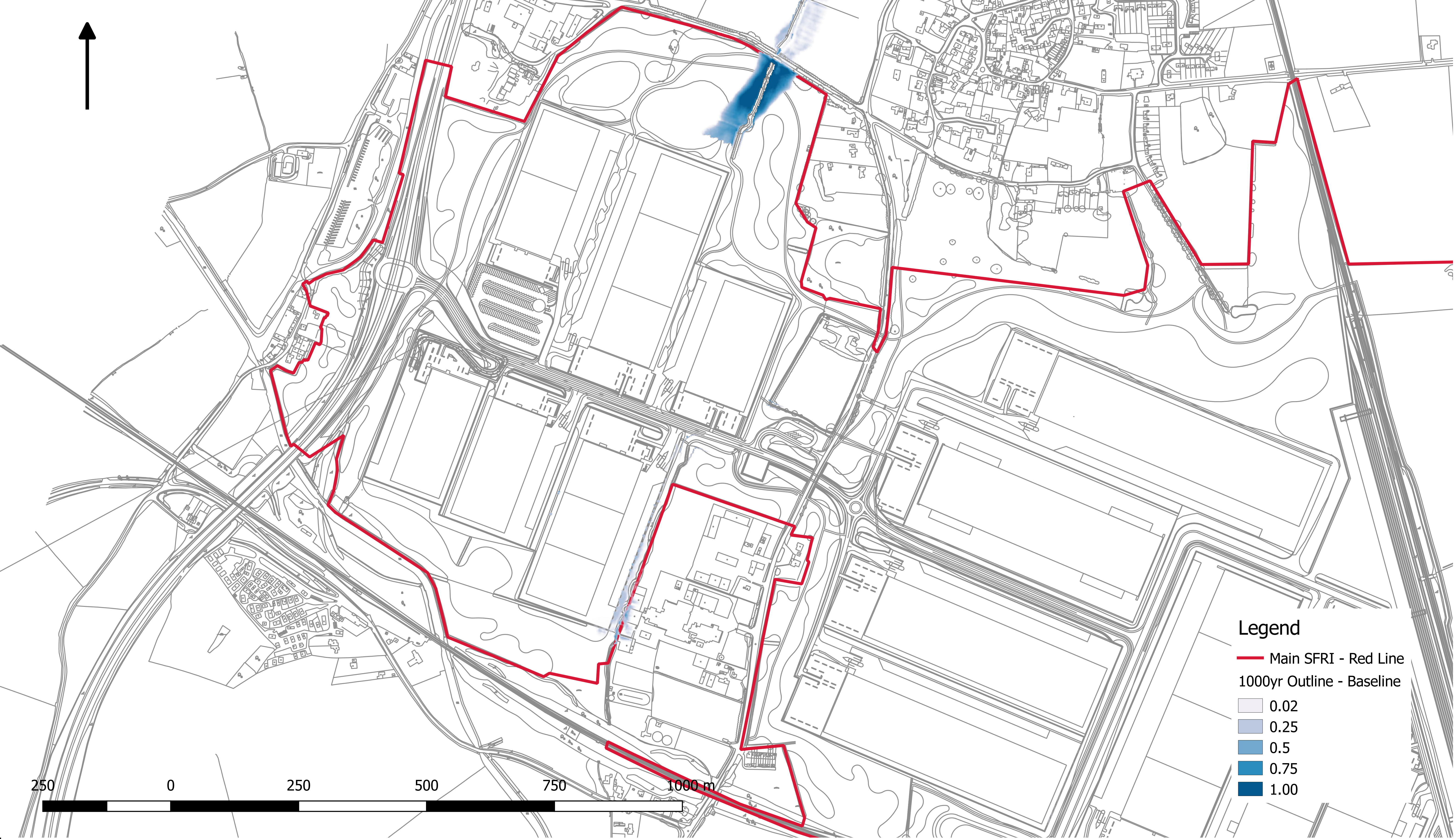
Title
Baseline 1 in 1,000yr Event

Project No.
C151171

Drawn	Checked	Scale at A3	Drawn Date	First Issue
SDM	DL	1:6,000	18 06 2017	18 07 2017

Drawing Status
INFORMATION

Drawing Ref.	Revision
C151171-102	-



NOTES

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Project	RAIL CENTRAL
Client	ASHFIELD LAND MANAGEMENT LIMITED
Title	Post Development 1 in 1,000yr Event
Project No.	C151171
Drawn	SDM
Checked	DL
Scale at A3	1:6,000
Drawn Date	18 06 2017
First Issue	18 07 2017
Drawing Status	INFORMATION
Drawing Ref.	C151171-103
Revision	-

APPENDIX C – DRAINAGE STRATEGY

Drawing No.	Title
Drawing Ref: C151171-C002C	Foul Drainage Strategy
Drawing Ref: C151171-C003C	Foul Drainage Diversion
Drawing Ref: C151171-C004B	Watercourse Works Strategy
Drawing Ref: C151171-C005C	Existing Sewer
Drawing Ref: C151171-C006C	Existing Watercourse
Drawing Ref: C151171-C007A	Drainage Strategy – Sheet 1
Drawing Ref: C151171-C008A	Drainage Strategy – Sheet 2
Drawing Ref: C151171-C009A	Drainage Strategy – Sheet 3
Drawing Ref: C151171-C0010A	Drainage Strategy – Sheet 4
Drawing Ref: NO REF	Supporting Calculations
Drawing Ref: NO REF	Anglian Water Pre-Planning Assessment
Drawing Ref: NO REF	Anglian Water Drainage Impact Assessment

Key

(yellow dashed line)	Existing Anglian Water public foul sewer
(green dashed line)	Proposed Diversion Route of Anglian Water public foul sewer
(red dashed line)	Proposed foul sewer
3.0 l/s	Estimated peak foul design flow from Unit
'C' 4.3 l/s	Total estimated peak foul design flow at connection point to existing public sewer

Rev	Date	Description	By	Ckd
C	13/02/18	Redrawn.	RJH	
B	18/01/18	Proposed foul storage tank added.	RJH	
A	16/12/16	Redrawn	RJH	

Notes:
All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. This drawing is copyright.

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Client:

ASHFIELD LAND LIMITED

Project:

RAIL CENTRAL NORTHAMPTONSHIRE

Project Number: C151171

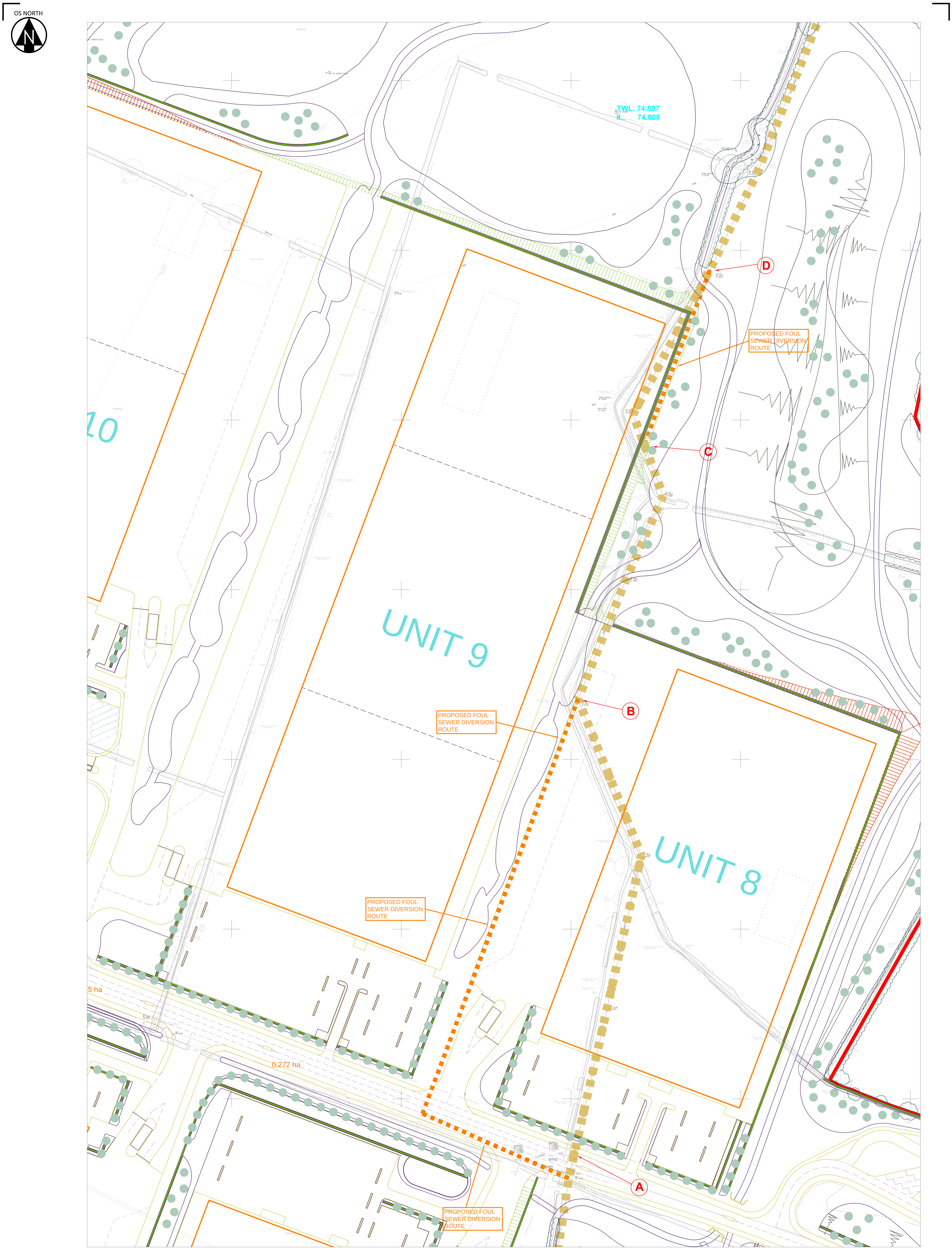
Drawing Title:

PROPOSED FOUL DRAINAGE STRATEGY

Drawn:	Checked:	Scale @ A1:	Drawn Date:	First Issue:
EAG	RJH	1:5,000	16/12/2016	16/12/2016

Drawing Status. FOR APPROVAL

Drawing No. C151171 - C002 Revision C



Key

- Existing Anglian Water public foul sewer
- Existing Anglian Water public foul sewer to be abandoned
- Proposed Diversion Route of Anglian Water public foul sewer

Rev	Date	Description	By	Ckd
C	13/02/18	Revised planning layout.	RJH	
B	15/08/17	Revised planning layout.	RJH	
A	16/12/16	First Issue	RJH	

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Notes:
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Project:
RAIL CENTRAL NORTHAMPTONSHIRE

Client:
ASHFIELD LAND LIMITED

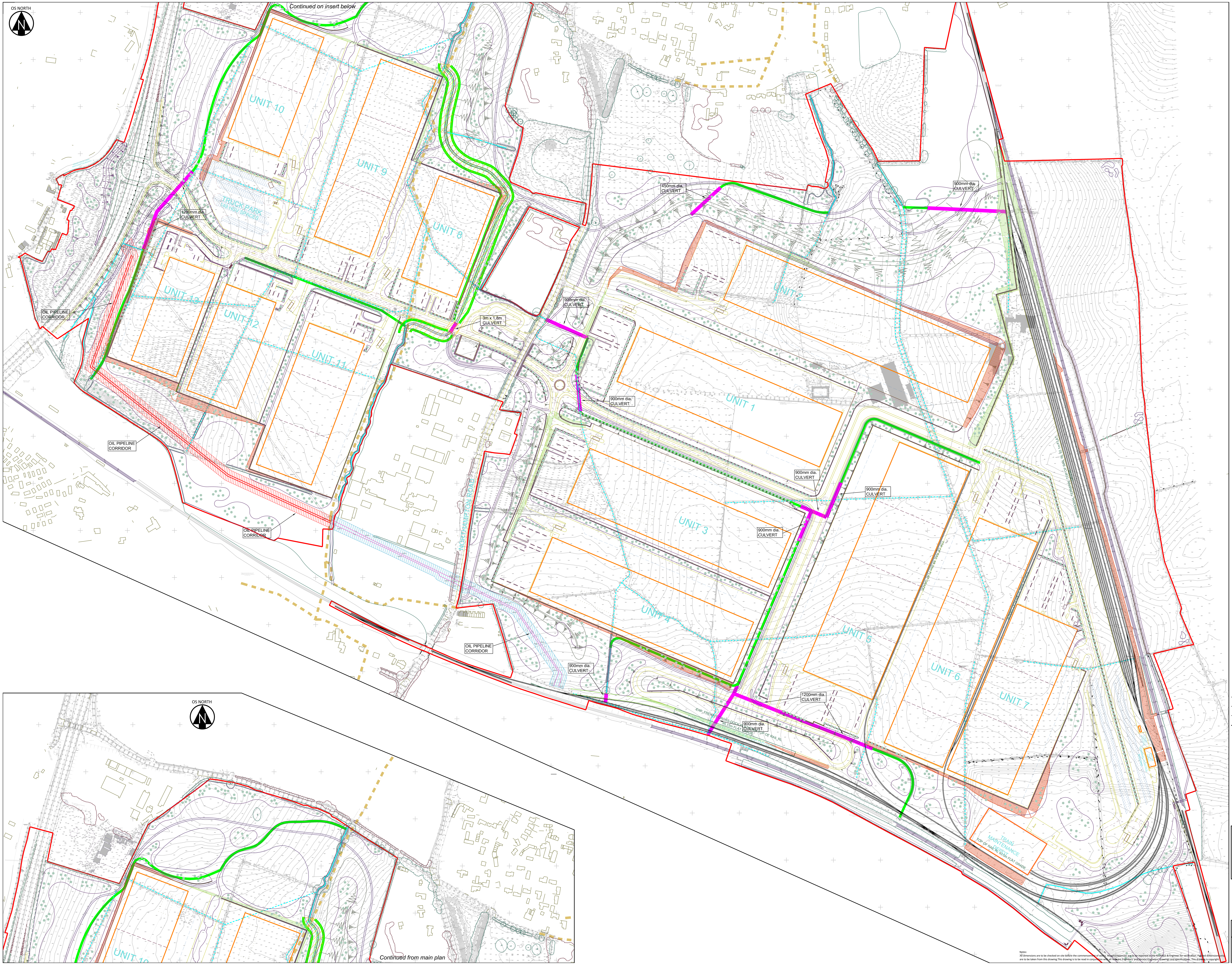
Drawing Title:
PROPOSED DIVERSION OF EXISTING PUBLIC FOUL SEWER

Project Number: C151171

Drawn:	Checked:	Scale @ A1:	Drawn Date:	First Issue:
RJH		1:1,000	16/12/2016	16/12/2016

Drawing Status. FOR APPROVAL

Drawing No. 151171 - C003 Revision C



Key

Green line	Proposed ditch/swale
Cyan dash-dot line	Existing ditch to be removed
Cyan line	Existing ditch to be retained
Orange hatched box	Provisional Milton Malsor ditch realignment corridor
Magenta bar	Proposed culverted watercourse

Rev	Date	Description	By	Ckd
B	14/02/18	Planning layout updated.Culvert information added.	RJH	
A	15/02/17	First Issue.	RJH	

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Client:

ASHFIELD LAND LIMITED

Project:

RAIL CENTRAL NORTHAMPTONSHIRE

Project Number: C151171

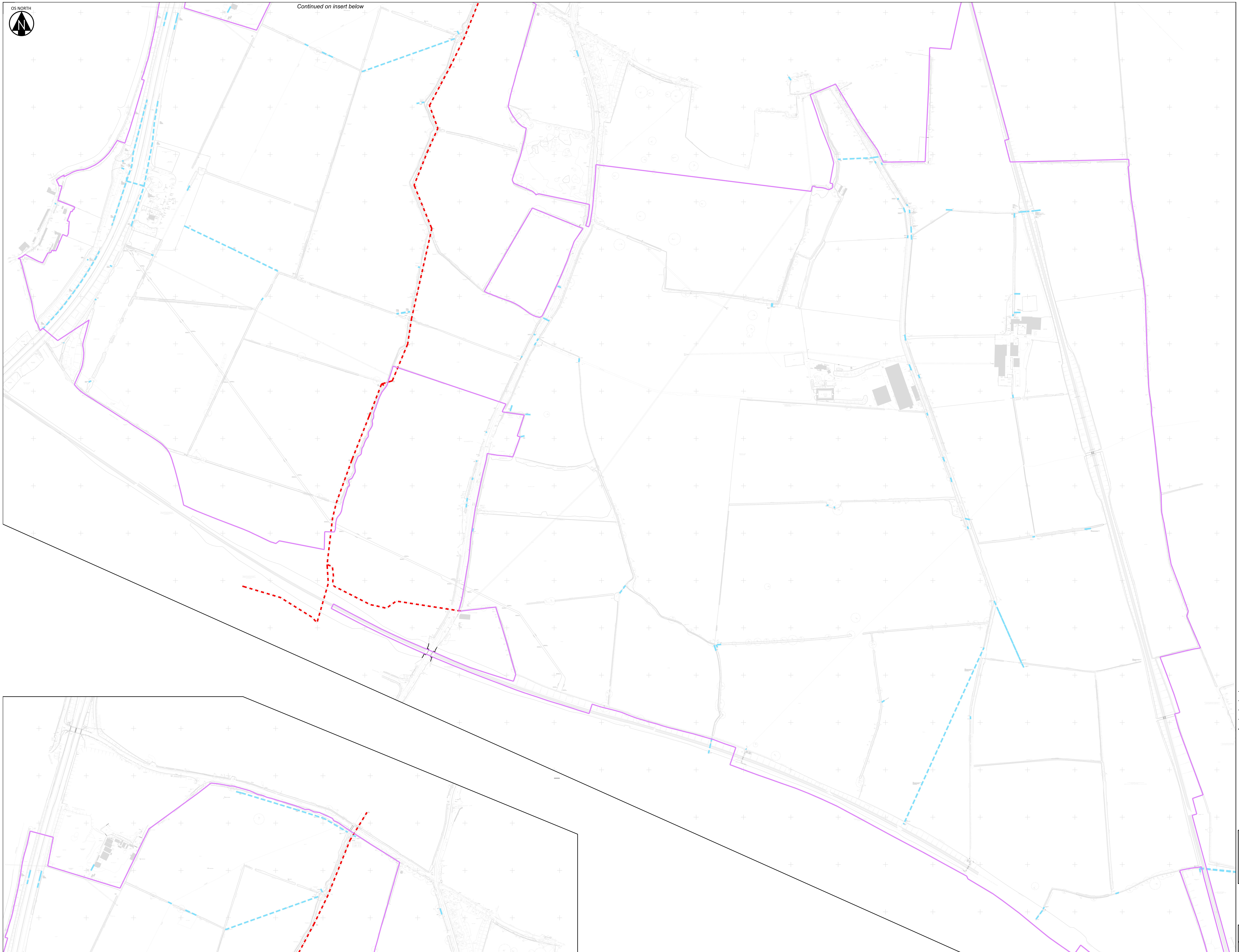
Drawing Title:

PROPOSED WATERCOURSE WORKS STRATEGY

Drawn:	Checked:	Scale @ A0:	Drawn Date:	First Issue:
RJH		1:2,500	15/02/2017	15/02/201

Drawing Status. FOR APPROVAL

Drawing No. C151171 - C004 Revision B



Notes:
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Key

Existing Anglian Water public foul sewer

Existing surface water drain

Proposed development boundary

Rev	Date	Description	By	Ckd
C	14/02/18	Site boundary updated.	RJH	
B	18/01/18	Key corrected.	RJH	
A	30/06/17	First Issue.	RJH	

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Project:

RAIL CENTRAL NORTHAMPTONSHIRE

Project Number: C151171

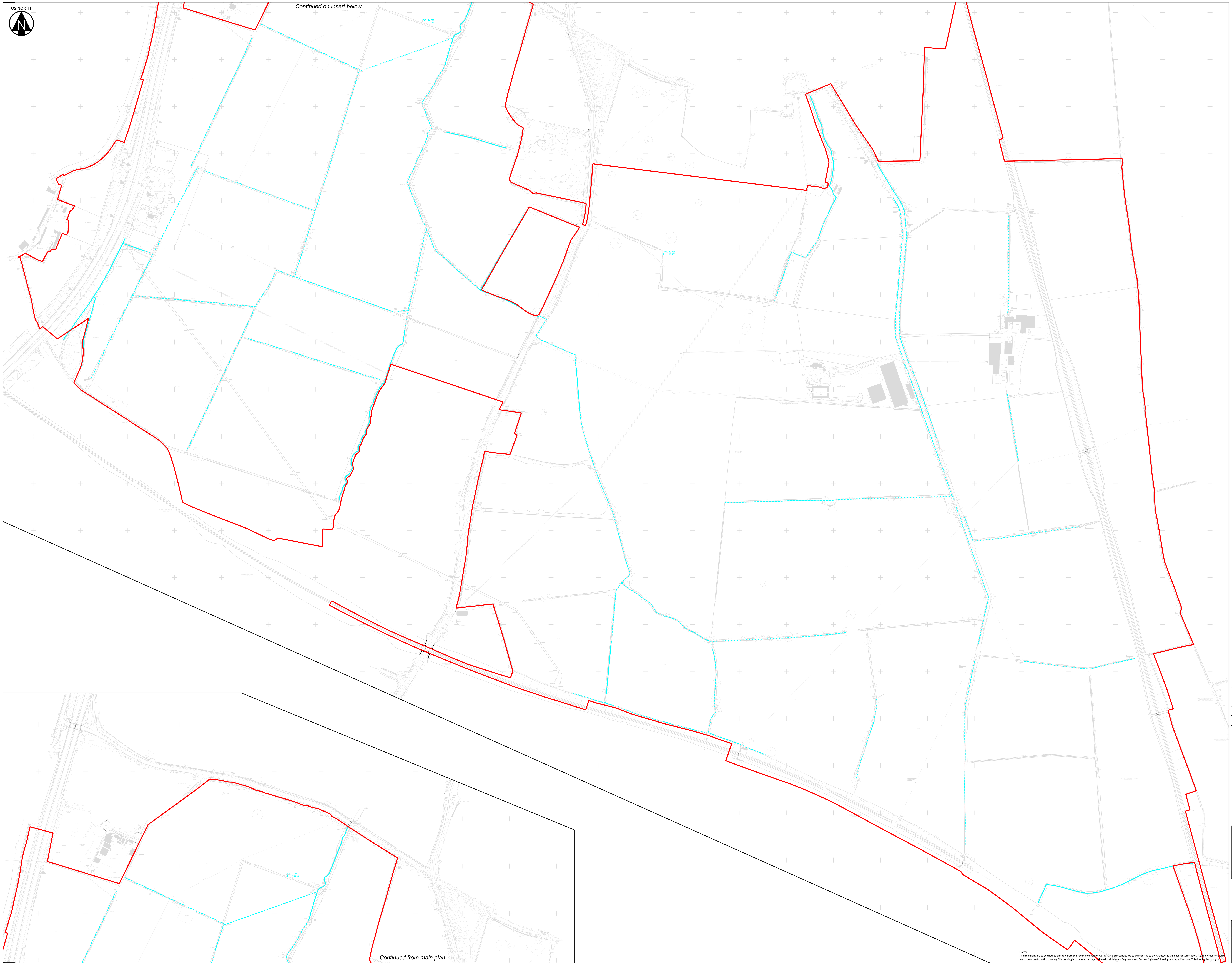
Drawing Title:

EXISTING UNDERGROUND DRAINAGE SYSTEMS

Drawn:	Checked:	Scale @ A0:	Drawn Date:	First Issue:
RJH		1:2,500	30/06/2017	30/06/2017

Drawing Status. INFORMATION

Drawing No. C151171 - C005 Revision C



Notes:
All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications. This drawing is copyright.

Key

Existing ditch/watercourse to be removed

Existing ditch/watercourse to be retained

Proposed development boundary

Rev	Date	Description	By	Ckd
c	14/02/18	Site boundary updated.	RJH	
B	18/01/18	Key amended.	RJH	
A	29/06/17	First Issue.	RJH	

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Project:

RAIL CENTRAL NORTHAMPTONSHIRE

Project Number: C151171

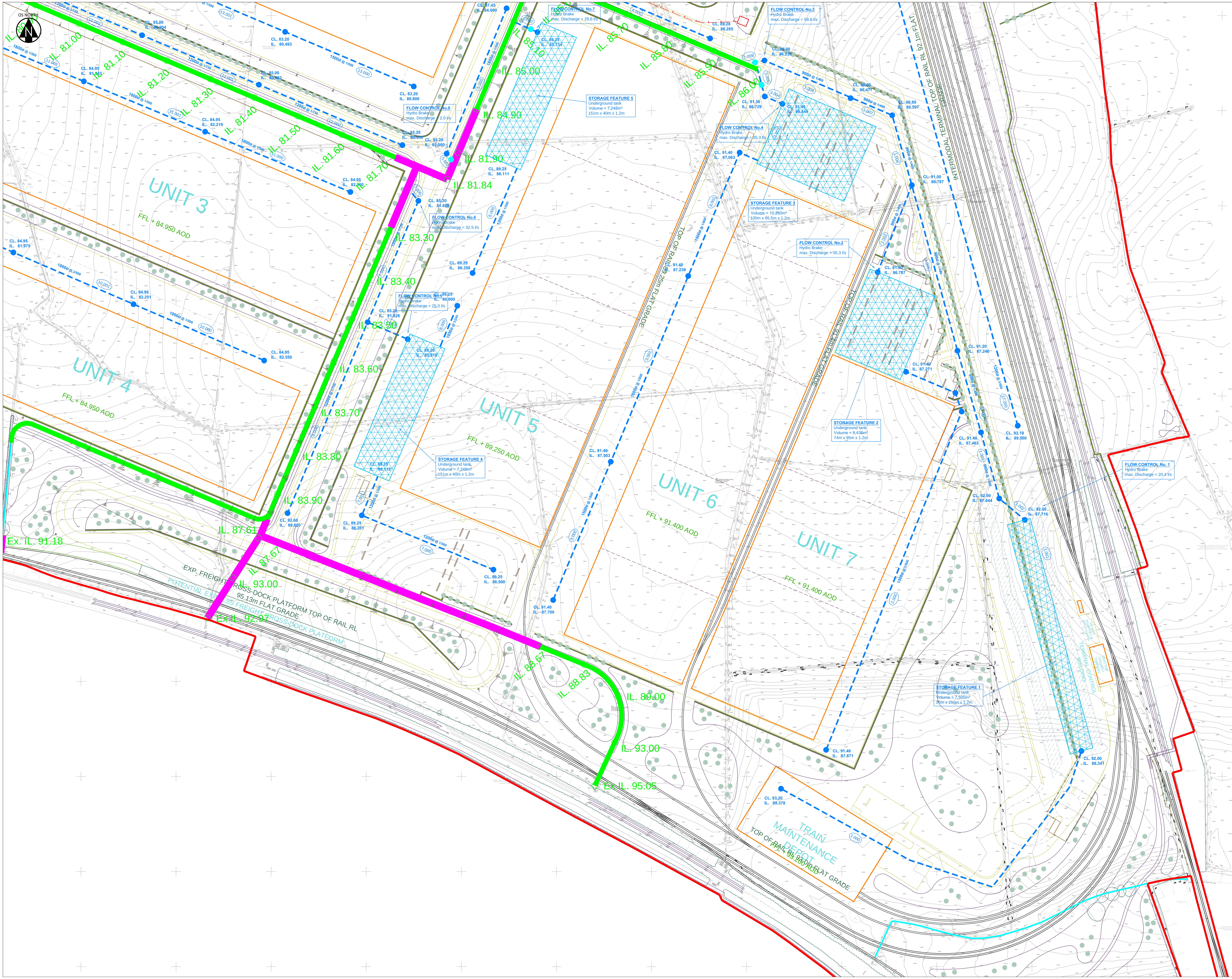
Drawing Title:

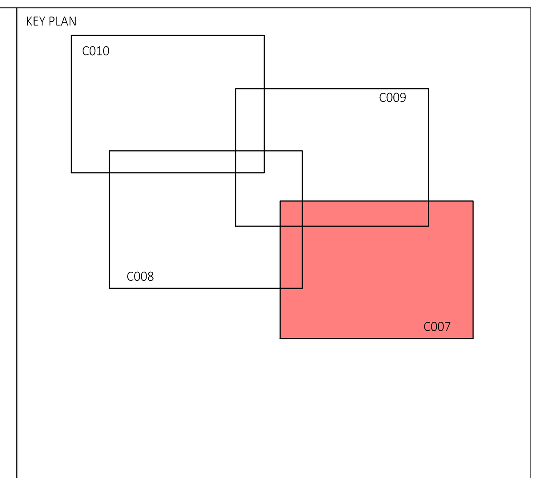
EXISTING WATERCOURSES AND DITCHES

Drawn:	Checked:	Scale @ A0:	Drawn Date:	First Issue:
RJH		1:2,500	29/06/2017	29/06/201

Drawing Status. FOR APPROVAL

Drawing No. C151171 - C006 Revision C





NOTES

1. All attenuation storage features are design to accommodate the the 1 in 200 year storm event plus an allowance of +40% for climate change.
2. Discharge rates are limited to the equivalent greenfield QBAR rate for the proposed impermeable areas. Greenfield QBAR has been calculated to be 4.1 litres/sec/ha.
3. All calculations are based on the FEH method and employ Micro Drainage software.

KEY

- Proposed surface water sewer
- Proposed underground surface attenuation tank
- Proposed watercourse culvert
- 30.001 Micro Drainage reference number
- Micro Drainage reference number
- Existing watercourse to be retained
- Proposed watercourse

REVISIONS

Rev	Date	Description	By	Ckd	App
A	12/02/18	First Issue.	RJH		

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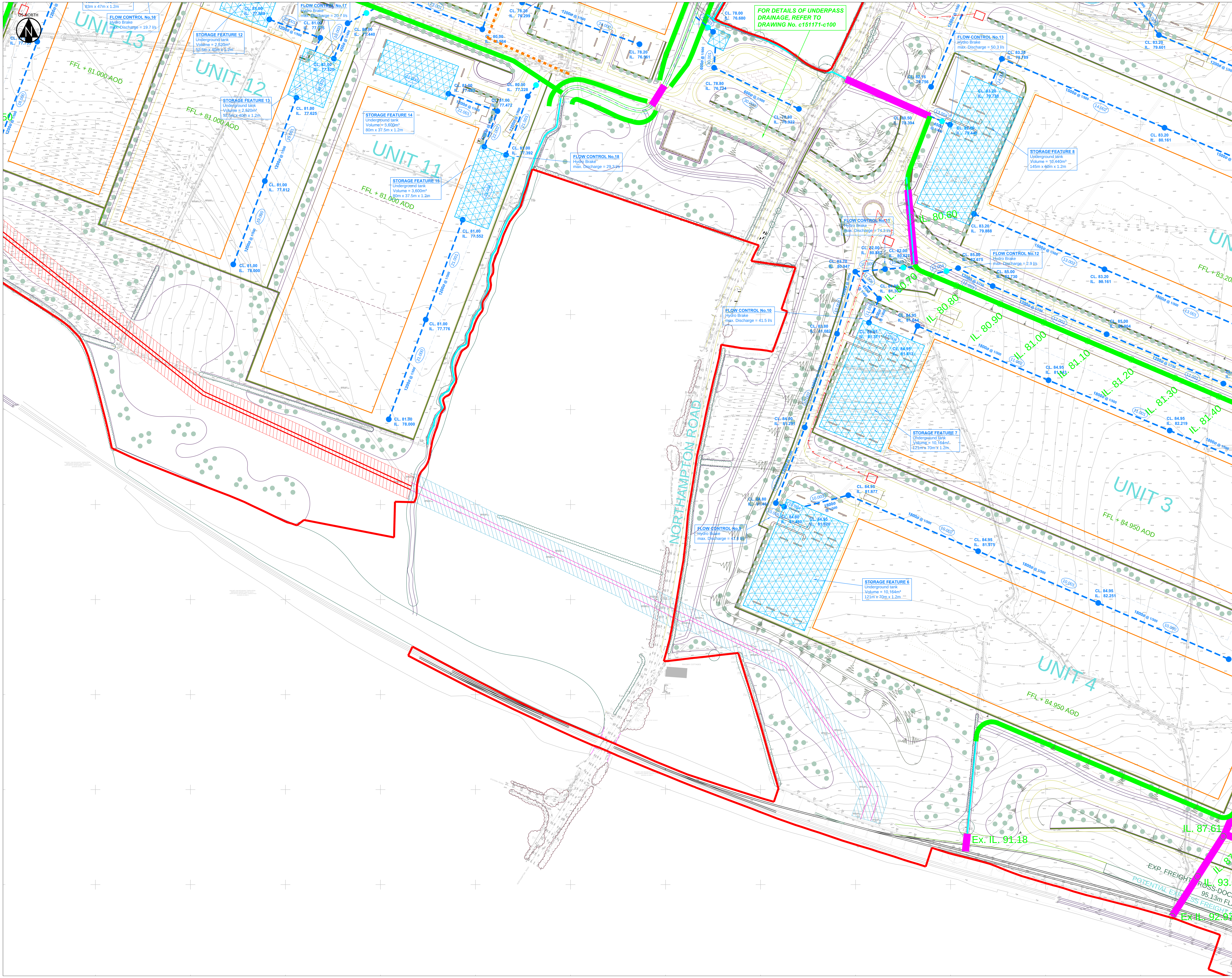
PROJECT
RAIL CENTRAL
NORTHAMPTONSHIRE

TITLE
PROPOSED SURFACE WATER
DRAINAGE LAYOUT
(Sheet 1 of 4)

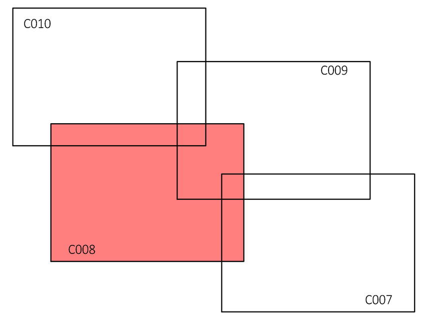
HYDROCK PROJECT NO.	SCALE @ A0
C-151171-C	1:1,250

STATUS DESCRIPTION	STATUS
FOR APPROVAL	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
C151171-C007	A



KEY PLAN



NOTES

1. All attenuation storage features are design to accommodate the the 1 in 200 year storm event plus an allowance of +40% for climate change.
2. Discharge rates are limited to the equivalent greenfield QBAR rate for the proposed impermeable areas. Greenfield QBAR has been calculated to be 4.1 litres/sec/ha.
3. All calculations are based on the FEH method and employ Micro Drainage software.

KEY

- Proposed surface water sewer
- Proposed underground surface attenuation tank
- Proposed watercourse culvert
- 30.001 Micro Drainage reference number
- Micro Drainage reference number
- Existing watercourse to be retained
- Proposed watercourse

REVISIONS

Rev	Date	Description	By	Ckd	App
A	12/02/18	First Issue.	RJH		

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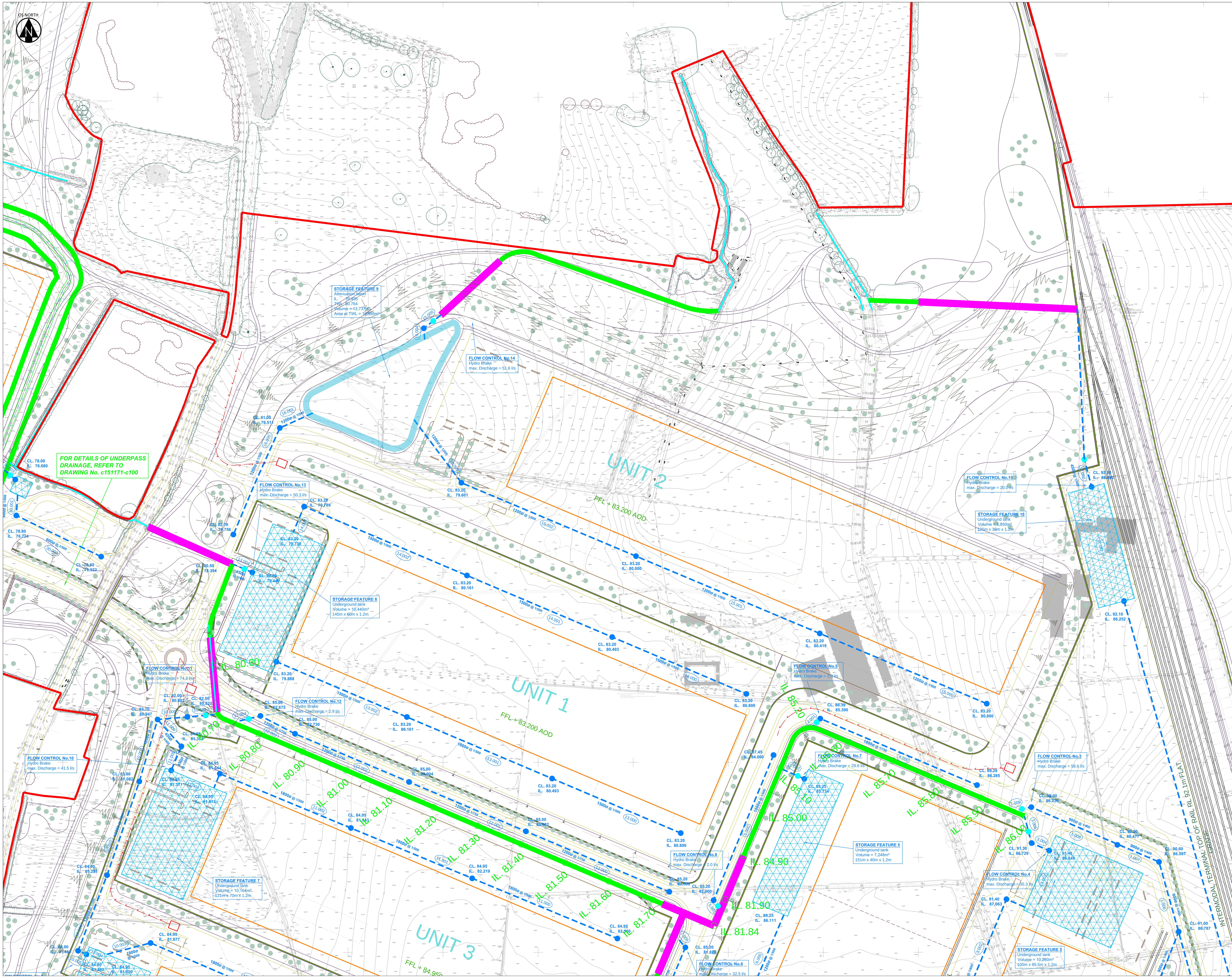
PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

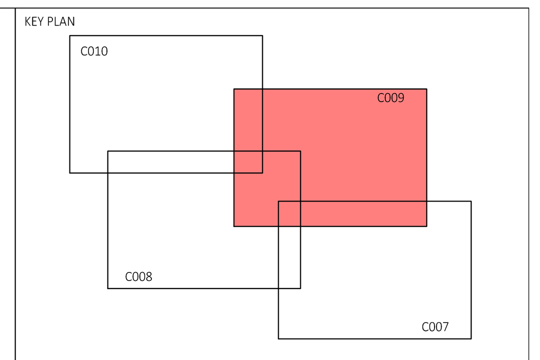
TITLE
PROPOSED SURFACE WATER DRAINAGE LAYOUT (Sheet 2 of 4)

HYDROCK PROJECT NO.	SCALE @ A0
C-151171-C	1:1,250

STATUS DESCRIPTION	STATUS
FOR APPROVAL	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
C151171-C008	A





NOTES

1. All attenuation storage features are design to accommodate the the 1 in 200 year storm event plus an allowance of +40% for climate change.
2. Discharge rates are limited to the equivalent greenfield QBAR rate for the proposed impermeable areas. Greenfield QBAR has been calculated to be 4.1 litres/sec/ha.
3. All calculations are based on the FEH method and employ Micro Drainage software.

KEY

- Proposed surface water sewer
- Proposed underground surface attenuation tank
- Proposed watercourse culvert
- 30.001 Micro Drainage reference number
- Micro Drainage reference number
- Existing watercourse to be retained
- Proposed watercourse

REVISIONS

Rev	Date	Description	By	Ckd	App
A	12/02/18	First Issue.	RJH		

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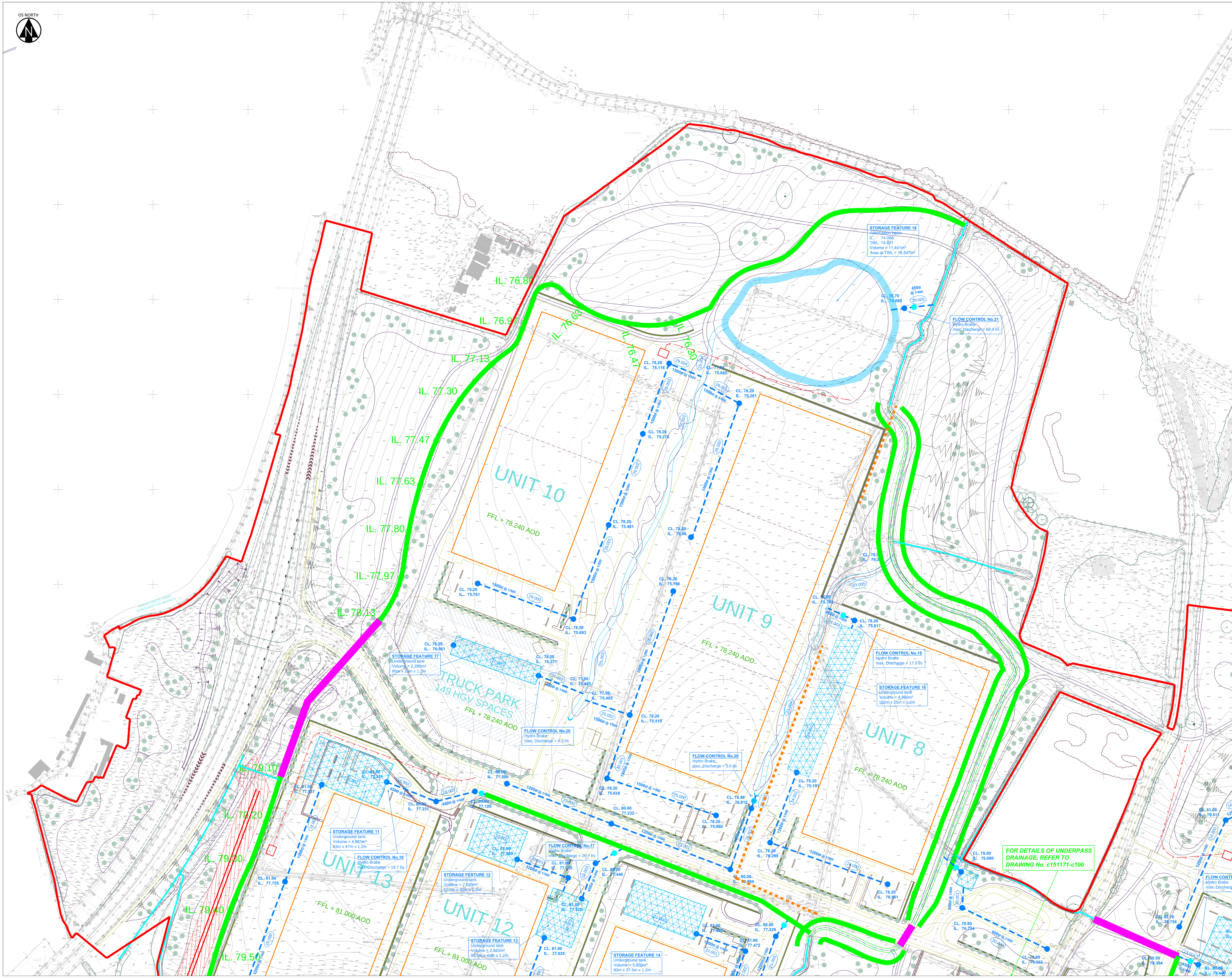
TITLE
PROPOSED SURFACE WATER DRAINAGE LAYOUT
(Sheet 3 of 4)

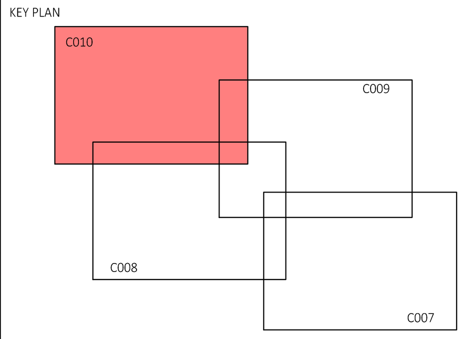
HYDROCK PROJECT NO.	SCALE @ A0
C-151171-C	1:1,250

STATUS DESCRIPTION	STATUS
FOR APPROVAL	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
C151171-C009	A



KEY PLAN



NOTES

1. All attenuation storage features are design to accommodate the the 1 in 200 year storm event plus an allowance of +40% for climate change.
2. Discharge rates are limited to the equivalent greenfield QBAR rate for the proposed impermeable areas. Greenfield QBAR has been calculated to be 4.1 litres/sec/ha.
3. All calculations are based on the FEH method and employ Micro Drainage software.

KEY

- Proposed surface water sewer
- Proposed underground surface attenuation tank
- Proposed watercourse culvert
- 30.001 Micro Drainage reference number
- Micro Drainage reference number
- Existing watercourse to be retained
- Proposed watercourse

REVISIONS

Rev	Date	Description	By	Ckd	App
A	12/02/18	First Issue.	RJH		

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CLIENT
ASHFIELD LAND LIMITED

PROJECT
RAIL CENTRAL NORTHAMPTONSHIRE

TITLE
PROPOSED SURFACE WATER DRAINAGE LAYOUT (Sheet 4 of 4)

HYDROCK PROJECT NO. C-151171-C

SCALE @ A0 1:1,250

STATUS DESCRIPTION FOR APPROVAL

STATUS S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) C151171-C010

REVISION A

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	3.463	4-8	7.793	8-12	1.015

Total Area Contributing (ha) = 12.271

Total Pipe Volume (m^3) = 12206.547

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E13.000	147.000	0.307	478.8	1.753	4.00	0.0	0.600	o	1500	Pipe/Conduit
E13.001	166.000	0.332	500.0	1.753	0.00	0.0	0.600	o	1500	Pipe/Conduit
E13.002	149.800	0.273	548.7	1.753	0.00	0.0	0.600	o	1500	Pipe/Conduit
E13.003	145.000	0.444	326.6	1.753	0.00	0.0	0.600	[]	-6	Pipe/Conduit
E14.000	153.600	0.307	500.3	1.753	5.00	0.0	0.600	o	1500	Pipe/Conduit
E14.001	165.900	0.332	499.7	1.753	0.00	0.0	0.600	o	1500	Pipe/Conduit
E14.002	185.800	0.372	499.5	1.753	0.00	0.0	0.600	o	1500	Pipe/Conduit
E14.003	29.500	0.059	500.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E13.004	22.900	1.336	17.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E13.000	80.800	1.753	0.0	1.95	3452.1
E13.001	80.493	3.506	0.0	1.91	3377.8
E13.002	80.161	5.259	0.0	1.82	3223.3
E13.003	79.888	7.012	0.0	3.12	224367.2
E14.000	80.800	1.753	0.0	1.91	3376.7
E14.001	80.493	3.506	0.0	1.91	3378.8
E14.002	80.161	5.259	0.0	1.91	3379.6
E14.003	79.789	5.259	0.0	1.91	3377.8
E13.004	79.730	12.271	0.0	4.93	783.9

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-6	[]	60000	1200	90.0		2.353	72.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E13.000	o	1500	E1	83.200	80.800	0.900	Open Manhole	2100
E13.001	o	1500	E2	83.200	80.493	1.207	Open Manhole	2100
E13.002	o	1500	E3	83.200	80.161	1.539	Open Manhole	2100
E13.003	[]	-6	E4	83.200	79.888	2.112	Open Manhole	60725
E14.000	o	1500	E5	83.200	80.800	0.900	Open Manhole	2100
E14.001	o	1500	E6	83.200	80.493	1.207	Open Manhole	2100
E14.002	o	1500	E7	83.200	80.161	1.539	Open Manhole	2100
E14.003	o	1500	E8	83.200	79.789	1.911	Open Manhole	2100
E13.004	o	450	E9	82.000	79.730	1.820	Open Manhole	2100

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)
E13.000	147.000	478.8	E2	83.200	80.493	1.207	Open Manhole	2100
E13.001	166.000	500.0	E3	83.200	80.161	1.539	Open Manhole	2100
E13.002	149.800	548.7	E4	83.200	79.888	1.812	Open Manhole	60725
E13.003	145.000	326.6	E9	82.000	79.444	1.356	Open Manhole	2100
E14.000	153.600	500.3	E6	83.200	80.493	1.207	Open Manhole	2100
E14.001	165.900	499.7	E7	83.200	80.161	1.539	Open Manhole	2100
E14.002	185.800	499.5	E8	83.200	79.789	1.911	Open Manhole	2100
E14.003	29.500	500.0	E9	82.000	79.730	0.770	Open Manhole	2100
E13.004	22.900	17.1	E	80.500	78.394	1.656	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E13.004	E	80.500	78.394	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	C (1km)	-0.026	D3 (1km)	0.243
Return Period (years)	2	D1 (1km)	0.319	E (1km)	0.302
Site Location		D2 (1km)	0.300	F (1km)	2.496

Synthetic Rainfall Details

Summer Storms	Yes	Cv (Summer)	0.750	Storm Duration (mins)	30
Winter Storms	No	Cv (Winter)	0.840		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E9, DS/PN: E13.004, Volume (m^3): 8234.6

Unit Reference	MD-SHE-0289-5030-1500-5030
Design Head (m)	1.500
Design Flow (l/s)	50.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	289
Invert Level (m)	79.730
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	50.3	Kick-Flo®	1.065	42.7
Flush-Flo™	0.502	50.2	Mean Flow over Head Range	-	42.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.0	0.800	48.5	2.000	57.8	4.000	80.8	7.000	106.2
0.200	29.8	1.000	45.1	2.200	60.5	4.500	85.6	7.500	109.8
0.300	48.0	1.200	45.2	2.400	63.1	5.000	90.1	8.000	113.3
0.400	49.8	1.400	48.6	2.600	65.6	5.500	94.4	8.500	116.7
0.500	50.2	1.600	51.9	3.000	70.3	6.000	98.5	9.000	120.0
0.600	50.0	1.800	54.9	3.500	75.8	6.500	102.4	9.500	123.2

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	**US/MH Name**	**Storm**	**Return Period**	**Climate Change**	**First (X) Surcharge**	**First (Y) Flood**	**First (Z) Overflow**	**Overflow Act.**	**Water Level (m)**	**Surcharged Depth (m)**
E13.000	E1	15 Winter	1	+0%	200/15 Winter				81.098	-1.202
E13.001	E2	15 Winter	1	+0%	200/15 Summer				80.860	-1.133
E13.002	E3	15 Winter	1	+0%	100/15 Winter				80.599	-1.062
E13.003	E4	1440 Winter	1	+0%					79.968	-1.120
E14.000	E5	15 Winter	1	+0%	200/15 Winter				81.090	-1.210
E14.001	E6	15 Winter	1	+0%	200/15 Summer				80.855	-1.138
E14.002	E7	15 Winter	1	+0%	200/15 Summer				80.578	-1.083
E14.003	E8	15 Winter	1	+0%	200/15 Summer				80.261	-1.028
E13.004	E9	1440 Winter	1	+0%	30/360 Winter				79.966	-0.214

PN	**US/MH Name**	**Flooded Volume (m³)**	**Flow / Cap.**	**Overflow (l/s)**	**Pipe Flow (l/s)**	**Status**	**Level Exceeded**
E13.000	E1	0.000	0.08		238.3	OK	
E13.001	E2	0.000	0.13		377.9	OK	
E13.002	E3	0.000	0.19		527.8	OK	
E13.003	E4	0.000	0.00		52.9	OK	
E14.000	E5	0.000	0.07		221.4	OK	
E14.001	E6	0.000	0.12		371.3	OK	
E14.002	E7	0.000	0.16		488.1	OK	
E14.003	E8	0.000	0.22		456.9	OK	
E13.004	E9	0.000	0.06		37.8	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E13.000	E1	15 Winter	30	+0%	200/15 Winter				81.346	-0.954
E13.001	E2	15 Winter	30	+0%	200/15 Summer				81.191	-0.802
E13.002	E3	15 Winter	30	+0%	100/15 Winter				80.990	-0.671
E13.003	E4	720 Winter	30	+0%					80.246	-0.842
E14.000	E5	15 Winter	30	+0%	200/15 Winter				81.332	-0.968
E14.001	E6	15 Winter	30	+0%	200/15 Summer				81.171	-0.822
E14.002	E7	15 Winter	30	+0%	200/15 Summer				80.942	-0.719
E14.003	E8	15 Winter	30	+0%	200/15 Summer				80.686	-0.603
E13.004	E9	720 Winter	30	+0%	30/360 Winter				80.233	0.053

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E13.000	E1	0.000	0.25		741.5	OK	
E13.001	E2	0.000	0.40		1198.4	OK	
E13.002	E3	0.000	0.59		1650.2	OK	
E13.003	E4	0.000	0.00		119.9	OK	
E14.000	E5	0.000	0.23		692.5	OK	
E14.001	E6	0.000	0.39		1158.8	OK	
E14.002	E7	0.000	0.50		1502.8	OK	
E14.003	E8	0.000	0.67		1399.1	OK	
E13.004	E9	0.000	0.08		50.2	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E13.000	E1	15 Winter	100	+40%	200/15 Winter				81.925	-0.375
E13.001	E2	15 Winter	100	+40%	200/15 Summer				81.850	-0.143
E13.002	E3	15 Winter	100	+40%	100/15 Winter				81.679	0.018
E13.003	E4	960 Winter	100	+40%					80.780	-0.308
E14.000	E5	15 Winter	100	+40%	200/15 Winter				81.765	-0.535
E14.001	E6	15 Winter	100	+40%	200/15 Summer				81.710	-0.283
E14.002	E7	15 Winter	100	+40%	200/15 Summer				81.579	-0.082
E14.003	E8	15 Winter	100	+40%	200/15 Summer				81.289	0.000
E13.004	E9	1440 Winter	100	+40%	30/360 Winter				80.746	0.566

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E13.000	E1	0.000	0.52		1553.4	OK	
E13.001	E2	0.000	0.75		2228.0	OK	
E13.002	E3	0.000	1.14		3212.5	SURCHARGED	
E13.003	E4	0.000	0.00		155.1	OK	
E14.000	E5	0.000	0.49		1455.6	OK	
E14.001	E6	0.000	0.75		2250.8	OK	
E14.002	E7	0.000	0.95		2869.8	OK	
E14.003	E8	0.000	1.32		2761.7	OK	
E13.004	E9	0.000	0.08		50.2	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E13.000	E1	15 Winter	200	+40%	200/15 Winter				82.545	0.245
E13.001	E2	15 Winter	200	+40%	200/15 Summer				82.418	0.425
E13.002	E3	15 Winter	200	+40%	100/15 Winter				82.007	0.346
E13.003	E4	1440 Winter	200	+40%					81.060	-0.028
E14.000	E5	15 Winter	200	+40%	200/15 Winter				82.394	0.094
E14.001	E6	15 Winter	200	+40%	200/15 Summer				82.301	0.308
E14.002	E7	15 Winter	200	+40%	200/15 Summer				82.088	0.427
E14.003	E8	15 Winter	200	+40%	200/15 Summer				81.499	0.210
E13.004	E9	960 Winter	200	+40%	30/360 Winter				80.993	0.813

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E13.000	E1	0.000	0.63		1903.4	SURCHARGED	
E13.001	E2	0.000	0.99		2950.3	SURCHARGED	
E13.002	E3	0.000	1.56		4377.9	SURCHARGED	
E13.003	E4	0.000	0.00		131.7	OK	
E14.000	E5	0.000	0.62		1818.0	SURCHARGED	
E14.001	E6	0.000	0.94		2804.8	SURCHARGED	
E14.002	E7	0.000	1.22		3692.8	SURCHARGED	
E14.003	E8	0.000	1.73		3625.8	SURCHARGED	
E13.004	E9	0.000	0.08		50.2	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	3.448	4-8	7.591	8-12	1.544

Total Area Contributing (ha) = 12.583

Total Pipe Volume (m^3) = 1941.015

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E15.000	190.500	0.381	500.0	3.060	4.00	0.0	0.600	o	1800	Pipe/Conduit
E15.001	209.700	0.419	500.5	3.060	0.00	0.0	0.600	o	1800	Pipe/Conduit
E15.002	199.200	0.399	499.2	3.060	0.00	0.0	0.600	o	1800	Pipe/Conduit
E15.003	83.100	0.166	500.6	3.060	0.00	0.0	0.600	o	1800	Pipe/Conduit
E16.000	122.400	0.245	499.6	0.270	5.00	0.0	0.600	o	1200	Pipe/Conduit
E16.001	38.100	0.076	501.3	0.073	0.00	0.0	0.600	o	1200	Pipe/Conduit
E15.004	18.000	0.036	500.0	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit
E15.005	15.000	0.037	405.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E15.000	80.800	3.060	0.0	2.14	5438.4
E15.001	80.419	6.120	0.0	2.14	5435.8
E15.002	80.000	9.180	0.0	2.14	5442.5
E15.003	79.601	12.240	0.0	2.14	5435.1
E16.000	79.756	0.270	0.0	1.67	1885.3
E16.001	79.511	0.343	0.0	1.66	1882.0
E15.004	79.435	12.583	0.0	1.67	1884.5
E15.005	79.390	12.583	0.0	1.00	159.6

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E15.000	o	1800	E1	83.200	80.800	0.600	Open Manhole	2700
E15.001	o	1800	E2	83.200	80.419	0.981	Open Manhole	2700
E15.002	o	1800	E3	83.200	80.000	1.400	Open Manhole	2700
E15.003	o	1800	E4	83.200	79.601	1.799	Open Manhole	2700
E16.000	o	1200	E5	82.160	79.756	1.204	Open Manhole	2100
E16.001	o	1200	E6	83.200	79.511	2.489	Open Manhole	2100
E15.004	o	1200	E7	81.500	79.435	0.865	Open Manhole	2100
E15.005	o	450	E8	81.500	79.390	1.660	Open Manhole	2100

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)
E15.000	190.500	500.0	E2	83.200	80.419	0.981	Open Manhole	2700
E15.001	209.700	500.5	E3	83.200	80.000	1.400	Open Manhole	2700
E15.002	199.200	499.2	E4	83.200	79.601	1.799	Open Manhole	2700
E15.003	83.100	500.6	E7	81.500	79.435	0.265	Open Manhole	2100
E16.000	122.400	499.6	E6	83.200	79.511	2.489	Open Manhole	2100
E16.001	38.100	501.3	E7	81.500	79.435	0.865	Open Manhole	2100
E15.004	18.000	500.0	E8	81.500	79.399	0.901	Open Manhole	2100
E15.005	15.000	405.4	E	81.500	79.353	1.697	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E15.005	E	81.500	79.353	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E8, DS/PN: E15.005, Volume (m³): 25.3

Unit Reference	MD-SHE-0294-5160-1400-5160
Design Head (m)	1.400
Design Flow (l/s)	51.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	294
Invert Level (m)	79.390
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.400	51.6	Kick-Flo®	1.013	44.2
Flush-Flo™	0.492	51.6	Mean Flow over Head Range	-	43.2

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	9.1	0.800	49.5	2.000	61.3	4.000	85.8	7.000	112.7
0.200	30.2	1.000	44.8	2.200	64.2	4.500	90.8	7.500	116.5
0.300	49.5	1.200	47.9	2.400	66.9	5.000	95.6	8.000	120.3
0.400	51.2	1.400	51.6	2.600	69.6	5.500	100.2	8.500	123.9
0.500	51.6	1.600	55.0	3.000	74.6	6.000	104.5	9.000	127.4
0.600	51.2	1.800	58.3	3.500	80.4	6.500	108.7	9.500	130.8

Storage Structures for Existing

Tank or Pond Manhole: E4, DS/PN: E15.003

Invert Level (m) 79.601

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	8656.0	1.200	10772.0	2.400	11139.0	3.600	11139.0	4.800	11139.0
0.200	8998.0	1.400	11139.0	2.600	11139.0	3.800	11139.0	5.000	11139.0
0.400	9345.0	1.600	11139.0	2.800	11139.0	4.000	11139.0		
0.600	9696.0	1.800	11139.0	3.000	11139.0	4.200	11139.0		
0.800	10051.0	2.000	11139.0	3.200	11139.0	4.400	11139.0		
1.000	10410.0	2.200	11139.0	3.400	11139.0	4.600	11139.0		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E15.000	E1	15 Winter	1	+0%	200/15 Winter				81.173	-1.427
E15.001	E2	15 Winter	1	+0%	200/15 Summer				80.872	-1.347
E15.002	E3	15 Winter	1	+0%	100/15 Winter				80.521	-1.279
E15.003	E4	720 Winter	1	+0%					79.794	-1.607
E16.000	E5	15 Winter	1	+0%					79.879	-1.077
E16.001	E6	720 Winter	1	+0%	200/480 Winter				79.753	-0.958
E15.004	E7	720 Winter	1	+0%	200/240 Winter				79.753	-0.882
E15.005	E8	720 Winter	1	+0%	30/15 Winter				79.746	-0.094

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E15.000	E1	0.000	0.08		402.7	OK	
E15.001	E2	0.000	0.13		636.0	OK	
E15.002	E3	0.000	0.18		881.5	OK	
E15.003	E4	0.000	0.01		49.7	OK	
E16.000	E5	0.000	0.02		35.8	OK	
E16.001	E6	0.000	0.00		3.9	OK	
E15.004	E7	0.000	0.05		50.3	OK	
E15.005	E8	0.000	0.48		50.3	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E15.000	E1	15 Winter	30	+0%	200/15 Winter				81.476	-1.124
E15.001	E2	15 Winter	30	+0%	200/15 Summer				81.277	-0.942
E15.002	E3	15 Winter	30	+0%	100/15 Winter				80.981	-0.819
E15.003	E4	720 Winter	30	+0%					80.100	-1.301
E16.000	E5	600 Winter	30	+0%					80.086	-0.870
E16.001	E6	600 Winter	30	+0%	200/480 Winter				80.086	-0.625
E15.004	E7	600 Winter	30	+0%	200/240 Winter				80.085	-0.550
E15.005	E8	600 Winter	30	+0%	30/15 Winter				80.077	0.237

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E15.000	E1	0.000	0.27		1266.7	OK	
E15.001	E2	0.000	0.42		2005.3	OK	
E15.002	E3	0.000	0.58		2756.8	OK	
E15.003	E4	0.000	0.01		54.2	OK	
E16.000	E5	0.000	0.01		9.0	OK	
E16.001	E6	0.000	0.01		7.1	OK	
E15.004	E7	0.000	0.06		52.3	OK	
E15.005	E8	0.000	0.49		51.6	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E15.000	E1	15 Winter	100	+40%	200/15 Winter				82.098	-0.502
E15.001	E2	15 Winter	100	+40%	200/15 Summer				82.038	-0.181
E15.002	E3	15 Winter	100	+40%	100/15 Winter				81.836	0.036
E15.003	E4	960 Winter	100	+40%					80.597	-0.804
E16.000	E5	960 Winter	100	+40%					80.576	-0.380
E16.001	E6	960 Winter	100	+40%	200/480 Winter				80.575	-0.136
E15.004	E7	960 Winter	100	+40%	200/240 Winter				80.575	-0.060
E15.005	E8	960 Winter	100	+40%	30/15 Winter				80.543	0.703

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E15.000	E1	0.000	0.56		2645.1	OK	
E15.001	E2	0.000	0.79		3787.8	OK	
E15.002	E3	0.000	1.05		5006.8	SURCHARGED	
E15.003	E4	0.000	0.03		117.6	OK	
E16.000	E5	0.000	0.01		11.5	OK	
E16.001	E6	0.000	0.01		15.9	OK	
E15.004	E7	0.000	0.08		71.4	OK	
E15.005	E8	0.000	0.49		51.6	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E15.000	E1	15 Winter	200	+40%	200/15 Winter				82.918	0.318
E15.001	E2	15 Winter	200	+40%	200/15 Summer				82.826	0.607
E15.002	E3	15 Winter	200	+40%	100/15 Winter				82.287	0.487
E15.003	E4	960 Winter	200	+40%					80.773	-0.628
E16.000	E5	960 Winter	200	+40%					80.754	-0.202
E16.001	E6	960 Winter	200	+40%	200/480 Winter				80.754	0.043
E15.004	E7	960 Winter	200	+40%	200/240 Winter				80.752	0.117
E15.005	E8	960 Winter	200	+40%	30/15 Winter				80.764	0.924

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E15.000	E1	0.000	0.69		3267.1	FLOOD RISK	
E15.001	E2	0.000	1.02		4893.3	SURCHARGED	
E15.002	E3	0.000	1.39		6664.3	SURCHARGED	
E15.003	E4	0.000	0.03		124.1	OK	
E16.000	E5	0.000	0.01		13.6	OK	
E16.001	E6	0.000	0.01		17.5	SURCHARGED	
E15.004	E7	0.000	0.09		81.4	SURCHARGED	
E15.005	E8	0.000	0.49		51.6	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.161	4-8	0.455	8-12	0.086

Total Area Contributing (ha) = 0.701

Total Pipe Volume (m^3) = 832.838

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E12.000	164.000	0.218	752.3	0.290	4.00	0.0	0.600	o	1500	Pipe/Conduit
E12.001	133.400	0.178	749.4	0.180	0.00	0.0	0.600	o	1500	Pipe/Conduit
E12.002	130.200	0.174	748.3	0.176	0.00	0.0	0.600	o	1500	Pipe/Conduit
E12.003	40.900	0.055	743.6	0.055	0.00	0.0	0.600	o	1500	Pipe/Conduit
E12.004	31.000	0.675	45.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E12.000	82.300	0.290	0.0	1.56	2749.6
E12.001	82.082	0.470	0.0	1.56	2754.9
E12.002	81.904	0.646	0.0	1.56	2757.1
E12.003	81.730	0.701	0.0	1.57	2765.7
E12.004	81.675	0.701	0.0	3.01	478.1

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E12.000	o	1500	E1	85.200	82.300	1.400	Open Manhole	2700
E12.001	o	1500	E2	85.000	82.082	1.418	Open Manhole	2700
E12.002	o	1500	E3	85.000	81.904	1.596	Open Manhole	2700
E12.003	o	1500	E4	85.000	81.730	1.770	Open Manhole	2700
E12.004	o	450	E5	85.000	81.675	2.875	Open Manhole	1800

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)
E12.000	164.000	752.3	E2	85.000	82.082	1.418	Open Manhole	2700
E12.001	133.400	749.4	E3	85.000	81.904	1.596	Open Manhole	2700
E12.002	130.200	748.3	E4	85.000	81.730	1.770	Open Manhole	2700
E12.003	40.900	743.6	E5	85.000	81.675	1.825	Open Manhole	1800
E12.004	31.000	45.9	E	82.000	81.000	0.550	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E12.004	E	82.000	81.000	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E5, DS/PN: E12.004, Volume (m^3): 76.8

Unit Reference	MD-SHE-0074-2900-1500-2900
Design Head (m)	1.500
Design Flow (l/s)	2.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	74
Invert Level (m)	81.675
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.9	Kick-Flo®	0.662	2.0
Flush-Flo™	0.325	2.5	Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	2.2	2.000	3.3	4.000	4.6	7.000	5.9
0.200	2.4	1.000	2.4	2.200	3.5	4.500	4.8	7.500	6.1
0.300	2.5	1.200	2.6	2.400	3.6	5.000	5.1	8.000	6.3
0.400	2.5	1.400	2.8	2.600	3.7	5.500	5.3	8.500	6.5
0.500	2.4	1.600	3.0	3.000	4.0	6.000	5.5	9.000	6.7
0.600	2.2	1.800	3.2	3.500	4.3	6.500	5.7	9.500	6.9

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km) 0.319	E (1km) 0.302	Cv (Winter) 0.840
Site Location		D2 (1km) 0.300	F (1km) 2.496	
C (1km)	-0.026	D3 (1km) 0.243	Cv (Summer) 0.750	

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E12.000	E1	15 Winter	1	+0%					82.427	-1.373
E12.001	E2	15 Winter	1	+0%					82.239	-1.343
E12.002	E3	360 Winter	1	+0%					82.226	-1.178
E12.003	E4	360 Winter	1	+0%					82.226	-1.004
E12.004	E5	360 Winter	1	+0%	1/30 Summer				82.226	0.101

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E12.000	E1	0.000	0.02		41.0	OK	
E12.001	E2	0.000	0.02		48.7	OK	
E12.002	E3	0.000	0.00		10.8	OK	
E12.003	E4	0.000	0.00		4.9	OK	
E12.004	E5	0.000	0.01		2.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E12.000	E1	600 Winter	30	+0%					82.554	-1.246
E12.001	E2	600 Winter	30	+0%					82.554	-1.028
E12.002	E3	600 Winter	30	+0%					82.554	-0.850
E12.003	E4	600 Winter	30	+0%					82.554	-0.676
E12.004	E5	600 Winter	30	+0%	1/30 Summer				82.554	0.429

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E12.000	E1	0.000	0.00		9.7	OK	
E12.001	E2	0.000	0.01		12.3	OK	
E12.002	E3	0.000	0.00		11.5	OK	
E12.003	E4	0.000	0.00		4.9	OK	
E12.004	E5	0.000	0.01		2.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E12.000	E1	960 Winter	100	+40%					82.989	-0.811
E12.001	E2	960 Winter	100	+40%					82.989	-0.593
E12.002	E3	960 Winter	100	+40%					82.988	-0.416
E12.003	E4	960 Winter	100	+40%					82.988	-0.242
E12.004	E5	960 Winter	100	+40%	1/30 Summer				82.988	0.863

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E12.000	E1	0.000	0.01		12.2	OK	
E12.001	E2	0.000	0.00		11.5	OK	
E12.002	E3	0.000	0.00		10.9	OK	
E12.003	E4	0.000	0.00		4.9	OK	
E12.004	E5	0.000	0.01		2.7	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E12.000	E1	960 Winter	200	+40%					83.172	-0.628
E12.001	E2	960 Winter	200	+40%					83.172	-0.410
E12.002	E3	960 Winter	200	+40%					83.172	-0.232
E12.003	E4	960 Winter	200	+40%					83.171	-0.059
E12.004	E5	960 Winter	200	+40%	1/30 Summer				83.169	1.044

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E12.000	E1	0.000	0.01		14.4	OK	
E12.001	E2	0.000	0.01		12.7	OK	
E12.002	E3	0.000	0.01		12.0	OK	
E12.003	E4	0.000	0.00		5.3	OK	
E12.004	E5	0.000	0.01		2.9	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.215	4-8	9.793	8-12	8.024	12-16	0.090

Total Area Contributing (ha) = 18.123

Total Pipe Volume (m^3) = 23100.982

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E10.000	149.500	0.299	500.0	2.529	4.00	0.0	0.600	o	1800	Pipe/Conduit
E10.001	137.600	0.276	498.6	2.529	0.00	0.0	0.600	o	1800	Pipe/Conduit
E10.002	148.800	0.298	499.3	2.529	0.00	0.0	0.600	o	1800	Pipe/Conduit
E10.003	50.000	0.057	877.2	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit
E10.004	121.000	0.140	864.3	2.529	0.00	0.0	0.600	[]	-6	Pipe/Conduit
E10.005	9.500	0.019	500.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E10.006	85.200	0.170	501.2	0.110	0.00	0.0	0.600	o	1200	Pipe/Conduit
E10.007	104.300	0.209	499.0	0.104	0.00	0.0	0.600	o	1200	Pipe/Conduit
E10.008	68.000	0.624	109.0	0.068	0.00	0.0	0.600	o	1200	Pipe/Conduit
E11.000	165.400	0.331	499.7	2.549	5.00	0.0	0.600	o	1800	Pipe/Conduit
E11.001	138.100	0.276	500.4	2.549	0.00	0.0	0.600	o	1800	Pipe/Conduit
E11.002	149.100	0.299	498.7	2.549	0.00	0.0	0.600	o	1800	Pipe/Conduit
E11.003	16.300	0.031	525.8	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit
E11.004	121.000	0.242	500.0	0.000	0.00	0.0	0.600	[]	-6	Pipe/Conduit
E11.005	27.500	0.069	398.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E11.006	37.800	0.094	402.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E10.009	31.500	0.063	500.0	0.078	0.00	0.0	0.600	o	1200	Pipe/Conduit
E10.010	28.700	0.072	398.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E10.000	82.550	2.529	0.0	2.14	5438.4
E10.001	82.251	5.058	0.0	2.14	5446.3
E10.002	81.975	7.587	0.0	2.14	5442.1
E10.003	81.677	7.587	0.0	1.61	4098.1
E10.004	81.620	10.116	0.0	1.91	160766.4
E10.005	81.480	10.116	0.0	0.90	143.5
E10.006	81.461	10.226	0.0	1.66	1882.2
E10.007	81.291	10.330	0.0	1.67	1886.3
E10.008	81.082	10.398	0.0	3.58	4053.1
E11.000	82.550	2.549	0.0	2.14	5440.1
E11.001	82.219	5.098	0.0	2.14	5436.4
E11.002	81.943	7.647	0.0	2.14	5445.7
E11.003	81.644	7.647	0.0	2.08	5302.5
E11.004	81.613	7.647	0.0	2.52	211703.6
E11.005	81.371	7.647	0.0	1.01	161.0
E11.006	81.302	7.647	0.0	1.01	160.3
E10.009	80.458	18.123	0.0	1.67	1884.5
E10.010	80.395	18.123	0.0	1.01	161.0

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-6	[]	70000	1200	90.0		2.360	84.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E10.000	o	1800	E1	84.950	82.550	0.600	Open Manhole	2100
E10.001	o	1800	E2	84.950	82.251	0.899	Open Manhole	2100
E10.002	o	1800	E3	84.950	81.975	1.175	Open Manhole	2100
E10.003	o	1800	E4	84.950	81.677	1.473	Open Manhole	2100
E10.004	[]	-6	E5	84.950	81.620	2.130	Open Manhole	70725
E10.005	o	450	E6	84.800	81.480	2.870	Open Manhole	1500
E10.006	o	1200	E7	84.800	81.461	2.139	Open Manhole	2100
E10.007	o	1200	E8	84.000	81.291	1.509	Open Manhole	2100
E10.008	o	1200	E9	83.800	81.082	1.518	Open Manhole	2100
E11.000	o	1800	E10	84.950	82.550	0.600	Open Manhole	2100
E11.001	o	1800	E11	84.950	82.219	0.931	Open Manhole	2100
E11.002	o	1800	E12	84.950	81.943	1.207	Open Manhole	2100
E11.003	o	1800	E13	84.950	81.644	1.506	Open Manhole	2100
E11.004	[]	-6	E14	84.950	81.613	2.137	Open Manhole	70725
E11.005	o	450	E15	84.950	81.371	3.129	Open Manhole	1500
E11.006	o	450	E16	84.950	81.302	3.198	Open Manhole	1500
E10.009	o	1200	E17	83.700	80.458	2.042	Open Manhole	2100
E10.010	o	450	E18	82.800	80.395	1.955	Open Manhole	2100

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)
E10.000	149.500	500.0	E2	84.950	82.251	0.899	Open Manhole	2100
E10.001	137.600	498.6	E3	84.950	81.975	1.175	Open Manhole	2100
E10.002	148.800	499.3	E4	84.950	81.677	1.473	Open Manhole	2100
E10.003	50.000	877.2	E5	84.950	81.620	1.530	Open Manhole	70725
E10.004	121.000	864.3	E6	84.800	81.480	2.120	Open Manhole	1500
E10.005	9.500	500.0	E7	84.800	81.461	2.889	Open Manhole	2100
E10.006	85.200	501.2	E8	84.000	81.291	1.509	Open Manhole	2100
E10.007	104.300	499.0	E9	83.800	81.082	1.518	Open Manhole	2100
E10.008	68.000	109.0	E17	83.700	80.458	2.042	Open Manhole	2100
E11.000	165.400	499.7	E11	84.950	82.219	0.931	Open Manhole	2100
E11.001	138.100	500.4	E12	84.950	81.943	1.207	Open Manhole	2100
E11.002	149.100	498.7	E13	84.950	81.644	1.506	Open Manhole	2100
E11.003	16.300	525.8	E14	84.950	81.613	1.537	Open Manhole	70725
E11.004	121.000	500.0	E15	84.950	81.371	2.379	Open Manhole	1500
E11.005	27.500	398.6	E16	84.950	81.302	3.198	Open Manhole	1500
E11.006	37.800	402.1	E17	83.700	81.208	2.042	Open Manhole	2100
E10.009	31.500	500.0	E18	82.800	80.395	1.205	Open Manhole	2100
E10.010	28.700	398.6	E	82.000	80.323	1.227	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E10.010	E	82.000	80.323	0.000	0	0

Simulation Criteria for Existing

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	3	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E6, DS/PN: E10.005, Volume (m³): 7136.4

Unit Reference	MD-SHE-0267-4180-1500-4180
Design Head (m)	1.500
Design Flow (l/s)	41.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	267
Invert Level (m)	81.480
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	41.8	Kick-Flo®	1.055	35.3
Flush-Flo™	0.490	41.8	Mean Flow over Head Range	-	35.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	0.800	40.3	2.000	48.0	4.000	67.1	7.000	88.1
0.200	27.5	1.000	37.1	2.200	50.2	4.500	71.0	7.500	91.1
0.300	40.1	1.200	37.5	2.400	52.4	5.000	74.8	8.000	94.0
0.400	41.5	1.400	40.4	2.600	54.5	5.500	78.3	8.500	96.8
0.500	41.8	1.600	43.1	3.000	58.4	6.000	81.7	9.000	99.6
0.600	41.5	1.800	45.6	3.500	62.9	6.500	84.9	9.500	102.2

Hydro-Brake Optimum® Manhole: E15, DS/PN: E11.005, Volume (m³): 7136.9

Unit Reference	MD-SHE-0270-4150-1200-4150
Design Head (m)	1.200
Design Flow (l/s)	41.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	270
Invert Level (m)	81.371
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	41.5	Kick-Flo®	0.885	35.9
Flush-Flo™	0.442	41.5	Mean Flow over Head Range	-	34.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.6	0.400	41.4	0.800	38.4	1.400	44.7	2.000	53.1
0.200	27.8	0.500	41.3	1.000	38.0	1.600	47.7	2.200	55.6
0.300	40.4	0.600	40.8	1.200	41.5	1.800	50.4	2.400	58.0

Hydro-Brake Optimum® Manhole: E15, DS/PN: E11.005, Volume (m³): 7136.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	60.3	4.000	74.3	5.500	86.7	7.000	97.5	8.500	107.2
3.000	64.6	4.500	78.6	6.000	90.5	7.500	100.8	9.000	110.2
3.500	69.6	5.000	82.8	6.500	94.0	8.000	104.1	9.500	113.2

Hydro-Brake Optimum® Manhole: E17, DS/PN: E10.009, Volume (m³): 91.5

Unit Reference	MD-SHE-0328-7430-2500-7430
Design Head (m)	2.500
Design Flow (l/s)	74.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	328
Invert Level (m)	80.458
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	74.2	Kick-Flo®	1.628	60.3
Flush-Flo™	0.745	74.3	Mean Flow over Head Range	-	64.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.7	0.800	74.2	2.000	66.6	4.000	93.2	7.000	122.4
0.200	33.5	1.000	73.2	2.200	69.8	4.500	98.7	7.500	126.6
0.300	59.7	1.200	71.4	2.400	72.8	5.000	103.9	8.000	130.7
0.400	69.6	1.400	68.2	2.600	75.6	5.500	108.9	8.500	134.6
0.500	72.3	1.600	61.8	3.000	81.1	6.000	113.6	9.000	138.4
0.600	73.7	1.800	63.3	3.500	87.4	6.500	118.1	9.500	142.1

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E10.000	E1	15 Winter	1	+0%	200/15 Winter				82.894	-1.456
E10.001	E2	15 Winter	1	+0%	200/15 Summer				82.679	-1.372
E10.002	E3	15 Winter	1	+0%	200/15 Summer				82.474	-1.301
E10.003	E4	15 Winter	1	+0%	200/15 Summer				82.288	-1.189
E10.004	E5	960 Winter	1	+0%					81.778	-1.042
E10.005	E6	960 Winter	1	+0%	30/180 Winter				81.772	-0.158
E10.006	E7	960 Winter	1	+0%					81.568	-1.093
E10.007	E8	960 Winter	1	+0%					81.390	-1.101
E10.008	E9	15 Winter	1	+0%					81.137	-1.145
E11.000	E10	15 Winter	1	+0%	200/15 Winter				82.880	-1.470
E11.001	E11	15 Winter	1	+0%	200/15 Summer				82.643	-1.376
E11.002	E12	15 Winter	1	+0%	200/15 Summer				82.453	-1.290
E11.003	E13	15 Winter	1	+0%	100/15 Winter				82.334	-1.110
E11.004	E14	720 Winter	1	+0%					81.653	-1.160
E11.005	E15	720 Winter	1	+0%	30/480 Winter				81.650	-0.171
E11.006	E16	720 Winter	1	+0%	100/120 Winter				81.440	-0.312
E10.009	E17	720 Winter	1	+0%	100/120 Summer				80.891	-0.767
E10.010	E18	720 Winter	1	+0%					80.598	-0.247

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.000	E1	0.000	0.08		346.2	OK	
E10.001	E2	0.000	0.12		559.1	OK	
E10.002	E3	0.000	0.16		759.1	OK	
E10.003	E4	0.000	0.25		700.6	OK	
E10.004	E5	0.000	0.00		70.9	OK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.005	E6	0.000	0.35		27.9	OK	
E10.006	E7	0.000	0.02		28.2	OK	
E10.007	E8	0.000	0.02		28.5	OK	
E10.008	E9	0.000	0.01		30.4	OK	
E11.000	E10	0.000	0.07		322.9	OK	
E11.001	E11	0.000	0.12		551.2	OK	
E11.002	E12	0.000	0.15		712.9	OK	
E11.003	E13	0.000	0.33		643.8	OK	
E11.004	E14	0.000	0.00		95.6	OK	
E11.005	E15	0.000	0.21		29.0	OK	
E11.006	E16	0.000	0.21		29.0	OK	
E10.009	E17	0.000	0.04		57.9	OK	
E10.010	E18	0.000	0.42		57.9	OK	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	3	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E10.000	E1	15 Winter	30	+0%	200/15 Winter				83.200	-1.150
E10.001	E2	15 Winter	30	+0%	200/15 Summer				83.070	-0.981
E10.002	E3	15 Winter	30	+0%	200/15 Summer				82.948	-0.827
E10.003	E4	15 Winter	30	+0%	200/15 Summer				82.836	-0.641
E10.004	E5	720 Winter	30	+0%					82.027	-0.793
E10.005	E6	720 Winter	30	+0%	30/180 Winter				81.998	0.068
E10.006	E7	600 Winter	30	+0%					81.642	-1.019
E10.007	E8	600 Winter	30	+0%					81.596	-0.895
E10.008	E9	600 Winter	30	+0%					81.576	-0.706
E11.000	E10	15 Winter	30	+0%	200/15 Winter				83.166	-1.184
E11.001	E11	15 Winter	30	+0%	200/15 Summer				83.028	-0.991
E11.002	E12	15 Winter	30	+0%	200/15 Summer				82.932	-0.811
E11.003	E13	15 Winter	30	+0%	100/15 Winter				82.838	-0.606
E11.004	E14	600 Winter	30	+0%					81.841	-0.972
E11.005	E15	600 Winter	30	+0%	30/480 Winter				81.824	0.003
E11.006	E16	600 Winter	30	+0%	100/120 Winter				81.593	-0.159
E10.009	E17	600 Winter	30	+0%	100/120 Summer				81.552	-0.106
E10.010	E18	1440 Winter	30	+0%					80.630	-0.215

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.000	E1	0.000	0.23		1073.3	OK	
E10.001	E2	0.000	0.38		1720.0	OK	
E10.002	E3	0.000	0.49		2235.6	OK	
E10.003	E4	0.000	0.75		2080.4	OK	
E10.004	E5	0.000	0.00		190.2	OK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.005	E6	0.000	0.51		40.9	SURCHARGED	
E10.006	E7	0.000	0.03		43.1	OK	
E10.007	E8	0.000	0.03		45.1	OK	
E10.008	E9	0.000	0.01		42.8	OK	
E11.000	E10	0.000	0.22		1010.2	OK	
E11.001	E11	0.000	0.37		1662.5	OK	
E11.002	E12	0.000	0.46		2121.4	OK	
E11.003	E13	0.000	1.02		1984.9	OK	
E11.004	E14	0.000	0.00		167.1	OK	
E11.005	E15	0.000	0.29		39.7	SURCHARGED	
E11.006	E16	0.000	0.28		39.5	OK	
E10.009	E17	0.000	0.06		74.1	OK	
E10.010	E18	0.000	0.54		74.1	OK	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	3	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E10.000	E1	15 Winter	100	+40%	200/15 Winter				83.924	-0.426
E10.001	E2	15 Winter	100	+40%	200/15 Summer				83.861	-0.190
E10.002	E3	15 Winter	100	+40%	200/15 Summer				83.770	-0.005
E10.003	E4	15 Winter	100	+40%	200/15 Summer				83.477	0.000
E10.004	E5	960 Winter	100	+40%					82.461	-0.359
E10.005	E6	960 Winter	100	+40%	30/180 Winter				82.407	0.477
E10.006	E7	960 Winter	100	+40%					82.044	-0.617
E10.007	E8	960 Winter	100	+40%					82.003	-0.488
E10.008	E9	960 Winter	100	+40%					81.952	-0.330
E11.000	E10	15 Winter	100	+40%	200/15 Winter				83.942	-0.408
E11.001	E11	15 Winter	100	+40%	200/15 Summer				83.868	-0.151
E11.002	E12	15 Winter	100	+40%	200/15 Summer				83.717	-0.026
E11.003	E13	15 Winter	100	+40%	100/15 Winter				83.459	0.015
E11.004	E14	960 Winter	100	+40%					82.181	-0.632
E11.005	E15	960 Winter	100	+40%	30/480 Winter				82.146	0.325
E11.006	E16	960 Winter	100	+40%	100/120 Winter				81.920	0.168
E10.009	E17	960 Winter	100	+40%	100/120 Summer				81.905	0.247
E10.010	E18	2160 Winter	100	+40%					80.630	-0.215

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.000	E1	0.000	0.49		2244.8	OK	
E10.001	E2	0.000	0.73		3350.5	OK	
E10.002	E3	0.000	0.94		4330.9	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.003	E4	0.000	1.55		4307.7	OK	
E10.004	E5	0.000	0.00		274.2	OK	
E10.005	E6	0.000	0.52		41.5	SURCHARGED	
E10.006	E7	0.000	0.03		45.7	OK	
E10.007	E8	0.000	0.03		47.4	OK	
E10.008	E9	0.000	0.01		47.3	OK	
E11.000	E10	0.000	0.45		2116.3	OK	
E11.001	E11	0.000	0.70		3198.7	OK	
E11.002	E12	0.000	0.91		4201.9	OK	
E11.003	E13	0.000	2.17		4214.1	SURCHARGED	
E11.004	E14	0.000	0.00		209.7	OK	
E11.005	E15	0.000	0.29		39.5	SURCHARGED	
E11.006	E16	0.000	0.28		39.3	SURCHARGED	
E10.009	E17	0.000	0.06		74.2	SURCHARGED	
E10.010	E18	0.000	0.54		74.2	OK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E10.000	E1	15 Winter	200	+40%	200/15 Winter				84.549	0.199
E10.001	E2	15 Winter	200	+40%	200/15 Summer				84.472	0.421
E10.002	E3	15 Winter	200	+40%	200/15 Summer				84.272	0.497
E10.003	E4	15 Winter	200	+40%	200/15 Summer				83.760	0.283
E10.004	E5	960 Winter	200	+40%					82.635	-0.185
E10.005	E6	960 Winter	200	+40%	30/180 Winter				82.556	0.626
E10.006	E7	960 Winter	200	+40%					82.249	-0.412
E10.007	E8	960 Winter	200	+40%					82.191	-0.300
E10.008	E9	960 Winter	200	+40%					82.117	-0.165
E11.000	E10	15 Winter	200	+40%	200/15 Winter				84.388	0.038
E11.001	E11	15 Winter	200	+40%	200/15 Summer				84.336	0.317
E11.002	E12	15 Winter	200	+40%	200/15 Summer				84.151	0.408
E11.003	E13	15 Winter	200	+40%	100/15 Winter				83.721	0.277
E11.004	E14	960 Winter	200	+40%					82.314	-0.499
E11.005	E15	960 Winter	200	+40%	30/480 Winter				82.272	0.451
E11.006	E16	960 Winter	200	+40%	100/120 Winter				82.059	0.307
E10.009	E17	960 Winter	200	+40%	100/120 Summer				82.045	0.387
E10.010	E18	4320 Winter	200	+40%					80.630	-0.215

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.000	E1	0.000	0.60		2754.3	SURCHARGED	
E10.001	E2	0.000	0.93		4253.9	SURCHARGED	
E10.002	E3	0.000	1.27		5873.2	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E10.003	E4	0.000	2.08		5785.7	SURCHARGED	
E10.004	E5	0.000	0.00		317.3	OK	
E10.005	E6	0.000	0.51		41.4	SURCHARGED	
E10.006	E7	0.000	0.03		46.6	OK	
E10.007	E8	0.000	0.03		48.7	OK	
E10.008	E9	0.000	0.02		48.1	OK	
E11.000	E10	0.000	0.56		2624.0	SURCHARGED	
E11.001	E11	0.000	0.92		4191.6	SURCHARGED	
E11.002	E12	0.000	1.24		5730.5	SURCHARGED	
E11.003	E13	0.000	2.91		5649.8	SURCHARGED	
E11.004	E14	0.000	0.00		242.2	OK	
E11.005	E15	0.000	0.29		39.6	SURCHARGED	
E11.006	E16	0.000	0.28		39.3	SURCHARGED	
E10.009	E17	0.000	0.06		74.2	SURCHARGED	
E10.010	E18	0.000	0.54		74.2	OK	

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E6.000	119.600	0.239	500.4	3.616	4.00	0.0	0.600	o	1200	Pipe/Conduit
E6.001	151.000	0.377	400.5	3.616	0.00	0.0	0.600	[]	-5	Pipe/Conduit
E6.002	27.500	-0.331	-83.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E6.000	86.350	3.616	0.0	1.67	1883.7
E6.001	86.111	7.232	0.0	2.80	134207.6
E6.002	85.734	7.232	0.0	0.00	0.0

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-5	[]	40000	1200	90.0		2.330	48.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E6.000	o	1200	E1	89.250	86.350	1.700	Open Manhole	2100
E6.001	[]	-5	E2	89.250	86.111	1.939	Open Manhole	40725
E6.002	o	450	E3	89.250	85.734	3.066	Open Manhole	1350

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)
E6.000	119.600	500.4	E2	89.250	86.111	1.939	Open Manhole	40725
E6.001	151.000	400.5	E3	89.250	85.734	2.316	Open Manhole	1350
E6.002	27.500	-83.1	E	87.500	86.065	0.985	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
6.000	-	-	100	3.616	3.616	3.616
6.001	-	-	100	3.616	3.616	3.616
6.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				7.232	7.232	7.232

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E6.002	E	87.500	86.065	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E3, DS/PN: E6.002, Volume (m³): 6243.2

Unit Reference	MD-SHE-0233-2960-1200-2960
Design Head (m)	1.200
Design Flow (l/s)	29.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	233
Invert Level (m)	85.734
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	29.6	Kick-Flo®	0.859	25.2
Flush-Flo™	0.404	29.6	Mean Flow over Head Range	-	25.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.7	0.800	26.7	2.000	37.8	4.000	52.8	7.000	69.3
0.200	23.4	1.000	27.1	2.200	39.6	4.500	55.9	7.500	71.7
0.300	29.1	1.200	29.6	2.400	41.3	5.000	58.9	8.000	74.0
0.400	29.6	1.400	31.9	2.600	42.9	5.500	61.7	8.500	76.2
0.500	29.4	1.600	34.0	3.000	46.0	6.000	64.3	9.000	78.3
0.600	28.9	1.800	35.9	3.500	49.5	6.500	66.9	9.500	80.4

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E6.000	E1	15 Winter	1	+0%	100/15 Summer				86.822	-0.728
E6.001	E2	1440 Winter	1	+0%					86.226	-1.085
E6.002	E3	1440 Winter	1	+0%	1/600 Winter				86.226	0.042

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E6.000	E1	0.000	0.33		540.5	OK	
E6.001	E2	0.000	0.00		55.5	OK	
E6.002	E3	0.000	0.15		9.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E6.000	E1	15 Winter	30	+0%	100/15 Summer				87.452	-0.098
E6.001	E2	1440 Winter	30	+0%					86.442	-0.869
E6.002	E3	1440 Winter	30	+0%	1/600 Winter				86.441	0.257

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E6.000	E1	0.000	1.00		1653.1	OK	
E6.001	E2	0.000	0.00		101.1	OK	
E6.002	E3	0.000	0.46		29.2	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E6.000	E1	15 Winter	100	+40%	100/15 Summer				88.383	0.833
E6.001	E2	1440 Winter	100	+40%					86.906	-0.405
E6.002	E3	1440 Winter	100	+40%	1/600 Winter				86.904	0.720

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E6.000	E1	0.000	2.06		3406.2	SURCHARGED	
E6.001	E2	0.000	0.00		181.7	OK	
E6.002	E3	0.000	0.46		29.6	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E6.000	E1	15 Winter	200	+40%	100/15 Summer				89.058	1.508
E6.001	E2	1440 Winter	200	+40%					87.130	-0.181
E6.002	E3	1440 Winter	200	+40%	1/600 Winter				87.126	0.942

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E6.000	E1	0.000	2.55		4216.6	FLOOD RISK	
E6.001	E2	0.000	0.00		210.2	OK	
E6.002	E3	0.000	0.46		29.6	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	2.099	4-8	5.456	8-12	0.377

Total Area Contributing (ha) = 7.931

Total Pipe Volume (m^3) = 8751.550

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E7.000	149.700	0.299	500.7	2.411	4.00	0.0	0.600	o	1200	Pipe/Conduit
E7.001	44.900	0.089	504.5	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit
E7.002	151.000	0.302	500.0	2.411	0.00	0.0	0.600	[]	-5	Pipe/Conduit
E8.000	46.600	0.190	245.3	2.411	5.00	0.0	0.600	o	1050	Pipe/Conduit
E7.003	45.600	2.150	21.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E9.000	217.700	7.590	28.7	0.450	5.00	0.0	0.600	o	2100	Pipe/Conduit
E7.004	138.300	0.184	751.6	0.248	0.00	0.0	0.600	o	2100	Pipe/Conduit
E7.005	17.700	0.044	402.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E7.000	86.500	2.411	0.0	1.67	1883.2
E7.001	86.201	2.411	0.0	1.66	1876.0
E7.002	86.112	4.822	0.0	2.50	120053.9
E8.000	86.000	2.411	0.0	2.20	1901.6
E7.003	85.810	7.233	0.0	4.43	704.5
E9.000	89.600	0.450	0.0	9.84	34095.9
E7.004	82.010	7.931	0.0	1.91	6624.5
E7.005	81.826	7.931	0.0	1.01	160.2

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-5	[]	40000	1200	90.0		2.330	48.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E7.000	o	1200	E1	89.250	86.500	1.550	Open Manhole	2100
E7.001	o	1200	E2	89.250	86.201	1.849	Open Manhole	2100
E7.002	[]	-5	E3	89.250	86.112	1.938	Open Manhole	40725
E8.000	o	1050	E4	89.250	86.000	2.200	Open Manhole	1800
E7.003	o	450	E5	89.250	85.810	2.990	Open Manhole	1500
E9.000	o	2100	E6	92.600	89.600	0.900	Open Manhole	3000
E7.004	o	2100	E7	85.200	82.010	1.090	Open Manhole	3000
E7.005	o	450	E8	85.200	81.826	2.924	Open Manhole	2100

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)
E7.000	149.700	500.7	E2	89.250	86.201	1.849	Open Manhole	2100
E7.001	44.900	504.5	E3	89.250	86.112	1.938	Open Manhole	40725
E7.002	151.000	500.0	E5	89.250	85.810	2.240	Open Manhole	1500
E8.000	46.600	245.3	E5	89.250	85.810	2.390	Open Manhole	1500
E7.003	45.600	21.2	E7	85.200	83.660	1.090	Open Manhole	3000
E9.000	217.700	28.7	E7	85.200	82.010	1.090	Open Manhole	3000
E7.004	138.300	751.6	E8	85.200	81.826	1.274	Open Manhole	2100
E7.005	17.700	402.3	E	85.000	81.782	2.768	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E7.005	E	85.000	81.782	0.000	0	0

Simulation Criteria for Existing

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Return Period (years) 2 Site Location

Synthetic Rainfall Details

C (1km)	-0.026	E (1km)	0.302	Cv (Summer)	0.750
D1 (1km)	0.319	F (1km)	2.496	Cv (Winter)	0.840
D2 (1km)	0.300	Summer Storms	Yes	Storm Duration (mins)	30
D3 (1km)	0.243	Winter Storms	No		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E5, DS/PN: E7.003, Volume (m³): 6279.6

Unit Reference	MD-SHE-0216-2500-1250-2500
Design Head (m)	1.250
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	216
Invert Level (m)	85.810
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.250	25.0	Kick-Flo®	0.871	21.1
Flush-Flo™	0.400	25.0	Mean Flow over Head Range	-	21.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.3	0.800	22.6	2.000	31.3	4.000	43.7	7.000	57.3
0.200	21.1	1.000	22.5	2.200	32.8	4.500	46.3	7.500	59.3
0.300	24.6	1.200	24.5	2.400	34.2	5.000	48.7	8.000	61.2
0.400	25.0	1.400	26.4	2.600	35.5	5.500	51.0	8.500	63.0
0.500	24.8	1.600	28.1	3.000	38.0	6.000	53.2	9.000	64.8
0.600	24.4	1.800	29.8	3.500	41.0	6.500	55.3	9.500	66.5

Hydro-Brake Optimum® Manhole: E8, DS/PN: E7.005, Volume (m³): 481.9

Unit Reference	MD-SHE-0220-3250-2700-3250
Design Head (m)	2.700
Design Flow (l/s)	32.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	220
Invert Level (m)	81.826
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	32.4	Kick-Flo®	1.632	25.5
Flush-Flo™	0.781	32.3	Mean Flow over Head Range	-	28.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.4	0.400	29.9	0.800	32.3	1.400	29.4	2.000	28.1
0.200	21.7	0.500	31.2	1.000	31.9	1.600	26.2	2.200	29.4
0.300	27.9	0.600	31.9	1.200	31.0	1.800	26.7	2.400	30.6

Hydro-Brake Optimum® Manhole: E8, DS/PN: E7.005, Volume (m³): 481.9

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
2.600	31.8	4.000	39.2	5.500	45.7	7.000	51.3	8.500	56.4
3.000	34.1	4.500	41.5	6.000	47.6	7.500	53.1	9.000	58.0
3.500	36.7	5.000	43.6	6.500	49.5	8.000	54.8	9.500	59.5

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E7.000	E1	15 Winter	1	+0%	100/15 Summer				86.874	-0.826
E7.001	E2	15 Winter	1	+0%	100/15 Summer				86.571	-0.830
E7.002	E3	600 Winter	1	+0%					86.144	-1.168
E8.000	E4	15 Winter	1	+0%	100/15 Summer				86.349	-0.701
E7.003	E5	600 Winter	1	+0%	30/60 Summer				86.143	-0.117
E9.000	E6	15 Winter	1	+0%					89.621	-2.079
E7.004	E7	180 Winter	1	+0%					82.334	-1.776
E7.005	E8	180 Winter	1	+0%	1/30 Winter				82.330	0.054

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E7.000	E1	0.000	0.19		319.9	OK	
E7.001	E2	0.000	0.21		291.9	OK	
E7.002	E3	0.000	0.00		71.1	OK	
E8.000	E4	0.000	0.24		332.2	OK	
E7.003	E5	0.000	0.04		24.8	OK	
E9.000	E6	0.000	0.00		62.2	OK	
E7.004	E7	0.000	0.01		45.9	OK	
E7.005	E8	0.000	0.26		31.2	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E7.000	E1	15 Winter	30	+0%	100/15 Summer				87.221	-0.479
E7.001	E2	15 Winter	30	+0%	100/15 Summer				86.910	-0.491
E7.002	E3	720 Winter	30	+0%					86.421	-0.891
E8.000	E4	15 Winter	30	+0%	100/15 Summer				86.690	-0.360
E7.003	E5	720 Winter	30	+0%	30/60 Summer				86.416	0.156
E9.000	E6	15 Winter	30	+0%					89.667	-2.033
E7.004	E7	180 Winter	30	+0%					82.826	-1.284
E7.005	E8	180 Winter	30	+0%	1/30 Winter				82.811	0.535

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E7.000	E1	0.000	0.59		1006.9	OK	
E7.001	E2	0.000	0.65		915.7	OK	
E7.002	E3	0.000	0.00		102.8	OK	
E8.000	E4	0.000	0.74		1041.2	OK	
E7.003	E5	0.000	0.04		25.0	SURCHARGED	
E9.000	E6	0.000	0.01		194.5	OK	
E7.004	E7	0.000	0.01		79.0	OK	
E7.005	E8	0.000	0.27		32.2	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km) 0.319	E (1km) 0.302	Cv (Winter) 0.840	
Site Location		D2 (1km) 0.300	F (1km) 2.496		
C (1km)	-0.026	D3 (1km) 0.243	Cv (Summer) 0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E7.000	E1	15 Winter	100	+40%	100/15 Summer				87.956	0.256
E7.001	E2	15 Winter	100	+40%	100/15 Summer				87.522	0.121
E7.002	E3	960 Winter	100	+40%					86.903	-0.409
E8.000	E4	15 Winter	100	+40%	100/15 Summer				87.354	0.304
E7.003	E5	960 Winter	100	+40%	30/60 Summer				86.883	0.623
E9.000	E6	15 Winter	100	+40%					89.742	-1.958
E7.004	E7	360 Winter	100	+40%					83.574	-0.536
E7.005	E8	360 Winter	100	+40%	1/30 Winter				83.549	1.273

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E7.000	E1	0.000	1.24		2103.8	SURCHARGED	
E7.001	E2	0.000	1.39		1945.9	SURCHARGED	
E7.002	E3	0.000	0.00		146.2	OK	
E8.000	E4	0.000	1.57		2201.0	SURCHARGED	
E7.003	E5	0.000	0.04		25.0	SURCHARGED	
E9.000	E6	0.000	0.01		410.6	OK	
E7.004	E7	0.000	0.02		82.5	OK	
E7.005	E8	0.000	0.27		32.2	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E7.000	E1	15 Winter	200	+40%	100/15 Summer				88.605	0.905
E7.001	E2	15 Winter	200	+40%	100/15 Summer				87.684	0.283
E7.002	E3	960 Winter	200	+40%					87.108	-0.204
E8.000	E4	15 Winter	200	+40%	100/15 Summer				87.683	0.633
E7.003	E5	960 Winter	200	+40%	30/60 Summer				87.068	0.808
E9.000	E6	15 Winter	200	+40%					89.780	-1.920
E7.004	E7	360 Winter	200	+40%					83.959	-0.151
E7.005	E8	480 Winter	200	+40%	1/30 Winter				83.886	1.610

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E7.000	E1	0.000	1.56		2638.3	SURCHARGED	
E7.001	E2	0.000	1.83		2564.6	SURCHARGED	
E7.002	E3	0.000	0.00		168.6	OK	
E8.000	E4	0.000	1.98		2788.4	SURCHARGED	
E7.003	E5	0.000	0.04		25.1	SURCHARGED	
E9.000	E6	0.000	0.02		519.5	OK	
E7.004	E7	0.000	0.02		91.2	OK	
E7.005	E8	0.000	0.27		32.2	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	3.307	4-8	5.694	8-12	2.411

Total Area Contributing (ha) = 11.412

Total Pipe Volume (m^3) = 11168.355

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E3.000	157.500	0.187	842.2	2.853	4.00	0.0	0.600	o	1500	Pipe/Conduit
E3.001	211.600	0.264	801.5	2.853	0.00	0.0	0.600	o	1500	Pipe/Conduit
E3.002	140.500	0.176	798.3	2.853	0.00	0.0	0.600	o	1500	Pipe/Conduit
E3.003	85.500	0.214	399.5	2.853	0.00	0.0	0.600	[]	-4	Pipe/Conduit
E3.004	20.300	0.120	169.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E3.005	29.500	0.499	59.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E3.000	87.700	2.853	0.0	1.47	2597.4
E3.001	87.503	5.706	0.0	1.51	2663.2
E3.002	87.239	8.559	0.0	1.51	2668.6
E3.003	87.063	11.412	0.0	2.83	339551.4
E3.004	86.849	11.412	0.0	1.56	248.1
E3.005	86.729	11.412	0.0	2.65	421.2

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-4	[]	99999	1200	90.0		2.372	119.999

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E3.000	o	1500	E1	91.400	87.700	2.200	Open Manhole	2400
E3.001	o	1500	E2	91.400	87.503	2.397	Open Manhole	2400
E3.002	o	1500	E3	91.400	87.239	2.661	Open Manhole	2400
E3.003	[]	-4	E4	91.400	87.063	3.137	Open Manhole	100724
E3.004	o	450	E5	91.400	86.849	4.101	Open Manhole	1350
E3.005	o	450	E6	91.300	86.729	4.121	Open Manhole	1350

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)
E3.000	157.500	842.2	E2	91.400	87.513	2.387	Open Manhole	2400
E3.001	211.600	801.5	E3	91.400	87.239	2.661	Open Manhole	2400
E3.002	140.500	798.3	E4	91.400	87.063	2.837	Open Manhole	100724
E3.003	85.500	399.5	E5	91.400	86.849	3.351	Open Manhole	1350
E3.004	20.300	169.2	E6	91.300	86.729	4.121	Open Manhole	1350
E3.005	29.500	59.1	E	91.200	86.230	4.520	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.000	-	-	100	2.853	2.853	2.853
3.001	-	-	100	2.853	2.853	2.853
3.002	-	-	100	2.853	2.853	2.853
3.003	-	-	100	2.853	2.853	2.853
3.004	-	-	100	0.000	0.000	0.000
3.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				11.412	11.412	11.412

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E5, DS/PN: E3.004, Volume (m^3): 4142.0

Unit Reference	MD-SHE-0251-3530-1200-3530
Design Head (m)	1.200
Design Flow (l/s)	35.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	251
Invert Level (m)	86.849
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	35.3	Kick-Flo®	0.867	30.2
Flush-Flo™	0.422	35.1	Mean Flow over Head Range	-	29.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.1	0.800	32.1	2.000	45.1	4.000	63.1	7.000	82.8
0.200	25.7	1.000	32.3	2.200	47.2	4.500	66.8	7.500	85.7
0.300	34.4	1.200	35.3	2.400	49.3	5.000	70.3	8.000	88.4
0.400	35.1	1.400	38.0	2.600	51.2	5.500	73.6	8.500	91.0
0.500	35.0	1.600	40.5	3.000	54.9	6.000	76.8	9.000	93.6
0.600	34.4	1.800	42.9	3.500	59.1	6.500	79.9	9.500	96.1

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E3.000	E1	15 Winter	1	+0%	100/15 Summer	200/15 Winter			88.148	-1.052
E3.001	E2	15 Winter	1	+0%	100/15 Summer				88.019	-0.984
E3.002	E3	15 Winter	1	+0%	100/15 Summer				87.815	-0.924
E3.003	E4	720 Winter	1	+0%					87.176	-1.087
E3.004	E5	720 Winter	1	+0%	30/60 Winter				87.175	-0.124
E3.005	E6	720 Winter	1	+0%					86.822	-0.357

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E3.000	E1	0.000	0.16		357.9	OK	1
E3.001	E2	0.000	0.22		532.7	OK	
E3.002	E3	0.000	0.31		724.0	OK	
E3.003	E4	0.000	0.00		67.9	OK	
E3.004	E5	0.000	0.18		34.7	OK	
E3.005	E6	0.000	0.10		34.7	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E3.000	E1	15 Winter	30	+0%	100/15 Summer	200/15 Winter			88.634	-0.566
E3.001	E2	15 Winter	30	+0%	100/15 Summer				88.544	-0.459
E3.002	E3	15 Winter	30	+0%	100/15 Summer				88.408	-0.331
E3.003	E4	720 Winter	30	+0%					87.429	-0.834
E3.004	E5	720 Winter	30	+0%	30/60 Winter				87.428	0.129
E3.005	E6	60 Winter	30	+0%					86.823	-0.356

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E3.000	E1	0.000	0.49		1119.6	OK	1
E3.001	E2	0.000	0.67		1620.0	OK	
E3.002	E3	0.000	0.96		2217.0	OK	
E3.003	E4	0.000	0.00		124.8	OK	
E3.004	E5	0.000	0.18		35.1	SURCHARGED	
E3.005	E6	0.000	0.10		35.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E3.000	E1	15 Winter	100	+40%	100/15 Summer	200/15 Winter			90.440
E3.001	E2	15 Winter	100	+40%	100/15 Summer				90.243
E3.002	E3	15 Winter	100	+40%	100/15 Summer				89.440
E3.003	E4	1440 Winter	100	+40%					87.860
E3.004	E5	1440 Winter	100	+40%	30/60 Winter				87.858
E3.005	E6	960 Winter	100	+40%					86.823

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E3.000	E1	1.240	0.000	0.99		2250.7	SURCHARGED	1
E3.001	E2	1.240	0.000	1.45		3500.3	SURCHARGED	
E3.002	E3	0.701	0.000	2.26		5213.3	SURCHARGED	
E3.003	E4	-0.403	0.000	0.00		128.8	OK	
E3.004	E5	0.559	0.000	0.18		35.1	SURCHARGED	
E3.005	E6	-0.356	0.000	0.10		35.1	OK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH | D1 (1km) 0.319 | E (1km) 0.302 | Cv (Winter) 0.840
Site Location | D2 (1km) 0.300 | F (1km) 2.496
C (1km) -0.026 | D3 (1km) 0.243 | Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E3.000	E1	15 Winter	200	+40%	100/15 Summer	200/15 Winter			91.430
E3.001	E2	15 Winter	200	+40%	100/15 Summer				91.285
E3.002	E3	15 Winter	200	+40%	100/15 Summer				90.032
E3.003	E4	1440 Winter	200	+40%					88.018
E3.004	E5	1440 Winter	200	+40%	30/60 Winter				88.014
E3.005	E6	960 Summer	200	+40%					86.823

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E3.000	E1	2.230	31.479	1.21		2769.8	FLOOD	1
E3.001	E2	2.282	0.000	1.86		4491.6	FLOOD RISK	
E3.002	E3	1.293	0.000	2.87		6639.0	SURCHARGED	
E3.003	E4	-0.245	0.000	0.00		145.0	OK	
E3.004	E5	0.715	0.000	0.18		35.1	SURCHARGED	
E3.005	E6	-0.356	0.000	0.10		35.1	OK	

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E1.000	415.000	1.037	400.2	2.485	4.00	0.0	0.600	o	1200	Pipe/Conduit
E1.001	250.000	0.625	400.0	2.485	0.00	0.0	0.600	[]	-2	Pipe/Conduit
E1.002	28.700	0.072	398.6	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.003	72.100	0.181	398.3	0.087	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.004	89.300	0.223	400.4	0.107	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.005	180.600	0.453	398.7	0.216	0.00	0.0	0.600	o	900	Pipe/Conduit
E2.000	480.000	0.600	800.0	4.300	5.00	0.0	0.600	o	1500	Pipe/Conduit
E2.001	95.000	0.238	399.2	4.301	0.00	0.0	0.600	[]	-3	Pipe/Conduit
E2.002	98.400	0.246	400.0	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.006	76.300	0.190	401.6	0.092	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.007	47.700	0.120	397.5	0.057	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.008	98.800	0.247	400.0	0.170	0.00	0.0	0.600	o	900	Pipe/Conduit
E1.009	19.900	0.030	663.3	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E1.000	89.378	2.485	0.0	1.86	2108.1
E1.001	88.341	4.970	0.0	2.77	83057.0
E1.002	87.716	4.970	0.0	1.56	994.4
E1.003	87.644	5.057	0.0	1.56	994.8
E1.004	87.463	5.164	0.0	1.56	992.1
E1.005	87.240	5.380	0.0	1.56	994.4
E2.000	87.871	4.300	0.0	1.51	2665.7
E2.001	87.271	8.601	0.0	2.82	250754.8
E2.002	87.033	8.601	0.0	1.56	992.7
E1.006	86.787	14.073	0.0	1.56	990.7
E1.007	86.597	14.130	0.0	1.57	995.8
E1.008	86.477	14.300	0.0	1.56	992.7
E1.009	86.230	14.300	0.0	1.21	769.1

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-2	[]	25000	1200	90.0		2.290	30.000
-3	[]	74000	1200	90.0		2.362	88.800

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E1.000	o	1200	E1	93.200	89.378	2.622	Open Manhole	2100
E1.001	[]	-2	E2	92.000	88.341	2.459	Open Manhole	25725
E1.002	o	900	E4	92.000	87.716	3.384	Open Manhole	1800
E1.003	o	900	E5	92.000	87.644	3.456	Open Manhole	1800
E1.004	o	900	E6	91.400	87.463	3.037	Open Manhole	1800
E1.005	o	900	E7	91.200	87.240	3.060	Open Manhole	1800
E2.000	o	1500	E8	91.400	87.871	2.029	Open Manhole	2100
E2.001	[]	-3	E9	91.400	87.271	2.929	Open Manhole	74725
E2.002	o	900	E11	91.400	87.033	3.467	Open Manhole	1800
E1.006	o	900	E12	91.000	86.787	3.313	Open Manhole	1800
E1.007	o	900	E13	90.600	86.597	3.103	Open Manhole	1800
E1.008	o	900	E14	90.500	86.477	3.123	Open Manhole	1800
E1.009	o	900	E15	91.200	86.230	4.070	Open Manhole	1800

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)
E1.000	415.000	400.2	E2	92.000	88.341	2.459	Open Manhole	25725
E1.001	250.000	400.0	E4	92.000	87.716	3.084	Open Manhole	1800
E1.002	28.700	398.6	E5	92.000	87.644	3.456	Open Manhole	1800
E1.003	72.100	398.3	E6	91.400	87.463	3.037	Open Manhole	1800
E1.004	89.300	400.4	E7	91.200	87.240	3.060	Open Manhole	1800
E1.005	180.600	398.7	E12	91.000	86.787	3.313	Open Manhole	1800
E2.000	480.000	800.0	E9	91.400	87.271	2.629	Open Manhole	74725
E2.001	95.000	399.2	E11	91.400	87.033	3.167	Open Manhole	1800
E2.002	98.400	400.0	E12	91.000	86.787	3.313	Open Manhole	1800
E1.006	76.300	401.6	E13	90.600	86.597	3.103	Open Manhole	1800
E1.007	47.700	397.5	E14	90.500	86.477	3.123	Open Manhole	1800
E1.008	98.800	400.0	E15	91.200	86.230	4.070	Open Manhole	1800
E1.009	19.900	663.3	E	88.000	86.200	0.900	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	2.485	2.485	2.485
1.001	-	-	100	2.485	2.485	2.485
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.087	0.087	0.087
1.004	-	-	100	0.107	0.107	0.107
1.005	-	-	100	0.216	0.216	0.216
2.000	-	-	100	4.300	4.300	4.300
2.001	-	-	100	4.301	4.301	4.301
2.002	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.092	0.092	0.092
1.007	-	-	100	0.057	0.057	0.057
1.008	-	-	100	0.170	0.170	0.170
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				14.300	14.300	14.300

Simulation Criteria for Existing

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	3	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E4, DS/PN: E1.002, Volume (m³): 7098.0

Unit Reference	MD-SHE-0198-2040-1200-2040
Design Head (m)	1.200
Design Flow (l/s)	20.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	198
Invert Level (m)	87.716
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	20.4	Kick-Flo®	0.831	17.1
Flush-Flo™	0.380	20.4	Mean Flow over Head Range	-	17.4

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	6.8	0.800	17.8	2.000	26.0	4.000	36.3	7.000	47.6
0.200	18.6	1.000	18.7	2.200	27.2	4.500	38.5	7.500	49.2
0.300	20.2	1.200	20.4	2.400	28.4	5.000	40.5	8.000	50.8
0.400	20.4	1.400	22.0	2.600	29.5	5.500	42.4	8.500	52.3
0.500	20.2	1.600	23.4	3.000	31.6	6.000	44.2	9.000	53.8
0.600	19.8	1.800	24.8	3.500	34.1	6.500	45.9	9.500	55.2

Hydro-Brake Optimum® Manhole: E11, DS/PN: E2.002, Volume (m³): 5049.4

Unit Reference	MD-SHE-0251-3530-1200-3530
Design Head (m)	1.200
Design Flow (l/s)	35.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	251
Invert Level (m)	87.033
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	35.3	Kick-Flo®	0.867	30.2
Flush-Flo™	0.422	35.1	Mean Flow over Head Range	-	29.5

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	8.1	0.400	35.1	0.800	32.1	1.400	38.0	2.000	45.1
0.200	25.7	0.500	35.0	1.000	32.3	1.600	40.5	2.200	47.2
0.300	34.4	0.600	34.4	1.200	35.3	1.800	42.9	2.400	49.3

Hydro-Brake Optimum® Manhole: E11, DS/PN: E2.002, Volume (m³): 5049.4

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	51.2	4.000	63.1	5.500	73.6	7.000	82.8	8.500	91.0
3.000	54.9	4.500	66.8	6.000	76.8	7.500	85.7	9.000	93.6
3.500	59.1	5.000	70.3	6.500	79.9	8.000	88.4	9.500	96.1

Hydro-Brake Optimum® Manhole: E15, DS/PN: E1.009, Volume (m³): 74.4

Unit Reference	MD-SHE-0291-5860-2750-5860
Design Head (m)	2.750
Design Flow (l/s)	58.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	291
Invert Level (m)	86.230
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.750	58.5	Kick-Flo®	1.727	46.8
Flush-Flo™	0.805	58.6	Mean Flow over Head Range	-	50.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.0	0.800	58.6	2.000	50.2	4.000	70.2	7.000	92.1
0.200	30.0	1.000	58.1	2.200	52.5	4.500	74.3	7.500	95.2
0.300	50.1	1.200	56.9	2.400	54.8	5.000	78.2	8.000	98.3
0.400	54.0	1.400	54.8	2.600	57.0	5.500	81.9	8.500	101.2
0.500	56.3	1.600	50.9	3.000	61.0	6.000	85.4	9.000	104.1
0.600	57.7	1.800	47.7	3.500	65.8	6.500	88.8	9.500	106.9

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E1.000	E1	15 Winter	1	+0%	100/15 Summer				89.724	-0.854
E1.001	E2	15 Winter	1	+0%					88.366	-1.175
E1.002	E4	480 Winter	1	+0%	100/360 Winter				88.074	-0.542
E1.003	E5	60 Winter	1	+0%					87.745	-0.799
E1.004	E6	60 Winter	1	+0%					87.569	-0.794
E1.005	E7	15 Winter	1	+0%	200/15 Winter				87.368	-0.772
E2.000	E8	15 Winter	1	+0%	100/15 Summer				88.366	-1.005
E2.001	E9	480 Winter	1	+0%					87.347	-1.124
E2.002	E11	480 Winter	1	+0%	100/360 Winter				87.341	-0.592
E1.006	E12	600 Winter	1	+0%	100/60 Winter				87.022	-0.665
E1.007	E13	600 Winter	1	+0%	100/30 Winter				86.986	-0.511
E1.008	E14	600 Winter	1	+0%	100/15 Winter				86.950	-0.427
E1.009	E15	600 Winter	1	+0%	100/15 Summer				86.895	-0.235

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.000	0.18		370.8	OK	
E1.001	E2	0.000	0.01		582.0	OK	
E1.002	E4	0.000	0.03		20.2	OK	
E1.003	E5	0.000	0.03		23.3	OK	
E1.004	E6	0.000	0.03		28.8	OK	
E1.005	E7	0.000	0.05		42.4	OK	
E2.000	E8	0.000	0.24		599.8	OK	
E2.001	E9	0.000	0.00		116.9	OK	
E2.002	E11	0.000	0.04		34.5	OK	
E1.006	E12	0.000	0.07		60.2	OK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.007	E13	0.000	0.07		59.3	OK	
E1.008	E14	0.000	0.07		59.9	OK	
E1.009	E15	0.000	0.15		57.7	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E1.000	E1	15 Winter	30	+0%	100/15 Summer				90.034	-0.544
E1.001	E2	15 Winter	30	+0%					88.415	-1.126
E1.002	E4	600 Winter	30	+0%	100/360 Winter				88.336	-0.280
E1.003	E5	15 Winter	30	+0%					87.793	-0.751
E1.004	E6	15 Winter	30	+0%					87.661	-0.702
E1.005	E7	15 Winter	30	+0%	200/15 Winter				87.496	-0.644
E2.000	E8	15 Winter	30	+0%	100/15 Summer				88.846	-0.525
E2.001	E9	600 Winter	30	+0%					87.602	-0.869
E2.002	E11	600 Winter	30	+0%	100/360 Winter				87.580	-0.353
E1.006	E12	360 Winter	30	+0%	100/60 Winter				87.329	-0.358
E1.007	E13	360 Winter	30	+0%	100/30 Winter				87.268	-0.229
E1.008	E14	360 Winter	30	+0%	100/15 Winter				87.202	-0.175
E1.009	E15	360 Winter	30	+0%	100/15 Summer				87.104	-0.026

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.000	0.58		1166.2	OK	
E1.001	E2	0.000	0.02		1723.8	OK	
E1.002	E4	0.000	0.03		20.4	OK	
E1.003	E5	0.000	0.05		42.8	OK	
E1.004	E6	0.000	0.09		82.6	OK	
E1.005	E7	0.000	0.16		146.0	OK	
E2.000	E8	0.000	0.74		1881.9	OK	
E2.001	E9	0.000	0.00		155.2	OK	
E2.002	E11	0.000	0.04		35.0	OK	
E1.006	E12	0.000	0.08		69.7	OK	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.007	E13	0.000	0.08		66.3	OK	
E1.008	E14	0.000	0.08		67.2	OK	
E1.009	E15	0.000	0.15		58.6	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E1.000	E1	15 Winter	100	+40%	100/15 Summer				91.029	0.451
E1.001	E2	600 Winter	100	+40%					88.689	-0.852
E1.002	E4	960 Winter	100	+40%	100/360 Winter				88.664	0.048
E1.003	E5	15 Winter	100	+40%					87.870	-0.674
E1.004	E6	120 Winter	100	+40%					87.817	-0.546
E1.005	E7	120 Winter	100	+40%	200/15 Winter				87.786	-0.354
E2.000	E8	15 Winter	100	+40%	100/15 Summer				90.198	0.827
E2.001	E9	960 Winter	100	+40%					88.028	-0.443
E2.002	E11	720 Winter	100	+40%	100/360 Winter				87.983	0.050
E1.006	E12	120 Winter	100	+40%	100/60 Winter				87.736	0.049
E1.007	E13	480 Winter	100	+40%	100/30 Winter				87.732	0.235
E1.008	E14	480 Winter	100	+40%	100/15 Winter				87.732	0.355
E1.009	E15	480 Winter	100	+40%	100/15 Summer				87.728	0.598

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.000	1.04		2095.1	SURCHARGED	
E1.001	E2	0.000	0.00		305.0	OK	
E1.002	E4	0.000	0.03		20.4	SURCHARGED	
E1.003	E5	0.000	0.10		85.7	OK	
E1.004	E6	0.000	0.07		63.6	OK	
E1.005	E7	0.000	0.11		105.8	OK	
E2.000	E8	0.000	1.30		3320.6	SURCHARGED	
E2.001	E9	0.000	0.00		187.0	OK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E2.002	E11	0.000	0.04		35.1	SURCHARGED	
E1.006	E12	0.000	0.11		97.3	SURCHARGED	
E1.007	E13	0.000	0.09		71.3	SURCHARGED	
E1.008	E14	0.000	0.08		70.4	SURCHARGED	
E1.009	E15	0.000	0.15		58.6	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E1.000	E1	15 Winter	200	+40%	100/15 Summer				91.950	1.372
E1.001	E2	600 Winter	200	+40%					88.831	-0.710
E1.002	E4	960 Winter	200	+40%	100/360 Winter				88.792	0.176
E1.003	E5	120 Winter	200	+40%					88.172	-0.372
E1.004	E6	120 Winter	200	+40%					88.141	-0.222
E1.005	E7	15 Winter	200	+40%	200/15 Winter				88.166	0.026
E2.000	E8	15 Winter	200	+40%	100/15 Summer				91.076	1.705
E2.001	E9	960 Winter	200	+40%					88.201	-0.270
E2.002	E11	720 Winter	200	+40%	100/360 Winter				88.139	0.206
E1.006	E12	30 Winter	200	+40%	100/60 Winter				88.261	0.574
E1.007	E13	15 Winter	200	+40%	100/30 Winter				88.457	0.960
E1.008	E14	15 Winter	200	+40%	100/15 Winter				88.708	1.331
E1.009	E15	15 Winter	200	+40%	100/15 Summer				88.712	1.582

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E1.000	E1	0.000	1.18		2393.8	SURCHARGED	
E1.001	E2	0.000	0.00		342.4	OK	
E1.002	E4	0.000	0.03		20.4	SURCHARGED	
E1.003	E5	0.000	0.05		44.4	OK	
E1.004	E6	0.000	0.08		72.3	OK	
E1.005	E7	0.000	0.40		375.0	SURCHARGED	
E2.000	E8	0.000	1.64		4181.0	SURCHARGED	
E2.001	E9	0.000	0.00		214.3	OK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E2.002	E11	0.000	0.04		35.1	SURCHARGED	
E1.006	E12	0.000	0.23		200.2	SURCHARGED	
E1.007	E13	0.000	0.33		266.0	SURCHARGED	
E1.008	E14	0.000	0.34		297.2	SURCHARGED	
E1.009	E15	0.000	0.15		58.6	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.181	4-8	3.809	8-12	0.502

Total Area Contributing (ha) = 5.492

Total Pipe Volume (m^3) = 5888.473

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E23.000	134.000	0.268	500.0	0.345	4.00	0.0	0.600	o	1500	Pipe/Conduit
E23.001	134.000	0.268	500.0	0.272	0.00	0.0	0.600	o	1500	Pipe/Conduit
E23.002	76.150	0.152	501.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E23.003	6.000	0.015	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E23.004	211.000	1.055	200.0	0.000	0.00	0.0	0.600	\/	-10	Pipe/Conduit
E24.000	131.100	0.262	500.4	1.625	5.00	0.0	0.600	o	1200	Pipe/Conduit
E24.001	78.900	0.158	499.4	1.625	0.00	0.0	0.600	o	1200	Pipe/Conduit
E24.002	162.000	0.324	500.0	1.625	0.00	0.0	0.600	[]	-2	Pipe/Conduit
E24.003	30.500	0.075	406.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E23.005	84.000	0.420	200.0	0.000	0.00	0.0	0.600	\/	-10	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E23.000	77.500	0.345	0.0	1.91	3377.8
E23.001	77.232	0.617	0.0	1.91	3377.8
E23.002	76.964	0.617	0.0	1.91	3374.4
E23.003	76.812	0.617	0.0	1.01	160.7
E23.004	76.797	0.617	0.0	2.49	1494.8
E24.000	76.561	1.625	0.0	1.67	1883.8
E24.001	76.299	3.250	0.0	1.67	1885.7
E24.002	76.141	4.875	0.0	2.47	74247.9
E24.003	75.817	4.875	0.0	1.00	159.3
E23.005	75.742	5.492	0.0	2.49	1494.8

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-2	[]	25000	1200	90.0		2.290	30.000
-10	\/	1000	600	90.0		1.091	0.600

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E23.000	o	1500	E1	80.000	77.500	1.000	Open Manhole	2400
E23.001	o	1500	E2	80.000	77.232	1.268	Open Manhole	2400
E23.002	o	1500	E3	80.000	76.964	1.536	Open Manhole	2400
E23.003	o	450	E4	78.400	76.812	1.138	Open Manhole	1500
E23.004	\/	-10	E5	78.400	76.797	1.003	Open Manhole	1725
E24.000	o	1200	E6	78.200	76.561	0.439	Open Manhole	2100
E24.001	o	1200	E7	78.200	76.299	0.701	Open Manhole	2100
E24.002	[]	-2	E8	78.200	76.141	0.859	Open Manhole	25725
E24.003	o	450	E9	78.200	75.817	1.933	Open Manhole	1500
E23.005	\/	-10	E10	76.700	75.742	0.358	Open Manhole	1725

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)
E23.000	134.000	500.0	E2	80.000	77.232	1.268	Open Manhole	2400
E23.001	134.000	500.0	E3	80.000	76.964	1.536	Open Manhole	2400
E23.002	76.150	501.0	E4	78.400	76.812	0.088	Open Manhole	1500
E23.003	6.000	400.0	E5	78.400	76.797	1.153	Open Manhole	1725
E23.004	211.000	200.0	E10	76.700	75.742	0.358	Open Manhole	1725
E24.000	131.100	500.4	E7	78.200	76.299	0.701	Open Manhole	2100
E24.001	78.900	499.4	E8	78.200	76.141	0.859	Open Manhole	25725
E24.002	162.000	500.0	E9	78.200	75.817	1.183	Open Manhole	1500
E24.003	30.500	406.7	E10	76.700	75.742	0.508	Open Manhole	1725
E23.005	84.000	200.0	E	78.200	75.322	2.278	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E23.005	E	78.200	75.322	0.000	0	0

Simulation Criteria for Existing

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Return Period (years) 2 Site Location

Synthetic Rainfall Details

C (1km)	-0.026	E (1km)	0.302	Cv (Summer)	0.750
D1 (1km)	0.319	F (1km)	2.496	Cv (Winter)	0.840
D2 (1km)	0.300	Summer Storms	Yes	Storm Duration (mins)	30
D3 (1km)	0.243	Winter Storms	No		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E4, DS/PN: E23.003, Volume (m³): 133.9

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	76.812
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.800	4.3	2.000	5.7	4.000	7.9	7.000	10.3
0.200	4.4	1.000	4.1	2.200	6.0	4.500	8.4	7.500	10.7
0.300	4.8	1.200	4.5	2.400	6.2	5.000	8.8	8.000	11.0
0.400	4.9	1.400	4.8	2.600	6.5	5.500	9.2	8.500	11.3
0.500	4.9	1.600	5.1	3.000	6.9	6.000	9.6	9.000	11.6
0.600	4.8	1.800	5.4	3.500	7.4	6.500	10.0	9.500	11.9

Hydro-Brake Optimum® Manhole: E9, DS/PN: E24.003, Volume (m³): 4455.8

Unit Reference	MD-SHE-0183-1750-1300-1750
Design Head (m)	1.300
Design Flow (l/s)	17.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	183
Invert Level (m)	75.817
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	17.5	Kick-Flo®	0.864	14.4
Flush-Flo™	0.390	17.5	Mean Flow over Head Range	-	15.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.4	0.400	17.5	0.800	15.5	1.400	18.1	2.000	21.5
0.200	16.2	0.500	17.3	1.000	15.5	1.600	19.3	2.200	22.5
0.300	17.3	0.600	17.0	1.200	16.8	1.800	20.4	2.400	23.4

Hydro-Brake Optimum® Manhole: E9, DS/PN: E24.003, Volume (m³): 4455.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	24.4	4.000	29.9	5.500	34.9	7.000	39.2	8.500	43.1
3.000	26.1	4.500	31.7	6.000	36.4	7.500	40.6	9.000	44.3
3.500	28.1	5.000	33.3	6.500	37.9	8.000	41.9	9.500	45.5

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E23.000	E1	15 Winter	1	+0%					77.626
E23.001	E2	15 Winter	1	+0%					77.396
E23.002	E3	120 Winter	1	+0%					77.324
E23.003	E4	120 Winter	1	+0%	1/15 Winter				77.324
E23.004	E5	60 Winter	1	+0%					76.803
E24.000	E6	15 Winter	1	+0%	100/15 Summer	200/15 Winter			76.856
E24.001	E7	15 Winter	1	+0%	100/15 Summer				76.689
E24.002	E8	15 Winter	1	+0%					76.164
E24.003	E9	600 Winter	1	+0%	30/30 Winter				76.150
E23.005	E10	600 Winter	1	+0%					75.768

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E23.000	E1	-1.374	0.000	0.02		50.3	OK	
E23.001	E2	-1.336	0.000	0.03		73.0	OK	
E23.002	E3	-1.140	0.000	0.01		15.8	OK	
E23.003	E4	0.062	0.000	0.04		4.9	SURCHARGED	
E23.004	E5	-0.594	0.000	0.00		4.9	OK	
E24.000	E6	-0.905	0.000	0.12		202.7	OK	1
E24.001	E7	-0.810	0.000	0.23		362.2	OK	
E24.002	E8	-1.177	0.000	0.01		507.5	OK	
E24.003	E9	-0.117	0.000	0.13		17.4	OK	
E23.005	E10	-0.574	0.000	0.02		22.3	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E23.000	E1	15 Winter	30	+0%					77.727
E23.001	E2	240 Winter	30	+0%					77.673
E23.002	E3	240 Winter	30	+0%					77.674
E23.003	E4	240 Winter	30	+0%	1/15 Winter				77.674
E23.004	E5	600 Winter	30	+0%					76.803
E24.000	E6	15 Winter	30	+0%	100/15 Summer	200/15 Winter			77.178
E24.001	E7	15 Winter	30	+0%	100/15 Summer				77.067
E24.002	E8	720 Winter	30	+0%					76.434
E24.003	E9	720 Winter	30	+0%	30/30 Winter				76.434
E23.005	E10	960 Winter	30	+0%					75.768

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E23.000	E1	-1.273	0.000	0.05		148.2	OK	
E23.001	E2	-1.059	0.000	0.01		36.1	OK	
E23.002	E3	-0.790	0.000	0.01		16.9	OK	
E23.003	E4	0.412	0.000	0.04		4.9	SURCHARGED	
E23.004	E5	-0.594	0.000	0.00		4.9	OK	
E24.000	E6	-0.583	0.000	0.38		632.4	OK	1
E24.001	E7	-0.432	0.000	0.73		1148.9	OK	
E24.002	E8	-0.907	0.000	0.00		126.6	OK	
E24.003	E9	0.167	0.000	0.13		17.5	SURCHARGED	
E23.005	E10	-0.574	0.000	0.02		22.3	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km) 0.319	E (1km)	0.302	Cv (Winter) 0.840
Site Location		D2 (1km) 0.300	F (1km)	2.496	
C (1km)	-0.026	D3 (1km) 0.243	Cv (Summer)	0.750	

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E23.000	E1	360 Winter	100	+40%					78.133
E23.001	E2	360 Winter	100	+40%					78.133
E23.002	E3	360 Winter	100	+40%					78.133
E23.003	E4	360 Winter	100	+40%	1/15 Winter				78.133
E23.004	E5	360 Winter	100	+40%					76.803
E24.000	E6	15 Winter	100	+40%	100/15 Summer	200/15 Winter			77.896
E24.001	E7	15 Winter	100	+40%	100/15 Summer				77.705
E24.002	E8	960 Winter	100	+40%					76.912
E24.003	E9	960 Winter	100	+40%	30/30 Winter				76.912
E23.005	E10	960 Winter	100	+40%					75.768

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E23.000	E1	-0.867	0.000	0.01		32.1	OK	
E23.001	E2	-0.599	0.000	0.01		39.1	OK	
E23.002	E3	-0.331	0.000	0.01		16.9	OK	
E23.003	E4	0.871	0.000	0.04		4.9	FLOOD RISK	
E23.004	E5	-0.594	0.000	0.00		4.9	OK	
E24.000	E6	0.135	0.000	0.79		1320.3	SURCHARGED	1
E24.001	E7	0.206	0.000	1.55		2423.7	SURCHARGED	
E24.002	E8	-0.429	0.000	0.00		181.8	OK	
E24.003	E9	0.645	0.000	0.13		17.5	SURCHARGED	
E23.005	E10	-0.574	0.000	0.02		22.3	OK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E23.000	E1	360 Winter	200	+40%					78.343
E23.001	E2	360 Winter	200	+40%					78.343
E23.002	E3	360 Winter	200	+40%					78.343
E23.003	E4	360 Winter	200	+40%	1/15 Winter				78.342
E23.004	E5	360 Winter	200	+40%					76.803
E24.000	E6	15 Winter	200	+40%	100/15 Summer	200/15 Winter			78.212
E24.001	E7	15 Winter	200	+40%	100/15 Summer				77.946
E24.002	E8	960 Winter	200	+40%					77.113
E24.003	E9	960 Winter	200	+40%	30/30 Winter				77.112
E23.005	E10	720 Winter	200	+40%					75.768

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E23.000	E1	-0.657	0.000	0.01		38.2	OK	
E23.001	E2	-0.389	0.000	0.02		45.1	OK	
E23.002	E3	-0.121	0.000	0.01		18.8	OK	
E23.003	E4	1.080	0.000	0.05		5.0	FLOOD RISK	
E23.004	E5	-0.594	0.000	0.00		5.0	OK	
E24.000	E6	0.451	11.999	1.00		1669.5	FLOOD	1
E24.001	E7	0.447	0.000	1.97		3081.3	FLOOD RISK	
E24.002	E8	-0.228	0.000	0.00		210.6	OK	
E24.003	E9	0.845	0.000	0.13		17.5	SURCHARGED	
E23.005	E10	-0.574	0.000	0.02		22.4	OK	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.711	4-8	9.557	8-12	5.415

Total Area Contributing (ha) = 16.683

Total Pipe Volume (m^3) = 5338.650

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E25.000	120.900	0.242	499.6	2.890	4.00	0.0	0.600	o	1500	Pipe/Conduit
E25.001	54.000	0.108	500.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E26.000	138.000	0.276	500.0	2.890	5.00	0.0	0.600	o	1500	Pipe/Conduit
E25.002	52.600	0.105	501.0	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E27.000	95.000	0.190	500.0	2.273	5.00	0.0	0.600	[]	-11	Pipe/Conduit
E27.001	50.800	0.266	191.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E25.003	360.500	0.360	1001.4	0.000	0.00	0.0	0.600	\/	-12	Pipe/Conduit
E28.000	149.700	0.299	500.7	2.890	5.00	0.0	0.600	o	1500	Pipe/Conduit
E28.001	42.500	0.216	196.8	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E29.000	107.500	0.375	286.7	1.435	5.00	0.0	0.600	o	1500	Pipe/Conduit
E29.001	105.900	0.212	499.5	1.435	0.00	0.0	0.600	o	1500	Pipe/Conduit
E29.002	102.400	0.205	499.5	1.435	0.00	0.0	0.600	o	1500	Pipe/Conduit
E29.003	79.100	0.158	500.6	1.435	0.00	0.0	0.600	o	1500	Pipe/Conduit
E29.004	36.600	0.073	501.4	0.000	0.00	0.0	0.600	o	1500	Pipe/Conduit
E25.004	72.000	0.072	1000.0	0.000	0.00	0.0	0.600	\/	-12	Pipe/Conduit
E25.005	31.500	0.079	398.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E25.000	75.860	2.890	0.0	1.91	3379.2
E25.001	75.618	2.890	0.0	1.91	3377.8
E26.000	75.786	2.890	0.0	1.91	3377.8
E25.002	75.510	5.780	0.0	1.91	3374.5
E27.000	76.561	2.273	0.0	2.46	58988.6
E27.001	76.371	2.273	0.0	1.47	233.4
E25.003	75.405	8.053	0.0	1.80	5386.9
E28.000	75.560	2.890	0.0	1.91	3375.5
E28.001	75.261	2.890	0.0	3.05	5397.9
E29.000	75.761	1.435	0.0	2.53	4468.1
E29.001	75.693	2.870	0.0	1.91	3379.4
E29.002	75.481	4.305	0.0	1.91	3379.4
E29.003	75.276	5.740	0.0	1.91	3375.6
E29.004	75.118	5.740	0.0	1.91	3373.1
E25.004	75.045	16.683	0.0	1.80	5390.7
E25.005	74.088	16.683	0.0	1.01	160.9

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-11	[]	20000	1200	90.0		2.264	24.000
-12	\/	3000	1000	90.0		2.400	3.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E25.000	o	1500	E1	78.200	75.860	0.840	Open Manhole	2400
E25.001	o	1500	E2	78.200	75.618	1.082	Open Manhole	2400
E26.000	o	1500	E3	78.200	75.786	0.914	Open Manhole	2400
E25.002	o	1500	E3	78.200	75.510	1.190	Open Manhole	2400
E27.000	[]	-11	E4	78.200	76.561	0.439	Open Manhole	20725
E27.001	o	450	E5	78.200	76.371	1.379	Open Manhole	1500
E25.003	\/	-12	E6	78.100	75.405	1.695	Open Manhole	1725
E28.000	o	1500	E8	78.200	75.560	1.140	Open Manhole	2400
E28.001	o	1500	E9	78.200	75.261	1.439	Open Manhole	2400
E29.000	o	1500	E10	78.200	75.761	0.939	Open Manhole	2400
E29.001	o	1500	E11	78.200	75.693	1.007	Open Manhole	2400
E29.002	o	1500	E12	78.200	75.481	1.219	Open Manhole	2400
E29.003	o	1500	E13	78.200	75.276	1.424	Open Manhole	2400
E29.004	o	1500	E14	78.200	75.118	1.582	Open Manhole	2400
E25.004	\/	-12	E10	77.745	75.045	1.700	Open Manhole	1725
E25.005	o	450	E11	76.700	74.088	2.162	Open Manhole	1500

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)
E25.000	120.900	499.6	E2	78.200	75.618	1.082	Open Manhole	2400
E25.001	54.000	500.0	E3	78.200	75.510	1.190	Open Manhole	2400
E26.000	138.000	500.0	E3	78.200	75.510	1.190	Open Manhole	2400
E25.002	52.600	501.0	E6	78.100	75.405	1.195	Open Manhole	1725
E27.000	95.000	500.0	E5	78.200	76.371	0.629	Open Manhole	1500
E27.001	50.800	191.0	E6	78.100	76.105	1.545	Open Manhole	1725
E25.003	360.500	1001.4	E10	77.745	75.045	1.700	Open Manhole	1725
E28.000	149.700	500.7	E9	78.200	75.261	1.439	Open Manhole	2400
E28.001	42.500	196.8	E10	77.745	75.045	1.200	Open Manhole	1725
E29.000	107.500	286.7	E11	78.200	75.386	1.314	Open Manhole	2400
E29.001	105.900	499.5	E12	78.200	75.481	1.219	Open Manhole	2400
E29.002	102.400	499.5	E13	78.200	75.276	1.424	Open Manhole	2400
E29.003	79.100	500.6	E14	78.200	75.118	1.582	Open Manhole	2400
E29.004	36.600	501.4	E10	77.745	75.045	1.200	Open Manhole	1725
E25.004	72.000	1000.0	E11	76.700	74.973	0.727	Open Manhole	1500
E25.005	31.500	398.7	E	75.500	74.009	1.041	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
25.000	-	-	100	2.890	2.890	2.890
25.001	-	-	100	0.000	0.000	0.000
26.000	-	-	100	2.890	2.890	2.890
25.002	-	-	100	0.000	0.000	0.000
27.000	-	-	100	2.273	2.273	2.273
27.001	-	-	100	0.000	0.000	0.000
25.003	-	-	100	0.000	0.000	0.000
28.000	-	-	100	2.890	2.890	2.890
28.001	-	-	100	0.000	0.000	0.000
29.000	-	-	100	1.435	1.435	1.435
29.001	-	-	100	1.435	1.435	1.435
29.002	-	-	100	1.435	1.435	1.435
29.003	-	-	100	1.435	1.435	1.435
29.004	-	-	100	0.000	0.000	0.000
25.004	-	-	100	0.000	0.000	0.000
25.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				16.683	16.683	16.683

Surcharged Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E25.005	E	75.500	74.009	0.000	0	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	74.770	26	74.770	51	74.770	76	74.770	101	74.770	126	74.770	151	74.770
2	74.770	27	74.770	52	74.770	77	74.770	102	74.770	127	74.770	152	74.770
3	74.770	28	74.770	53	74.770	78	74.770	103	74.770	128	74.770	153	74.770
4	74.770	29	74.770	54	74.770	79	74.770	104	74.770	129	74.770	154	74.770
5	74.770	30	74.770	55	74.770	80	74.770	105	74.770	130	74.770	155	74.770
6	74.770	31	74.770	56	74.770	81	74.770	106	74.770	131	74.770	156	74.770
7	74.770	32	74.770	57	74.770	82	74.770	107	74.770	132	74.770	157	74.770
8	74.770	33	74.770	58	74.770	83	74.770	108	74.770	133	74.770	158	74.770
9	74.770	34	74.770	59	74.770	84	74.770	109	74.770	134	74.770	159	74.770
10	74.770	35	74.770	60	74.770	85	74.770	110	74.770	135	74.770	160	74.770
11	74.770	36	74.770	61	74.770	86	74.770	111	74.770	136	74.770	161	74.770
12	74.770	37	74.770	62	74.770	87	74.770	112	74.770	137	74.770	162	74.770
13	74.770	38	74.770	63	74.770	88	74.770	113	74.770	138	74.770	163	74.770
14	74.770	39	74.770	64	74.770	89	74.770	114	74.770	139	74.770	164	74.770
15	74.770	40	74.770	65	74.770	90	74.770	115	74.770	140	74.770	165	74.770
16	74.770	41	74.770	66	74.770	91	74.770	116	74.770	141	74.770	166	74.770
17	74.770	42	74.770	67	74.770	92	74.770	117	74.770	142	74.770	167	74.770
18	74.770	43	74.770	68	74.770	93	74.770	118	74.770	143	74.770	168	74.770
19	74.770	44	74.770	69	74.770	94	74.770	119	74.770	144	74.770	169	74.770
20	74.770	45	74.770	70	74.770	95	74.770	120	74.770	145	74.770	170	74.770
21	74.770	46	74.770	71	74.770	96	74.770	121	74.770	146	74.770	171	74.770
22	74.770	47	74.770	72	74.770	97	74.770	122	74.770	147	74.770	172	74.770
23	74.770	48	74.770	73	74.770	98	74.770	123	74.770	148	74.770	173	74.770
24	74.770	49	74.770	74	74.770	99	74.770	124	74.770	149	74.770	174	74.770
25	74.770	50	74.770	75	74.770	100	74.770	125	74.770	150	74.770	175	74.770

Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
176	74.770	235	74.770	294	74.770	353	74.770	412	74.770	471	74.770	530	74.770
177	74.770	236	74.770	295	74.770	354	74.770	413	74.770	472	74.770	531	74.770
178	74.770	237	74.770	296	74.770	355	74.770	414	74.770	473	74.770	532	74.770
179	74.770	238	74.770	297	74.770	356	74.770	415	74.770	474	74.770	533	74.770
180	74.770	239	74.770	298	74.770	357	74.770	416	74.770	475	74.770	534	74.770
181	74.770	240	74.770	299	74.770	358	74.770	417	74.770	476	74.770	535	74.770
182	74.770	241	74.770	300	74.770	359	74.770	418	74.770	477	74.770	536	74.770
183	74.770	242	74.770	301	74.770	360	74.770	419	74.770	478	74.770	537	74.770
184	74.770	243	74.770	302	74.770	361	74.770	420	74.770	479	74.770	538	74.770
185	74.770	244	74.770	303	74.770	362	74.770	421	74.770	480	74.770	539	74.770
186	74.770	245	74.770	304	74.770	363	74.770	422	74.770	481	74.770	540	74.770
187	74.770	246	74.770	305	74.770	364	74.770	423	74.770	482	74.770	541	74.770
188	74.770	247	74.770	306	74.770	365	74.770	424	74.770	483	74.770	542	74.770
189	74.770	248	74.770	307	74.770	366	74.770	425	74.770	484	74.770	543	74.770
190	74.770	249	74.770	308	74.770	367	74.770	426	74.770	485	74.770	544	74.770
191	74.770	250	74.770	309	74.770	368	74.770	427	74.770	486	74.770	545	74.770
192	74.770	251	74.770	310	74.770	369	74.770	428	74.770	487	74.770	546	74.770
193	74.770	252	74.770	311	74.770	370	74.770	429	74.770	488	74.770	547	74.770
194	74.770	253	74.770	312	74.770	371	74.770	430	74.770	489	74.770	548	74.770
195	74.770	254	74.770	313	74.770	372	74.770	431	74.770	490	74.770	549	74.770
196	74.770	255	74.770	314	74.770	373	74.770	432	74.770	491	74.770	550	74.770
197	74.770	256	74.770	315	74.770	374	74.770	433	74.770	492	74.770	551	74.770
198	74.770	257	74.770	316	74.770	375	74.770	434	74.770	493	74.770	552	74.770
199	74.770	258	74.770	317	74.770	376	74.770	435	74.770	494	74.770	553	74.770
200	74.770	259	74.770	318	74.770	377	74.770	436	74.770	495	74.770	554	74.770
201	74.770	260	74.770	319	74.770	378	74.770	437	74.770	496	74.770	555	74.770
202	74.770	261	74.770	320	74.770	379	74.770	438	74.770	497	74.770	556	74.770
203	74.770	262	74.770	321	74.770	380	74.770	439	74.770	498	74.770	557	74.770
204	74.770	263	74.770	322	74.770	381	74.770	440	74.770	499	74.770	558	74.770
205	74.770	264	74.770	323	74.770	382	74.770	441	74.770	500	74.770	559	74.770
206	74.770	265	74.770	324	74.770	383	74.770	442	74.770	501	74.770	560	74.770
207	74.770	266	74.770	325	74.770	384	74.770	443	74.770	502	74.770	561	74.770
208	74.770	267	74.770	326	74.770	385	74.770	444	74.770	503	74.770	562	74.770
209	74.770	268	74.770	327	74.770	386	74.770	445	74.770	504	74.770	563	74.770
210	74.770	269	74.770	328	74.770	387	74.770	446	74.770	505	74.770	564	74.770
211	74.770	270	74.770	329	74.770	388	74.770	447	74.770	506	74.770	565	74.770
212	74.770	271	74.770	330	74.770	389	74.770	448	74.770	507	74.770	566	74.770
213	74.770	272	74.770	331	74.770	390	74.770	449	74.770	508	74.770	567	74.770
214	74.770	273	74.770	332	74.770	391	74.770	450	74.770	509	74.770	568	74.770
215	74.770	274	74.770	333	74.770	392	74.770	451	74.770	510	74.770	569	74.770
216	74.770	275	74.770	334	74.770	393	74.770	452	74.770	511	74.770	570	74.770
217	74.770	276	74.770	335	74.770	394	74.770	453	74.770	512	74.770	571	74.770
218	74.770	277	74.770	336	74.770	395	74.770	454	74.770	513	74.770	572	74.770
219	74.770	278	74.770	337	74.770	396	74.770	455	74.770	514	74.770	573	74.770
220	74.770	279	74.770	338	74.770	397	74.770	456	74.770	515	74.770	574	74.770
221	74.770	280	74.770	339	74.770	398	74.770	457	74.770	516	74.770	575	74.770
222	74.770	281	74.770	340	74.770	399	74.770	458	74.770	517	74.770	576	74.770
223	74.770	282	74.770	341	74.770	400	74.770	459	74.770	518	74.770	577	74.770
224	74.770	283	74.770	342	74.770	401	74.770	460	74.770	519	74.770	578	74.770
225	74.770	284	74.770	343	74.770	402	74.770	461	74.770	520	74.770	579	74.770
226	74.770	285	74.770	344	74.770	403	74.770	462	74.770	521	74.770	580	74.770
227	74.770	286	74.770	345	74.770	404	74.770	463	74.770	522	74.770	581	74.770
228	74.770	287	74.770	346	74.770	405	74.770	464	74.770	523	74.770	582	74.770
229	74.770	288	74.770	347	74.770	406	74.770	465	74.770	524	74.770	583	74.770
230	74.770	289	74.770	348	74.770	407	74.770	466	74.770	525	74.770	584	74.770
231	74.770	290	74.770	349	74.770	408	74.770	467	74.770	526	74.770	585	74.770
232	74.770	291	74.770	350	74.770	409	74.770	468	74.770	527	74.770	586	74.770
233	74.770	292	74.770	351	74.770	410	74.770	469	74.770	528	74.770	587	74.770
234	74.770	293	74.770	352	74.770	411	74.770	470	74.770	529	74.770	588	74.770

Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
589	74.770	648	74.770	707	74.770	766	74.770	825	74.770	884	74.770	943	74.770
590	74.770	649	74.770	708	74.770	767	74.770	826	74.770	885	74.770	944	74.770
591	74.770	650	74.770	709	74.770	768	74.770	827	74.770	886	74.770	945	74.770
592	74.770	651	74.770	710	74.770	769	74.770	828	74.770	887	74.770	946	74.770
593	74.770	652	74.770	711	74.770	770	74.770	829	74.770	888	74.770	947	74.770
594	74.770	653	74.770	712	74.770	771	74.770	830	74.770	889	74.770	948	74.770
595	74.770	654	74.770	713	74.770	772	74.770	831	74.770	890	74.770	949	74.770
596	74.770	655	74.770	714	74.770	773	74.770	832	74.770	891	74.770	950	74.770
597	74.770	656	74.770	715	74.770	774	74.770	833	74.770	892	74.770	951	74.770
598	74.770	657	74.770	716	74.770	775	74.770	834	74.770	893	74.770	952	74.770
599	74.770	658	74.770	717	74.770	776	74.770	835	74.770	894	74.770	953	74.770
600	74.770	659	74.770	718	74.770	777	74.770	836	74.770	895	74.770	954	74.770
601	74.770	660	74.770	719	74.770	778	74.770	837	74.770	896	74.770	955	74.770
602	74.770	661	74.770	720	74.770	779	74.770	838	74.770	897	74.770	956	74.770
603	74.770	662	74.770	721	74.770	780	74.770	839	74.770	898	74.770	957	74.770
604	74.770	663	74.770	722	74.770	781	74.770	840	74.770	899	74.770	958	74.770
605	74.770	664	74.770	723	74.770	782	74.770	841	74.770	900	74.770	959	74.770
606	74.770	665	74.770	724	74.770	783	74.770	842	74.770	901	74.770	960	74.770
607	74.770	666	74.770	725	74.770	784	74.770	843	74.770	902	74.770	961	74.770
608	74.770	667	74.770	726	74.770	785	74.770	844	74.770	903	74.770	962	74.770
609	74.770	668	74.770	727	74.770	786	74.770	845	74.770	904	74.770	963	74.770
610	74.770	669	74.770	728	74.770	787	74.770	846	74.770	905	74.770	964	74.770
611	74.770	670	74.770	729	74.770	788	74.770	847	74.770	906	74.770	965	74.770
612	74.770	671	74.770	730	74.770	789	74.770	848	74.770	907	74.770	966	74.770
613	74.770	672	74.770	731	74.770	790	74.770	849	74.770	908	74.770	967	74.770
614	74.770	673	74.770	732	74.770	791	74.770	850	74.770	909	74.770	968	74.770
615	74.770	674	74.770	733	74.770	792	74.770	851	74.770	910	74.770	969	74.770
616	74.770	675	74.770	734	74.770	793	74.770	852	74.770	911	74.770	970	74.770
617	74.770	676	74.770	735	74.770	794	74.770	853	74.770	912	74.770	971	74.770
618	74.770	677	74.770	736	74.770	795	74.770	854	74.770	913	74.770	972	74.770
619	74.770	678	74.770	737	74.770	796	74.770	855	74.770	914	74.770	973	74.770
620	74.770	679	74.770	738	74.770	797	74.770	856	74.770	915	74.770	974	74.770
621	74.770	680	74.770	739	74.770	798	74.770	857	74.770	916	74.770	975	74.770
622	74.770	681	74.770	740	74.770	799	74.770	858	74.770	917	74.770	976	74.770
623	74.770	682	74.770	741	74.770	800	74.770	859	74.770	918	74.770	977	74.770
624	74.770	683	74.770	742	74.770	801	74.770	860	74.770	919	74.770	978	74.770
625	74.770	684	74.770	743	74.770	802	74.770	861	74.770	920	74.770	979	74.770
626	74.770	685	74.770	744	74.770	803	74.770	862	74.770	921	74.770	980	74.770
627	74.770	686	74.770	745	74.770	804	74.770	863	74.770	922	74.770	981	74.770
628	74.770	687	74.770	746	74.770	805	74.770	864	74.770	923	74.770	982	74.770
629	74.770	688	74.770	747	74.770	806	74.770	865	74.770	924	74.770	983	74.770
630	74.770	689	74.770	748	74.770	807	74.770	866	74.770	925	74.770	984	74.770
631	74.770	690	74.770	749	74.770	808	74.770	867	74.770	926	74.770	985	74.770
632	74.770	691	74.770	750	74.770	809	74.770	868	74.770	927	74.770	986	74.770
633	74.770	692	74.770	751	74.770	810	74.770	869	74.770	928	74.770	987	74.770
634	74.770	693	74.770	752	74.770	811	74.770	870	74.770	929	74.770	988	74.770
635	74.770	694	74.770	753	74.770	812	74.770	871	74.770	930	74.770	989	74.770
636	74.770	695	74.770	754	74.770	813	74.770	872	74.770	931	74.770	990	74.770
637	74.770	696	74.770	755	74.770	814	74.770	873	74.770	932	74.770	991	74.770
638	74.770	697	74.770	756	74.770	815	74.770	874	74.770	933	74.770	992	74.770
639	74.770	698	74.770	757	74.770	816	74.770	875	74.770	934	74.770	993	74.770
640	74.770	699	74.770	758	74.770	817	74.770	876	74.770	935	74.770	994	74.770
641	74.770	700	74.770	759	74.770	818	74.770	877	74.770	936	74.770	995	74.770
642	74.770	701	74.770	760	74.770	819	74.770	878	74.770	937	74.770	996	74.770
643	74.770	702	74.770	761	74.770	820	74.770	879	74.770	938	74.770	997	74.770
644	74.770	703	74.770	762	74.770	821	74.770	880	74.770	939	74.770	998	74.770
645	74.770	704	74.770	763	74.770	822	74.770	881	74.770	940	74.770	999	74.770
646	74.770	705	74.770	764	74.770	823	74.770	882	74.770	941	74.770	1000	74.770
647	74.770	706	74.770	765	74.770	824	74.770	883	74.770	942	74.770	1001	74.770

Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1002	74.770	1061	74.770	1120	74.770	1179	74.770	1238	74.770	1297	74.770	1356	74.770
1003	74.770	1062	74.770	1121	74.770	1180	74.770	1239	74.770	1298	74.770	1357	74.770
1004	74.770	1063	74.770	1122	74.770	1181	74.770	1240	74.770	1299	74.770	1358	74.770
1005	74.770	1064	74.770	1123	74.770	1182	74.770	1241	74.770	1300	74.770	1359	74.770
1006	74.770	1065	74.770	1124	74.770	1183	74.770	1242	74.770	1301	74.770	1360	74.770
1007	74.770	1066	74.770	1125	74.770	1184	74.770	1243	74.770	1302	74.770	1361	74.770
1008	74.770	1067	74.770	1126	74.770	1185	74.770	1244	74.770	1303	74.770	1362	74.770
1009	74.770	1068	74.770	1127	74.770	1186	74.770	1245	74.770	1304	74.770	1363	74.770
1010	74.770	1069	74.770	1128	74.770	1187	74.770	1246	74.770	1305	74.770	1364	74.770
1011	74.770	1070	74.770	1129	74.770	1188	74.770	1247	74.770	1306	74.770	1365	74.770
1012	74.770	1071	74.770	1130	74.770	1189	74.770	1248	74.770	1307	74.770	1366	74.770
1013	74.770	1072	74.770	1131	74.770	1190	74.770	1249	74.770	1308	74.770	1367	74.770
1014	74.770	1073	74.770	1132	74.770	1191	74.770	1250	74.770	1309	74.770	1368	74.770
1015	74.770	1074	74.770	1133	74.770	1192	74.770	1251	74.770	1310	74.770	1369	74.770
1016	74.770	1075	74.770	1134	74.770	1193	74.770	1252	74.770	1311	74.770	1370	74.770
1017	74.770	1076	74.770	1135	74.770	1194	74.770	1253	74.770	1312	74.770	1371	74.770
1018	74.770	1077	74.770	1136	74.770	1195	74.770	1254	74.770	1313	74.770	1372	74.770
1019	74.770	1078	74.770	1137	74.770	1196	74.770	1255	74.770	1314	74.770	1373	74.770
1020	74.770	1079	74.770	1138	74.770	1197	74.770	1256	74.770	1315	74.770	1374	74.770
1021	74.770	1080	74.770	1139	74.770	1198	74.770	1257	74.770	1316	74.770	1375	74.770
1022	74.770	1081	74.770	1140	74.770	1199	74.770	1258	74.770	1317	74.770	1376	74.770
1023	74.770	1082	74.770	1141	74.770	1200	74.770	1259	74.770	1318	74.770	1377	74.770
1024	74.770	1083	74.770	1142	74.770	1201	74.770	1260	74.770	1319	74.770	1378	74.770
1025	74.770	1084	74.770	1143	74.770	1202	74.770	1261	74.770	1320	74.770	1379	74.770
1026	74.770	1085	74.770	1144	74.770	1203	74.770	1262	74.770	1321	74.770	1380	74.770
1027	74.770	1086	74.770	1145	74.770	1204	74.770	1263	74.770	1322	74.770	1381	74.770
1028	74.770	1087	74.770	1146	74.770	1205	74.770	1264	74.770	1323	74.770	1382	74.770
1029	74.770	1088	74.770	1147	74.770	1206	74.770	1265	74.770	1324	74.770	1383	74.770
1030	74.770	1089	74.770	1148	74.770	1207	74.770	1266	74.770	1325	74.770	1384	74.770
1031	74.770	1090	74.770	1149	74.770	1208	74.770	1267	74.770	1326	74.770	1385	74.770
1032	74.770	1091	74.770	1150	74.770	1209	74.770	1268	74.770	1327	74.770	1386	74.770
1033	74.770	1092	74.770	1151	74.770	1210	74.770	1269	74.770	1328	74.770	1387	74.770
1034	74.770	1093	74.770	1152	74.770	1211	74.770	1270	74.770	1329	74.770	1388	74.770
1035	74.770	1094	74.770	1153	74.770	1212	74.770	1271	74.770	1330	74.770	1389	74.770
1036	74.770	1095	74.770	1154	74.770	1213	74.770	1272	74.770	1331	74.770	1390	74.770
1037	74.770	1096	74.770	1155	74.770	1214	74.770	1273	74.770	1332	74.770	1391	74.770
1038	74.770	1097	74.770	1156	74.770	1215	74.770	1274	74.770	1333	74.770	1392	74.770
1039	74.770	1098	74.770	1157	74.770	1216	74.770	1275	74.770	1334	74.770	1393	74.770
1040	74.770	1099	74.770	1158	74.770	1217	74.770	1276	74.770	1335	74.770	1394	74.770
1041	74.770	1100	74.770	1159	74.770	1218	74.770	1277	74.770	1336	74.770	1395	74.770
1042	74.770	1101	74.770	1160	74.770	1219	74.770	1278	74.770	1337	74.770	1396	74.770
1043	74.770	1102	74.770	1161	74.770	1220	74.770	1279	74.770	1338	74.770	1397	74.770
1044	74.770	1103	74.770	1162	74.770	1221	74.770	1280	74.770	1339	74.770	1398	74.770
1045	74.770	1104	74.770	1163	74.770	1222	74.770	1281	74.770	1340	74.770	1399	74.770
1046	74.770	1105	74.770	1164	74.770	1223	74.770	1282	74.770	1341	74.770	1400	74.770
1047	74.770	1106	74.770	1165	74.770	1224	74.770	1283	74.770	1342	74.770	1401	74.770
1048	74.770	1107	74.770	1166	74.770	1225	74.770	1284	74.770	1343	74.770	1402	74.770
1049	74.770	1108	74.770	1167	74.770	1226	74.770	1285	74.770	1344	74.770	1403	74.770
1050	74.770	1109	74.770	1168	74.770	1227	74.770	1286	74.770	1345	74.770	1404	74.770
1051	74.770	1110	74.770	1169	74.770	1228	74.770	1287	74.770	1346	74.770	1405	74.770
1052	74.770	1111	74.770	1170	74.770	1229	74.770	1288	74.770	1347	74.770	1406	74.770
1053	74.770	1112	74.770	1171	74.770	1230	74.770	1289	74.770	1348	74.770	1407	74.770
1054	74.770	1113	74.770	1172	74.770	1231	74.770	1290	74.770	1349	74.770	1408	74.770
1055	74.770	1114	74.770	1173	74.770	1232	74.770	1291	74.770	1350	74.770	1409	74.770
1056	74.770	1115	74.770	1174	74.770	1233	74.770	1292	74.770	1351	74.770	1410	74.770
1057	74.770	1116	74.770	1175	74.770	1234	74.770	1293	74.770	1352	74.770	1411	74.770
1058	74.770	1117	74.770	1176	74.770	1235	74.770	1294	74.770	1353	74.770	1412	74.770
1059	74.770	1118	74.770	1177	74.770	1236	74.770	1295	74.770	1354	74.770	1413	74.770
1060	74.770	1119	74.770	1178	74.770	1237	74.770	1296	74.770	1355	74.770	1414	74.770

Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1415	74.770	1419	74.770	1423	74.770	1427	74.770	1431	74.770	1435	74.770	1439	74.770
1416	74.770	1420	74.770	1424	74.770	1428	74.770	1432	74.770	1436	74.770	1440	74.770
1417	74.770	1421	74.770	1425	74.770	1429	74.770	1433	74.770	1437	74.770		
1418	74.770	1422	74.770	1426	74.770	1430	74.770	1434	74.770	1438	74.770		

Simulation Criteria for Existing

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	2	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E5, DS/PN: E27.001, Volume (m³): 2016.5

Unit Reference	MD-SHE-0138-9300-1200-9300
Design Head (m)	1.200
Design Flow (l/s)	9.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	138
Invert Level (m)	76.371
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	9.3	Kick-Flo®	0.773	7.6
Flush-Flo™	0.356	9.3	Mean Flow over Head Range	-	8.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	0.800	7.7	2.000	11.8	4.000	16.5	7.000	21.5
0.200	8.8	1.000	8.5	2.200	12.4	4.500	17.4	7.500	22.2
0.300	9.2	1.200	9.3	2.400	12.9	5.000	18.3	8.000	22.9
0.400	9.3	1.400	10.0	2.600	13.4	5.500	19.2	8.500	23.6
0.500	9.1	1.600	10.6	3.000	14.3	6.000	20.0	9.000	24.3
0.600	8.9	1.800	11.3	3.500	15.4	6.500	20.8	9.500	24.9

Hydro-Brake Optimum® Manhole: E11, DS/PN: E25.005, Volume (m³): 215.8

Unit Reference	MD-SHE-0334-6840-1200-6840
Design Head (m)	1.200
Design Flow (l/s)	68.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	334
Invert Level (m)	74.088
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	68.4	Kick-Flo®	0.925	60.3
Flush-Flo™	0.511	68.3	Mean Flow over Head Range	-	55.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.8	0.400	67.5	0.800	64.9	1.400	73.7	2.000	87.6
0.200	34.0	0.500	68.3	1.000	62.6	1.600	78.6	2.200	91.8
0.300	61.0	0.600	68.0	1.200	68.4	1.800	83.2	2.400	95.7

Hydro-Brake Optimum® Manhole: E11, DS/PN: E25.005, Volume (m^3): 215.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	99.5	4.000	122.8	5.500	143.4	7.000	161.4	8.500	177.5
3.000	106.7	4.500	130.0	6.000	149.6	7.500	166.9	9.000	182.5
3.500	115.0	5.000	136.9	6.500	155.6	8.000	172.3	9.500	187.4

Storage Structures for Existing

Tank or Pond Manhole: E11, DS/PN: E25.005

Invert Level (m) 74.088

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	15225.0	1.200	17521.0	2.400	18318.0	3.600	18318.0	4.800	18318.0
0.200	15597.0	1.400	17917.0	2.600	18318.0	3.800	18318.0	5.000	18318.0
0.400	15974.0	1.600	18318.0	2.800	18318.0	4.000	18318.0		
0.600	16355.0	1.800	18318.0	3.000	18318.0	4.200	18318.0		
0.800	16739.0	2.000	18318.0	3.200	18318.0	4.400	18318.0		
1.000	17128.0	2.200	18318.0	3.400	18318.0	4.600	18318.0		

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E25.000	E1	15 Winter	1	+0%	100/15 Summer	200/15 Winter			76.247
E25.001	E2	15 Winter	1	+0%	100/15 Summer				76.078
E26.000	E3	15 Winter	1	+0%	100/15 Summer				76.158
E25.002	E3	15 Winter	1	+0%	100/15 Summer				76.016
E27.000	E4	480 Winter	1	+0%					76.641
E27.001	E5	480 Winter	1	+0%	30/120 Winter				76.641
E25.003	E6	15 Winter	1	+0%	200/15 Summer				75.644
E28.000	E8	15 Winter	1	+0%	200/15 Winter				75.930
E28.001	E9	15 Winter	1	+0%	200/15 Winter				75.583
E29.000	E10	15 Winter	1	+0%	200/15 Summer				76.070
E29.001	E11	15 Winter	1	+0%	200/15 Summer				76.030
E29.002	E12	15 Winter	1	+0%	100/15 Winter				75.881
E29.003	E13	15 Winter	1	+0%	100/15 Summer				75.731
E29.004	E14	15 Winter	1	+0%	100/15 Winter				75.580
E25.004	E10	15 Winter	1	+0%	100/15 Summer				75.387
E25.005	E11	1440 Winter	1	+0%	30/600 Winter				74.380

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E25.000	E1	-1.113	0.000	0.14		398.2	OK	1
E25.001	E2	-1.040	0.000	0.13		316.6	OK	
E26.000	E3	-1.128	0.000	0.13		368.9	OK	
E25.002	E3	-0.994	0.000	0.25		604.2	OK	
E27.000	E4	-1.120	0.000	0.00		34.7	OK	
E27.001	E5	-0.180	0.000	0.04		9.2	OK	
E25.003	E6	-0.761	0.000	0.10		483.2	OK	
E28.000	E8	-1.130	0.000	0.12		366.2	OK	
E28.001	E9	-1.178	0.000	0.10		354.3	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E29.000	E10	-1.191	0.000	0.05		187.2	OK	
E29.001	E11	-1.163	0.000	0.10		284.2	OK	
E29.002	E12	-1.100	0.000	0.14		391.4	OK	
E29.003	E13	-1.045	0.000	0.18		472.7	OK	
E29.004	E14	-1.038	0.000	0.21		462.0	OK	
E25.004	E10	-0.658	0.000	0.26		958.8	OK	
E25.005	E11	-0.158	0.000	0.42		58.7	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E25.000	E1	15 Winter	30	+0%	100/15 Summer	200/15 Winter			76.620
E25.001	E2	15 Winter	30	+0%	100/15 Summer				76.546
E26.000	E3	15 Winter	30	+0%	100/15 Summer				76.573
E25.002	E3	15 Winter	30	+0%	100/15 Summer				76.501
E27.000	E4	600 Winter	30	+0%					76.915
E27.001	E5	600 Winter	30	+0%	30/120 Winter				76.916
E25.003	E6	15 Winter	30	+0%	200/15 Summer				75.967
E28.000	E8	15 Winter	30	+0%	200/15 Winter				76.252
E28.001	E9	15 Winter	30	+0%	200/15 Winter				75.848
E29.000	E10	15 Winter	30	+0%	200/15 Summer				76.408
E29.001	E11	15 Winter	30	+0%	200/15 Summer				76.384
E29.002	E12	15 Winter	30	+0%	100/15 Winter				76.286
E29.003	E13	15 Winter	30	+0%	100/15 Summer				76.174
E29.004	E14	15 Winter	30	+0%	100/15 Winter				76.030
E25.004	E10	15 Winter	30	+0%	100/15 Summer				75.839
E25.005	E11	1440 Winter	30	+0%	30/600 Winter				74.659

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E25.000	E1	-0.740	0.000	0.43		1234.9	OK	1
E25.001	E2	-0.572	0.000	0.39		966.5	OK	
E26.000	E3	-0.713	0.000	0.39		1148.9	OK	
E25.002	E3	-0.509	0.000	0.76		1864.6	OK	
E27.000	E4	-0.846	0.000	0.00		64.3	OK	
E27.001	E5	0.095	0.000	0.04		9.2	SURCHARGED	
E25.003	E6	-0.438	0.000	0.30		1458.1	OK	
E28.000	E8	-0.808	0.000	0.39		1151.6	OK	
E28.001	E9	-0.913	0.000	0.32		1105.7	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E29.000	E10	-0.853	0.000	0.16		596.5	OK	
E29.001	E11	-0.809	0.000	0.34		948.9	OK	
E29.002	E12	-0.695	0.000	0.45		1262.8	OK	
E29.003	E13	-0.602	0.000	0.57		1536.8	OK	
E29.004	E14	-0.588	0.000	0.68		1516.2	OK	
E25.004	E10	-0.206	0.000	0.76		2795.1	OK	
E25.005	E11	0.121	0.000	0.49		68.2	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E25.000	E1	15 Winter	100	+40%	100/15 Summer	200/15 Winter			77.597
E25.001	E2	15 Winter	100	+40%	100/15 Summer				77.449
E26.000	E3	15 Winter	100	+40%	100/15 Summer				77.532
E25.002	E3	15 Winter	100	+40%	100/15 Summer				77.344
E27.000	E4	960 Winter	100	+40%					77.388
E27.001	E5	960 Winter	100	+40%	30/120 Winter				77.388
E25.003	E6	15 Winter	100	+40%	200/15 Summer				76.393
E28.000	E8	15 Winter	100	+40%	200/15 Winter				76.691
E28.001	E9	15 Winter	100	+40%	200/15 Winter				76.244
E29.000	E10	15 Winter	100	+40%	200/15 Summer				77.188
E29.001	E11	15 Winter	100	+40%	200/15 Summer				77.160
E29.002	E12	15 Winter	100	+40%	100/15 Winter				77.081
E29.003	E13	15 Winter	100	+40%	100/15 Summer				76.897
E29.004	E14	15 Winter	100	+40%	100/15 Winter				76.634
E25.004	E10	15 Winter	100	+40%	100/15 Summer				76.213
E25.005	E11	1440 Winter	100	+40%	30/600 Winter				75.015

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E25.000	E1	0.237	0.000	0.89		2543.4	SURCHARGED	1
E25.001	E2	0.331	0.000	0.90		2224.1	SURCHARGED	
E26.000	E3	0.246	0.000	0.80		2333.2	SURCHARGED	
E25.002	E3	0.334	0.000	1.77		4349.0	SURCHARGED	
E27.000	E4	-0.373	0.000	0.00		81.9	OK	
E27.001	E5	0.567	0.000	0.04		9.2	SURCHARGED	
E25.003	E6	-0.012	0.000	0.62		3021.0	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E28.000	E8	-0.369	0.000	0.83		2434.3	OK	
E28.001	E9	-0.517	0.000	0.67		2315.4	OK	
E29.000	E10	-0.073	0.000	0.33		1245.1	OK	
E29.001	E11	-0.033	0.000	0.68		1905.1	OK	
E29.002	E12	0.100	0.000	0.94		2622.9	SURCHARGED	
E29.003	E13	0.121	0.000	1.24		3320.9	SURCHARGED	
E29.004	E14	0.016	0.000	1.49		3321.4	SURCHARGED	
E25.004	E10	0.168	0.000	2.01		7362.4	SURCHARGED	
E25.005	E11	0.477	0.000	0.49		67.6	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E25.000	E1	15 Winter	200	+40%	100/15 Summer	200/15 Winter			78.200
E25.001	E2	15 Winter	200	+40%	100/15 Summer				77.927
E26.000	E3	15 Winter	200	+40%	100/15 Summer				78.087
E25.002	E3	15 Winter	200	+40%	100/15 Summer				77.757
E27.000	E4	960 Winter	200	+40%					77.569
E27.001	E5	960 Winter	200	+40%	30/120 Winter				77.569
E25.003	E6	15 Winter	200	+40%	200/15 Summer				77.088
E28.000	E8	15 Winter	200	+40%	200/15 Winter				77.094
E28.001	E9	15 Winter	200	+40%	200/15 Winter				76.834
E29.000	E10	15 Winter	200	+40%	200/15 Summer				78.089
E29.001	E11	15 Winter	200	+40%	200/15 Summer				78.064
E29.002	E12	15 Winter	200	+40%	100/15 Winter				77.982
E29.003	E13	15 Winter	200	+40%	100/15 Summer				77.743
E29.004	E14	15 Winter	200	+40%	100/15 Winter				77.277
E25.004	E10	15 Winter	200	+40%	100/15 Summer				76.785
E25.005	E11	1440 Winter	200	+40%	30/600 Winter				75.116

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E25.000	E1	0.840	0.068	1.09		3133.2	FLOOD	1
E25.001	E2	0.809	0.000	1.22		3001.8	FLOOD RISK	
E26.000	E3	0.801	0.000	1.01		2953.0	FLOOD RISK	
E25.002	E3	0.747	0.000	2.37		5803.1	SURCHARGED	
E27.000	E4	-0.192	0.000	0.00		95.8	OK	
E27.001	E5	0.748	0.000	0.04		9.3	SURCHARGED	
E25.003	E6	0.683	0.000	0.80		3879.0	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E28.000	E8	0.034	0.000	1.04		3072.4	SURCHARGED	
E28.001	E9	0.073	0.000	0.84		2889.4	SURCHARGED	
E29.000	E10	0.828	0.000	0.40		1497.1	FLOOD RISK	
E29.001	E11	0.871	0.000	0.91		2559.5	FLOOD RISK	
E29.002	E12	1.001	0.000	1.27		3549.7	FLOOD RISK	
E29.003	E13	0.967	0.000	1.67		4472.3	SURCHARGED	
E29.004	E14	0.659	0.000	1.99		4447.2	SURCHARGED	
E25.004	E10	0.740	0.000	2.70		9902.7	SURCHARGED	
E25.005	E11	0.578	0.000	0.47		66.0	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	2.213	4-8	4.931

Total Area Contributing (ha) = 7.144

Total Pipe Volume (m^3) = 7569.743

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E21.000	112.000	0.224	500.0	1.786	4.00	0.0	0.600	o	1200	Pipe/Conduit
E21.001	112.000	0.224	500.0	1.786	0.00	0.0	0.600	o	1200	Pipe/Conduit
E21.002	80.000	0.160	500.0	1.786	0.00	0.0	0.600	[]	-9	Pipe/Conduit
E22.000	80.000	0.160	500.0	1.786	5.00	0.0	0.600	[]	-9	Pipe/Conduit
E22.001	54.500	0.111	491.0	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit
E22.002	39.200	0.080	490.0	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit
E21.003	65.600	0.164	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E21.000	78.000	1.786	0.0	1.67	1884.5
E21.001	77.776	3.572	0.0	1.67	1884.5
E21.002	77.552	5.358	0.0	2.50	112417.9
E22.000	77.743	1.786	0.0	2.50	112417.9
E22.001	77.583	1.786	0.0	1.68	1901.8
E22.002	77.472	1.786	0.0	1.68	1903.8
E21.003	77.392	7.144	0.0	1.01	160.7

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-9	[]	37500	1200	90.0		2.326	45.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E21.000	o	1200	E1	81.000	78.000	1.800	Open Manhole	2100
E21.001	o	1200	E2	81.000	77.776	2.024	Open Manhole	2100
E21.002	[]	-9	E3	81.000	77.552	2.248	Open Manhole	38225
E22.000	[]	-9	E4	81.000	77.743	2.057	Open Manhole	38225
E22.001	o	1200	E5	81.000	77.583	2.217	Open Manhole	2100
E22.002	o	1200	E6	81.000	77.472	2.328	Open Manhole	2100
E21.003	o	450	E7	81.000	77.392	3.158	Open Manhole	1500

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)
E21.000	112.000	500.0	E2	81.000	77.776	2.024	Open Manhole	2100
E21.001	112.000	500.0	E3	81.000	77.552	2.248	Open Manhole	38225
E21.002	80.000	500.0	E7	81.000	77.392	2.408	Open Manhole	1500
E22.000	80.000	500.0	E5	81.000	77.583	2.217	Open Manhole	2100
E22.001	54.500	491.0	E6	81.000	77.472	2.328	Open Manhole	2100
E22.002	39.200	490.0	E7	81.000	77.392	2.408	Open Manhole	1500
E21.003	65.600	400.0	E	80.000	77.228	2.322	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E21.003	E	80.000	77.228	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E7, DS/PN: E21.003, Volume (m³): 2754.9

Unit Reference	MD-SHE-0232-2930-1200-2930
Design Head (m)	1.200
Design Flow (l/s)	29.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	232
Invert Level (m)	77.392
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	29.3	Kick-Flo®	0.858	25.0
Flush-Flo™	0.404	29.3	Mean Flow over Head Range	-	24.7

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	7.7	0.800	26.5	2.000	37.4	4.000	52.3	7.000	68.6
0.200	23.3	1.000	26.9	2.200	39.2	4.500	55.4	7.500	71.0
0.300	28.8	1.200	29.3	2.400	40.9	5.000	58.3	8.000	73.2
0.400	29.3	1.400	31.5	2.600	42.5	5.500	61.0	8.500	75.4
0.500	29.1	1.600	33.6	3.000	45.5	6.000	63.7	9.000	77.6
0.600	28.6	1.800	35.6	3.500	49.0	6.500	66.2	9.500	79.6

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E21.000	E1	15 Winter	1	+0%	100/15 Summer				78.336	-0.864
E21.001	E2	15 Winter	1	+0%	100/15 Summer				78.185	-0.791
E21.002	E3	480 Winter	1	+0%					77.742	-1.010
E22.000	E4	15 Winter	1	+0%					77.755	-1.188
E22.001	E5	480 Winter	1	+0%					77.744	-1.039
E22.002	E6	480 Winter	1	+0%					77.742	-0.930
E21.003	E7	480 Winter	1	+0%	30/30 Summer				77.742	-0.100

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E21.000	E1	0.000	0.15		243.2	OK	
E21.001	E2	0.000	0.26		419.4	OK	
E21.002	E3	0.000	0.00		64.5	OK	
E22.000	E4	0.000	0.00		224.9	OK	
E22.001	E5	0.000	0.01		17.5	OK	
E22.002	E6	0.000	0.01		16.8	OK	
E21.003	E7	0.000	0.20		29.2	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E21.000	E1	15 Winter	30	+0%	100/15 Summer				78.706	-0.494
E21.001	E2	15 Winter	30	+0%	100/15 Summer				78.615	-0.361
E21.002	E3	600 Winter	30	+0%					77.996	-0.756
E22.000	E4	600 Winter	30	+0%					77.995	-0.948
E22.001	E5	600 Winter	30	+0%					77.995	-0.788
E22.002	E6	600 Winter	30	+0%					77.996	-0.676
E21.003	E7	600 Winter	30	+0%	30/30 Summer				77.995	0.153

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E21.000	E1	0.000	0.46		758.3	OK	
E21.001	E2	0.000	0.81		1321.6	OK	
E21.002	E3	0.000	0.00		136.1	OK	
E22.000	E4	0.000	0.00		44.1	OK	
E22.001	E5	0.000	0.01		18.0	OK	
E22.002	E6	0.000	0.01		16.8	OK	
E21.003	E7	0.000	0.20		29.2	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E21.000	E1	15 Winter	100	+40%	100/15 Summer				79.696	0.496
E21.001	E2	15 Winter	100	+40%	100/15 Summer				79.440	0.464
E21.002	E3	960 Winter	100	+40%					78.423	-0.329
E22.000	E4	960 Winter	100	+40%					78.421	-0.522
E22.001	E5	960 Winter	100	+40%					78.421	-0.362
E22.002	E6	960 Winter	100	+40%					78.421	-0.251
E21.003	E7	960 Winter	100	+40%	30/30 Summer				78.421	0.579

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E21.000	E1	0.000	0.97		1587.4	SURCHARGED	
E21.001	E2	0.000	1.69		2773.5	SURCHARGED	
E21.002	E3	0.000	0.00		181.9	OK	
E22.000	E4	0.000	0.00		32.4	OK	
E22.001	E5	0.000	0.01		13.1	OK	
E22.002	E6	0.000	0.01		13.2	OK	
E21.003	E7	0.000	0.20		29.2	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E21.000	E1	15 Winter	200	+40%	100/15 Summer				80.291	1.091
E21.001	E2	15 Winter	200	+40%	100/15 Summer				79.884	0.908
E21.002	E3	720 Winter	200	+40%					78.589	-0.163
E22.000	E4	960 Winter	200	+40%					78.585	-0.358
E22.001	E5	960 Winter	200	+40%					78.585	-0.198
E22.002	E6	960 Winter	200	+40%					78.585	-0.087
E21.003	E7	960 Winter	200	+40%	30/30 Summer				78.584	0.742

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E21.000	E1	0.000	1.22		2009.6	SURCHARGED	
E21.001	E2	0.000	2.15		3531.3	SURCHARGED	
E21.002	E3	0.000	0.00		267.7	OK	
E22.000	E4	0.000	0.00		34.4	OK	
E22.001	E5	0.000	0.01		15.1	OK	
E22.002	E6	0.000	0.01		15.6	OK	
E21.003	E7	0.000	0.20		29.2	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	2.045	4-8	2.995

Total Area Contributing (ha) = 5.040

Total Pipe Volume (m^3) = 5323.127

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E19.000	93.800	0.188	498.9	1.680	4.00	0.0	0.600	o	1200	Pipe/Conduit
E19.001	93.800	0.187	501.6	1.680	0.00	0.0	0.600	o	1200	Pipe/Conduit
E19.002	52.500	0.105	500.0	0.000	0.00	0.0	0.600	[]	-5	Pipe/Conduit
E20.000	52.500	0.105	500.0	1.680	5.00	0.0	0.600	[]	-5	Pipe/Conduit
E20.001	57.100	0.114	500.9	0.000	5.00	0.0	0.600	o	1200	Pipe/Conduit
E19.003	40.100	0.080	501.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E19.000	78.000	1.680	0.0	1.67	1886.5
E19.001	77.812	3.360	0.0	1.66	1881.4
E19.002	77.625	3.360	0.0	2.50	120053.9
E20.000	77.994	1.680	0.0	2.50	120053.9
E20.001	77.889	1.680	0.0	1.66	1882.8
E19.003	77.520	5.040	0.0	0.90	143.3

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-5	[]	40000	1200	90.0		2.330	48.000

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E19.000	o	1200	E1	81.000	78.000	1.800	Open Manhole	2100
E19.001	o	1200	E2	81.000	77.812	1.988	Open Manhole	2100
E19.002	[]	-5	E3	81.000	77.625	2.175	Open Manhole	40725
E20.000	[]	-5	E4	81.000	77.994	1.806	Open Manhole	40725
E20.001	o	1200	E4	81.000	77.889	1.911	Open Manhole	2100
E19.003	o	450	E5	81.000	77.520	3.030	Open Manhole	1500

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)
E19.000	93.800	498.9	E2	81.000	77.812	1.988	Open Manhole	2100
E19.001	93.800	501.6	E3	81.000	77.625	2.175	Open Manhole	40725
E19.002	52.500	500.0	E5	81.000	77.520	2.280	Open Manhole	1500
E20.000	52.500	500.0	E4	81.000	77.889	1.911	Open Manhole	2100
E20.001	57.100	500.9	E5	81.000	77.775	2.025	Open Manhole	1500
E19.003	40.100	501.3	E	80.000	77.440	2.110	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E19.003	E	80.000	77.440	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E5, DS/PN: E19.003, Volume (m³): 1575.3

Unit Reference	MD-SHE-0199-2070-1200-2070
Design Head (m)	1.200
Design Flow (l/s)	20.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	199
Invert Level (m)	77.520
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	20.7	Kick-Flo®	0.827	17.3
Flush-Flo™	0.376	20.7	Mean Flow over Head Range	-	17.6

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	6.9	0.800	18.0	2.000	26.4	4.000	36.9	7.000	48.3
0.200	18.7	1.000	19.0	2.200	27.7	4.500	39.0	7.500	50.0
0.300	20.5	1.200	20.7	2.400	28.8	5.000	41.1	8.000	51.6
0.400	20.7	1.400	22.3	2.600	30.0	5.500	43.0	8.500	53.1
0.500	20.4	1.600	23.7	3.000	32.1	6.000	44.8	9.000	54.6
0.600	20.0	1.800	25.1	3.500	34.6	6.500	46.6	9.500	56.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E19.000	E1	15 Winter	1	+0%	100/15 Summer				78.346	-0.854
E19.001	E2	15 Winter	1	+0%	100/15 Summer				78.219	-0.793
E19.002	E3	600 Winter	1	+0%					77.867	-0.958
E20.000	E4	30 Winter	1	+0%					78.029	-1.165
E20.001	E4	30 Winter	1	+0%					78.028	-1.061
E19.003	E5	600 Winter	1	+0%	30/30 Summer				77.867	-0.103

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E19.000	E1	0.000	0.14		231.5	OK	
E19.001	E2	0.000	0.25		402.1	OK	
E19.002	E3	0.000	0.00		21.9	OK	
E20.000	E4	0.000	0.00		113.5	OK	
E20.001	E4	0.000	0.03		47.2	OK	
E19.003	E5	0.000	0.16		20.6	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E19.000	E1	15 Winter	30	+0%	100/15 Summer				78.725	-0.475
E19.001	E2	15 Winter	30	+0%	100/15 Summer				78.641	-0.371
E19.002	E3	480 Winter	30	+0%					78.168	-0.657
E20.000	E4	480 Winter	30	+0%					78.168	-1.026
E20.001	E4	480 Winter	30	+0%					78.168	-0.921
E19.003	E5	480 Winter	30	+0%	30/30 Summer				78.168	0.198

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E19.000	E1	0.000	0.45		722.9	OK	
E19.001	E2	0.000	0.80		1288.3	OK	
E19.002	E3	0.000	0.00		58.3	OK	
E20.000	E4	0.000	0.00		49.9	OK	
E20.001	E4	0.000	0.03		39.8	OK	
E19.003	E5	0.000	0.16		20.6	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E19.000	E1	15 Winter	100	+40%	100/15 Summer				79.571	0.371
E19.001	E2	15 Winter	100	+40%	100/15 Summer				79.371	0.359
E19.002	E3	960 Winter	100	+40%					78.568	-0.257
E20.000	E4	960 Winter	100	+40%					78.568	-0.626
E20.001	E4	960 Winter	100	+40%					78.568	-0.521
E19.003	E5	960 Winter	100	+40%	30/30 Summer				78.568	0.598

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E19.000	E1	0.000	0.95		1526.8	SURCHARGED	
E19.001	E2	0.000	1.70		2727.8	SURCHARGED	
E19.002	E3	0.000	0.00		91.5	OK	
E20.000	E4	0.000	0.00		36.6	OK	
E20.001	E4	0.000	0.02		27.9	OK	
E19.003	E5	0.000	0.16		20.6	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FEH D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E19.000	E1	15 Winter	200	+40%	100/15 Summer				80.052	0.852
E19.001	E2	15 Winter	200	+40%	100/15 Summer				79.733	0.721
E19.002	E3	960 Winter	200	+40%					78.721	-0.104
E20.000	E4	960 Winter	200	+40%					78.719	-0.475
E20.001	E4	960 Winter	200	+40%					78.719	-0.370
E19.003	E5	960 Winter	200	+40%	30/30 Summer				78.719	0.749

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E19.000	E1	0.000	1.20		1934.4	SURCHARGED	
E19.001	E2	0.000	2.15		3439.8	SURCHARGED	
E19.002	E3	0.000	0.00		105.6	OK	
E20.000	E4	0.000	0.00		37.0	OK	
E20.001	E4	0.000	0.02		27.5	OK	
E19.003	E5	0.000	0.16		20.7	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	1.082	4-8	3.754	8-12	0.204

Total Area Contributing (ha) = 5.040

Total Pipe Volume (m^3) = 4958.930

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E18.000	122.700	0.245	500.8	1.680	4.00	0.0	0.600	o	1200	Pipe/Conduit
E18.001	109.100	0.218	500.5	1.680	0.00	0.0	0.600	o	1200	Pipe/Conduit
E18.002	83.000	0.166	500.0	1.680	0.00	0.0	0.600	[]	-8	Pipe/Conduit
E18.003	55.800	0.140	398.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
E18.004	42.100	0.105	401.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E18.000	78.000	1.680	0.0	1.66	1882.9
E18.001	77.755	3.360	0.0	1.67	1883.6
E18.002	77.537	5.040	0.0	2.51	141436.4
E18.003	77.371	5.040	0.0	1.01	161.0
E18.004	77.231	5.040	0.0	1.01	160.5

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-8	[]	47000	1200	90.0		2.340	56.400

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E18.000	o	1200	E1	81.000	78.000	1.800	Open Manhole	2100
E18.001	o	1200	E2	81.000	77.755	2.045	Open Manhole	2100
E18.002	[]	-8	E3	81.000	77.537	2.263	Open Manhole	47725
E18.003	o	450	E4	81.000	77.371	3.179	Open Manhole	1500
E18.004	o	450	E5	80.500	77.231	2.819	Open Manhole	1500

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)
E18.000	122.700	500.8	E2	81.000	77.755	2.045	Open Manhole	2100
E18.001	109.100	500.5	E3	81.000	77.537	2.263	Open Manhole	47725
E18.002	83.000	500.0	E4	81.000	77.371	2.429	Open Manhole	1500
E18.003	55.800	398.6	E5	80.500	77.231	2.819	Open Manhole	1500
E18.004	42.100	401.0	E	80.000	77.126	2.424	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E18.004	E	80.000	77.126	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E4, DS/PN: E18.003, Volume (m³): 3299.5

Unit Reference	MD-SHE-0195-1970-1200-1970
Design Head (m)	1.200
Design Flow (l/s)	19.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	77.371
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	19.7	Kick-Flo®	0.827	16.5
Flush-Flo™	0.378	19.7	Mean Flow over Head Range	-	16.8

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	6.8	0.800	17.1	2.000	25.1	4.000	35.1	7.000	45.9
0.200	18.1	1.000	18.1	2.200	26.3	4.500	37.1	7.500	47.5
0.300	19.5	1.200	19.7	2.400	27.4	5.000	39.0	8.000	49.0
0.400	19.7	1.400	21.2	2.600	28.5	5.500	40.9	8.500	50.5
0.500	19.4	1.600	22.6	3.000	30.5	6.000	42.6	9.000	51.9
0.600	19.1	1.800	23.9	3.500	32.9	6.500	44.3	9.500	53.3

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E18.000	E1	15 Winter	1	+0%	100/15 Summer				78.315	-0.885
E18.001	E2	15 Winter	1	+0%	100/15 Summer				78.151	-0.804
E18.002	E3	480 Winter	1	+0%					77.652	-1.085
E18.003	E4	480 Winter	1	+0%	30/120 Winter				77.652	-0.169
E18.004	E5	480 Winter	1	+0%					77.340	-0.341

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E18.000	E1	0.000	0.14		228.1	OK	
E18.001	E2	0.000	0.24		390.0	OK	
E18.002	E3	0.000	0.00		59.4	OK	
E18.003	E4	0.000	0.13		19.4	OK	
E18.004	E5	0.000	0.14		19.4	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E18.000	E1	15 Winter	30	+0%	100/15 Summer				78.654	-0.546
E18.001	E2	15 Winter	30	+0%	100/15 Summer				78.553	-0.402
E18.002	E3	600 Winter	30	+0%					77.919	-0.818
E18.003	E4	600 Winter	30	+0%	30/120 Winter				77.918	0.097
E18.004	E5	30 Summer	30	+0%					77.341	-0.340

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E18.000	E1	0.000	0.43		710.3	OK	
E18.001	E2	0.000	0.77		1261.6	OK	
E18.002	E3	0.000	0.00		109.6	OK	
E18.003	E4	0.000	0.13		19.6	SURCHARGED	
E18.004	E5	0.000	0.14		19.7	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E18.000	E1	15 Winter	100	+40%	100/15 Summer				79.562	0.362
E18.001	E2	15 Winter	100	+40%	100/15 Summer				79.318	0.363
E18.002	E3	960 Winter	100	+40%					78.375	-0.362
E18.003	E4	960 Winter	100	+40%	30/120 Winter				78.374	0.553
E18.004	E5	960 Summer	100	+40%					77.341	-0.340

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E18.000	E1	0.000	0.89		1480.9	SURCHARGED	
E18.001	E2	0.000	1.63		2671.0	SURCHARGED	
E18.002	E3	0.000	0.00		135.4	OK	
E18.003	E4	0.000	0.13		19.6	SURCHARGED	
E18.004	E5	0.000	0.14		19.6	OK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E18.000	E1	15 Winter	200	+40%	100/15 Summer				80.092	0.892
E18.001	E2	15 Winter	200	+40%	100/15 Summer				79.704	0.749
E18.002	E3	960 Winter	200	+40%					78.548	-0.189
E18.003	E4	960 Winter	200	+40%	30/120 Winter				78.546	0.725
E18.004	E5	1440 Summer	200	+40%					77.341	-0.340

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E18.000	E1	0.000	1.13		1879.6	SURCHARGED	
E18.001	E2	0.000	2.06		3362.4	SURCHARGED	
E18.002	E3	0.000	0.00		156.2	OK	
E18.003	E4	0.000	0.13		19.6	SURCHARGED	
E18.004	E5	0.000	0.14		19.6	OK	

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E4.000	179.100	0.895	200.1	0.433	4.00	0.0	0.600	o	1800	Pipe/Conduit
E4.001	13.400	0.190	70.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E4.000	86.285	0.433	0.0	3.39	8615.4
E4.001	85.390	0.433	0.0	2.42	385.4

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E4.000	o	1800	E1	89.285	86.285	1.200	Open Manhole	2100
E4.001	o	450	E2	88.390	85.390	2.550	Open Manhole	2100

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)
E4.000	179.100	200.1	E2	88.390	85.390	1.200	Open Manhole	2100
E4.001	13.400	70.5	E	87.790	85.200	2.140	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
4.000	-	-	100	0.433	0.433	0.433
4.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.433	0.433	0.433

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E2, DS/PN: E4.001, Volume (m^3): 460.8

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	85.390
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.000	2.0	Kick-Flo®	0.506	1.1
Flush-Flo™	0.247	1.3	Mean Flow over Head Range	-	1.5

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.2	0.800	1.3	2.000	2.0	4.000	2.7	7.000	3.6
0.200	1.3	1.000	1.5	2.200	2.1	4.500	2.9	7.500	3.7
0.300	1.3	1.200	1.6	2.400	2.2	5.000	3.0	8.000	3.8
0.400	1.3	1.400	1.7	2.600	2.3	5.500	3.2	8.500	3.9
0.500	1.1	1.600	1.8	3.000	2.4	6.000	3.3	9.000	4.0
0.600	1.2	1.800	1.9	3.500	2.6	6.500	3.4	9.500	4.1

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km) 0.319	E (1km) 0.302	Cv (Winter)	0.840
Site Location		D2 (1km) 0.300	F (1km) 2.496		
C (1km)	-0.026	D3 (1km) 0.243	Cv (Summer) 0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E4.000	E1	15 Winter	1	+0%					86.359	-1.726
E4.001	E2	360 Winter	1	+0%	1/15 Summer				86.083	0.243

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E4.000	E1	0.000	0.01		60.9	OK	
E4.001	E2	0.000	0.01		1.3	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E4.000	E1	600 Winter	30	+0%					86.510	-1.575
E4.001	E2	600 Winter	30	+0%	1/15 Summer				86.510	0.670

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E4.000	E1	0.000	0.00		14.5	OK	
E4.001	E2	0.000	0.01		1.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E4.000	E1	960 Winter	100	+40%					87.106	-0.979
E4.001	E2	960 Winter	100	+40%	1/15 Summer				87.106	1.266

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E4.000	E1	0.000	0.00		18.3	OK	
E4.001	E2	0.000	0.01		1.9	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302
Cv (Winter)	0.840				
Site Location		D2 (1km)	0.300	F (1km)	2.496
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E4.000	E1	960 Winter	200	+40%					87.397	-0.688
E4.001	E2	960 Winter	200	+40%	1/15 Summer				87.397	1.557

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E4.000	E1	0.000	0.00		21.5	OK	
E4.001	E2	0.000	0.01		2.0	SURCHARGED	

Time Area Diagram for Existing

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.355	4-8	0.081

Total Area Contributing (ha) = 0.436

Total Pipe Volume (m³) = 421.512

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E5.000	164.800	2.000	82.4	0.436	4.00	0.0	0.600	o	1800	Pipe/Conduit
E5.001	13.500	0.034	397.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E5.000	84.000	0.436	0.0	5.28	13444.6
E5.001	82.000	0.436	0.0	1.01	161.3

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E5.000	o	1800	E1	87.450	84.000	1.650	Open Manhole	2700
E5.001	o	450	E2	85.200	82.000	2.750	Open Manhole	2700

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)
E5.000	164.800	82.4	E2	85.200	82.000	1.400	Open Manhole	2700
E5.001	13.500	397.1	E	85.000	81.966	2.584	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
5.000	-	-	100	0.436	0.436	0.436
5.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.436	0.436	0.436

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E5.001	E	85.000	81.966	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E2, DS/PN: E5.001, Volume (m^3): 430.8

Unit Reference	MD-SHE-0052-2000-3000-2000
Design Head (m)	3.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	82.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	2.0	Kick-Flo®	0.464	0.9
Flush-Flo™	0.228	1.1	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 (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	1.0	1.000	1.2	2.200	1.7	4.500	2.4	7.500	3.1
0.300	1.0	1.200	1.3	2.400	1.8	5.000	2.5	8.000	3.2
0.400	1.0	1.400	1.4	2.600	1.9	5.500	2.6	8.500	3.2
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.3
0.600	1.0	1.800	1.6	3.500	2.1	6.500	2.9	9.500	3.4

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E5.000	E1	15 Winter	1	+0%					84.048	-1.752
E5.001	E2	480 Winter	1	+0%	1/15 Summer				83.011	0.561

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E5.000	E1	0.000	0.01		64.1	OK	
E5.001	E2	0.000	0.01		1.2	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E5.000	E1	15 Winter	30	+0%					84.152	-1.648
E5.001	E2	720 Winter	30	+0%	1/15 Summer				83.663	1.213

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E5.000	E1	0.000	0.02		201.3	OK	
E5.001	E2	0.000	0.01		1.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E5.000	E1	960 Winter	100	+40%					84.568	-1.232
E5.001	E2	960 Winter	100	+40%	1/15 Summer				84.568	2.118

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E5.000	E1	0.000	0.00		18.8	OK	
E5.001	E2	0.000	0.02		1.9	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E5.000	E1	960 Winter	200	+40%					85.125	-0.675
E5.001	E2	960 Winter	200	+40%	1/15 Summer				85.125	2.675

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E5.000	E1	0.000	0.00		22.0	OK	
E5.001	E2	0.000	0.02		2.0	FLOOD RISK	

Summary of Results for 200 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.136	0.536	20.4	2412.8	O K
30 min Summer	8.206	0.606	20.4	2728.4	O K
60 min Summer	8.283	0.683	20.4	3075.4	O K
120 min Summer	8.366	0.766	20.4	3448.7	O K
180 min Summer	8.416	0.816	20.4	3672.9	O K
240 min Summer	8.451	0.851	20.4	3830.9	O K
360 min Summer	8.498	0.898	20.4	4041.8	O K
480 min Summer	8.528	0.928	20.4	4175.1	O K
600 min Summer	8.547	0.947	20.4	4263.1	O K
720 min Summer	8.560	0.960	20.4	4321.9	O K
960 min Summer	8.568	0.968	20.4	4355.3	O K
1440 min Summer	8.557	0.957	20.4	4305.6	O K
2160 min Summer	8.517	0.917	20.4	4126.7	O K
2880 min Summer	8.479	0.879	20.4	3955.9	O K
4320 min Summer	8.373	0.773	20.4	3480.4	O K
5760 min Summer	8.283	0.683	20.4	3073.0	O K
7200 min Summer	8.205	0.605	20.4	2720.8	O K
8640 min Summer	8.136	0.536	20.4	2409.8	O K
10080 min Summer	8.075	0.475	20.4	2135.9	O K
15 min Winter	8.201	0.601	20.4	2704.8	O K
30 min Winter	8.280	0.680	20.4	3059.9	O K
60 min Winter	8.367	0.767	20.4	3451.5	O K
120 min Winter	8.461	0.861	20.4	3875.3	O K
180 min Winter	8.518	0.918	20.4	4130.2	O K
240 min Winter	8.558	0.958	20.4	4309.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	261.584	0.0	1694.3	31
30 min Summer	148.306	0.0	1721.1	45
60 min Summer	84.083	0.0	2798.7	74
120 min Summer	47.672	0.0	3093.2	134
180 min Summer	34.205	0.0	3220.8	194
240 min Summer	27.028	0.0	3255.6	252
360 min Summer	19.393	0.0	3207.1	372
480 min Summer	15.323	0.0	3146.1	490
600 min Summer	12.765	0.0	3090.0	610
720 min Summer	10.995	0.0	3038.5	728
960 min Summer	8.640	0.0	2945.8	966
1440 min Summer	6.152	0.0	2777.3	1442
2160 min Summer	4.380	0.0	5502.0	1864
2880 min Summer	3.442	0.0	5588.4	2232
4320 min Summer	2.395	0.0	5328.2	2948
5760 min Summer	1.852	0.0	6543.4	3704
7200 min Summer	1.516	0.0	6689.8	4480
8640 min Summer	1.288	0.0	6799.3	5272
10080 min Summer	1.122	0.0	6859.8	5960
15 min Winter	261.584	0.0	1727.9	31
30 min Winter	148.306	0.0	1714.7	45
60 min Winter	84.083	0.0	3073.1	74
120 min Winter	47.672	0.0	3275.9	132
180 min Winter	34.205	0.0	3270.7	190
240 min Winter	27.028	0.0	3234.2	248

Summary of Results for 200 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	8.611	1.011	20.4	4550.8	O K
480 min Winter	8.646	1.046	20.4	4706.4	O K
600 min Winter	8.669	1.069	20.4	4812.0	O K
720 min Winter	8.686	1.086	20.4	4884.9	O K
960 min Winter	8.697	1.097	20.4	4937.4	O K
1440 min Winter	8.692	1.092	20.4	4914.3	O K
2160 min Winter	8.652	1.052	20.4	4734.2	O K
2880 min Winter	8.601	1.001	20.4	4505.2	O K
4320 min Winter	8.478	0.878	20.4	3952.3	O K
5760 min Winter	8.346	0.746	20.4	3359.0	O K
7200 min Winter	8.230	0.630	20.4	2834.8	O K
8640 min Winter	8.129	0.529	20.4	2379.6	O K
10080 min Winter	8.042	0.442	20.4	1986.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	19.393	0.0	3171.0	366
480 min Winter	15.323	0.0	3120.0	482
600 min Winter	12.765	0.0	3076.8	598
720 min Winter	10.995	0.0	3038.5	714
960 min Winter	8.640	0.0	2968.7	946
1440 min Winter	6.152	0.0	2843.9	1398
2160 min Winter	4.380	0.0	5967.8	2040
2880 min Winter	3.442	0.0	5836.6	2336
4320 min Winter	2.395	0.0	5324.4	3244
5760 min Winter	1.852	0.0	7329.6	4088
7200 min Winter	1.516	0.0	7494.9	4840
8640 min Winter	1.288	0.0	7624.2	5624
10080 min Winter	1.122	0.0	7703.8	6352

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	200	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 4.969

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.242	4	8	1.242	8	12	1.242	12	16	1.243

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 7.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4500.0	1.200	4500.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	4500.0	1.400	0.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	4500.0	1.600	0.0	2.800	0.0	4.000	0.0		
0.600	4500.0	1.800	0.0	3.000	0.0	4.200	0.0		
0.800	4500.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	4500.0	2.200	0.0	3.400	0.0	4.600	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0198-2040-1200-2040
Design Head (m)	1.200
Design Flow (l/s)	20.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	198
Invert Level (m)	7.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	20.4	Kick-Flo®	0.831	17.1
Flush-Flo™	0.380	20.4	Mean Flow over Head Range	-	17.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	0.800	17.8	2.000	26.0	4.000	36.3	7.000	47.6
0.200	18.6	1.000	18.7	2.200	27.2	4.500	38.5	7.500	49.2
0.300	20.2	1.200	20.4	2.400	28.4	5.000	40.5	8.000	50.8
0.400	20.4	1.400	22.0	2.600	29.5	5.500	42.4	8.500	52.3
0.500	20.2	1.600	23.4	3.000	31.6	6.000	44.2	9.000	53.8
0.600	19.8	1.800	24.8	3.500	34.1	6.500	45.9	9.500	55.2

Time Area Diagram for Existing

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.000	4-8	2.403	8-12	2.475

Total Area Contributing (ha) = 4.878

Total Pipe Volume (m^3) = 7441.067

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E17.000	624.000	1.248	500.0	4.878	4.00	0.0	0.600	o	1800	Pipe/Conduit
E17.001	125.000	0.250	500.0	0.000	0.00	0.0	0.600	[]	-7	Pipe/Conduit
E17.002	20.000	0.050	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E17.000	89.500	4.878	0.0	2.14	5438.4
E17.001	88.252	4.878	0.0	2.50	116999.4
E17.002	88.002	4.878	0.0	1.01	160.7

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-7	[]	39000	1200	90.0		2.328	46.800

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E17.000	o	1800	E1	92.100	89.500	0.800	Open Manhole	2700
E17.001	[]	-7	E2	92.100	88.252	2.648	Open Manhole	39725
E17.002	o	450	E3	92.100	88.002	3.648	Open Manhole	1500

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)
E17.000	624.000	500.0	E2	92.100	88.252	2.048	Open Manhole	39725
E17.001	125.000	500.0	E3	92.100	88.002	2.898	Open Manhole	1500
E17.002	20.000	400.0	E	91.200	87.952	2.798	Open Manhole	0

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E17.002	E	91.200	87.952	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E3, DS/PN: E17.002, Volume (m^3): 4892.6

Unit Reference	MD-SHE-0196-2000-1200-2000
Design Head (m)	1.200
Design Flow (l/s)	20.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	196
Invert Level (m)	88.002
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	20.0	Kick-Flo®	0.827	16.8
Flush-Flo™	0.376	20.0	Mean Flow over Head Range	-	17.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	0.800	17.4	2.000	25.5	4.000	35.6	7.000	46.7
0.200	18.3	1.000	18.3	2.200	26.7	4.500	37.7	7.500	48.2
0.300	19.8	1.200	20.0	2.400	27.8	5.000	39.6	8.000	49.8
0.400	20.0	1.400	21.5	2.600	28.9	5.500	41.5	8.500	51.3
0.500	19.7	1.600	22.9	3.000	31.0	6.000	43.3	9.000	52.7
0.600	19.4	1.800	24.3	3.500	33.4	6.500	45.0	9.500	54.1

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E17.000	E1	15 Winter	1	+0%	200/15 Summer				89.947	-1.353
E17.001	E2	600 Winter	1	+0%					88.276	-1.176
E17.002	E3	600 Winter	1	+0%	30/180 Winter				88.277	-0.175

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E17.000	E1	0.000	0.14		731.2	OK	
E17.001	E2	0.000	0.00		71.5	OK	
E17.002	E3	0.000	0.15		19.5	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E17.000	E1	15 Winter	30	+0%	200/15 Summer				90.336	-0.964
E17.001	E2	600 Winter	30	+0%					88.497	-0.955
E17.002	E3	600 Winter	30	+0%	30/180 Winter				88.496	0.044

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E17.000	E1	0.000	0.44		2298.3	OK	
E17.001	E2	0.000	0.00		130.1	OK	
E17.002	E3	0.000	0.15		20.0	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E17.000	E1	15 Winter	100	+40%	200/15 Summer				90.868	-0.432
E17.001	E2	960 Winter	100	+40%					88.878	-0.574
E17.002	E3	960 Winter	100	+40%	30/180 Winter				88.877	0.425

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E17.000	E1	0.000	0.93		4853.7	OK	
E17.001	E2	0.000	0.00		163.1	OK	
E17.002	E3	0.000	0.15		20.0	SURCHARGED	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
E17.000	E1	15 Winter	200	+40%	200/15 Summer				91.691	0.391
E17.001	E2	960 Winter	200	+40%					89.019	-0.433
E17.002	E3	960 Winter	200	+40%	30/180 Winter				89.018	0.566

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E17.000	E1	0.000	1.06		5521.0	SURCHARGED	
E17.001	E2	0.000	0.00		188.6	OK	
E17.002	E3	0.000	0.15		20.0	SURCHARGED	

Summary of Results for 200 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.181	0.581	9.3	1103.2	O K
30 min Summer	8.257	0.657	9.3	1247.6	O K
60 min Summer	8.340	0.740	9.3	1406.2	O K
120 min Summer	8.430	0.830	9.3	1576.6	O K
180 min Summer	8.483	0.883	9.3	1677.5	O K
240 min Summer	8.520	0.920	9.3	1747.3	O K
360 min Summer	8.568	0.968	9.3	1839.2	O K
480 min Summer	8.598	0.998	9.3	1896.0	O K
600 min Summer	8.617	1.017	9.3	1932.4	O K
720 min Summer	8.629	1.029	9.3	1955.6	O K
960 min Summer	8.634	1.034	9.3	1964.2	O K
1440 min Summer	8.616	1.016	9.3	1929.6	O K
2160 min Summer	8.567	0.967	9.3	1837.4	O K
2880 min Summer	8.523	0.923	9.3	1753.3	O K
4320 min Summer	8.414	0.814	9.3	1546.2	O K
5760 min Summer	8.307	0.707	9.3	1343.7	O K
7200 min Summer	8.217	0.617	9.3	1172.2	O K
8640 min Summer	8.140	0.540	9.3	1025.7	O K
10080 min Summer	8.072	0.472	9.3	897.2	O K
15 min Winter	8.251	0.651	9.3	1236.9	O K
30 min Winter	8.337	0.737	9.3	1399.5	O K
60 min Winter	8.431	0.831	9.3	1578.6	O K
120 min Winter	8.532	0.932	9.3	1770.4	O K
180 min Winter	8.592	0.992	9.3	1885.0	O K
240 min Winter	8.634	1.034	9.3	1965.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	261.584	0.0	782.4	31
30 min Summer	148.306	0.0	777.7	45
60 min Summer	84.083	0.0	1329.0	76
120 min Summer	47.672	0.0	1446.4	134
180 min Summer	34.205	0.0	1469.6	194
240 min Summer	27.028	0.0	1459.7	252
360 min Summer	19.393	0.0	1435.5	372
480 min Summer	15.323	0.0	1413.4	490
600 min Summer	12.765	0.0	1393.7	608
720 min Summer	10.995	0.0	1376.0	728
960 min Summer	8.640	0.0	1343.8	966
1440 min Summer	6.152	0.0	1285.3	1442
2160 min Summer	4.380	0.0	2575.0	1844
2880 min Summer	3.442	0.0	2610.2	2224
4320 min Summer	2.395	0.0	2400.8	2996
5760 min Summer	1.852	0.0	3011.8	3752
7200 min Summer	1.516	0.0	3081.5	4536
8640 min Summer	1.288	0.0	3136.3	5272
10080 min Summer	1.122	0.0	3173.2	5960
15 min Winter	261.584	0.0	781.6	31
30 min Winter	148.306	0.0	761.3	45
60 min Winter	84.083	0.0	1440.8	74
120 min Winter	47.672	0.0	1475.8	132
180 min Winter	34.205	0.0	1461.4	190
240 min Winter	27.028	0.0	1447.7	248

Summary of Results for 200 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	8.691	1.091	9.3	2072.2	O K
480 min Winter	8.726	1.126	9.3	2140.1	O K
600 min Winter	8.750	1.150	9.3	2185.3	O K
720 min Winter	8.766	1.166	9.3	2215.5	O K
960 min Winter	8.776	1.176	9.3	2233.7	O K
1440 min Winter	8.765	1.165	9.3	2212.7	O K
2160 min Winter	8.715	1.115	9.3	2117.8	O K
2880 min Winter	8.657	1.057	9.3	2007.9	O K
4320 min Winter	8.522	0.922	9.3	1751.3	O K
5760 min Winter	8.389	0.789	9.3	1499.5	O K
7200 min Winter	8.248	0.648	9.3	1230.7	O K
8640 min Winter	8.133	0.533	9.3	1012.1	O K
10080 min Winter	8.036	0.436	9.3	828.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	19.393	0.0	1426.6	366
480 min Winter	15.323	0.0	1411.0	482
600 min Winter	12.765	0.0	1398.3	598
720 min Winter	10.995	0.0	1387.5	714
960 min Winter	8.640	0.0	1367.8	944
1440 min Winter	6.152	0.0	1339.7	1396
2160 min Winter	4.380	0.0	2775.4	2032
2880 min Winter	3.442	0.0	2696.7	2312
4320 min Winter	2.395	0.0	2461.6	3240
5760 min Winter	1.852	0.0	3372.7	4160
7200 min Winter	1.516	0.0	3451.5	4904
8640 min Winter	1.288	0.0	3514.8	5624
10080 min Winter	1.122	0.0	3560.1	6352

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.243	Cv (Winter)	0.840
Return Period (years)	200	E (1km)	0.302	Shortest Storm (mins)	15
Site Location		F (1km)	2.496	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.319	Winter Storms	Yes		
D2 (1km)	0.300	Cv (Summer)	0.750		

Time Area Diagram

Total Area (ha) 2.273

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.568	4	8	0.568	8	12	0.568	12	16	0.569

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 7.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1900.0	1.200	1900.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	1900.0	1.400	0.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	1900.0	1.600	0.0	2.800	0.0	4.000	0.0		
0.600	1900.0	1.800	0.0	3.000	0.0	4.200	0.0		
0.800	1900.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	1900.0	2.200	0.0	3.400	0.0	4.600	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0138-9300-1200-9300
Design Head (m)	1.200
Design Flow (l/s)	9.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	138
Invert Level (m)	7.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	9.3	Kick-Flo®	0.773	7.6
Flush-Flo™	0.356	9.3	Mean Flow over Head Range	-	8.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	0.800	7.7	2.000	11.8	4.000	16.5	7.000	21.5
0.200	8.8	1.000	8.5	2.200	12.4	4.500	17.4	7.500	22.2
0.300	9.2	1.200	9.3	2.400	12.9	5.000	18.3	8.000	22.9
0.400	9.3	1.400	10.0	2.600	13.4	5.500	19.2	8.500	23.6
0.500	9.1	1.600	10.6	3.000	14.3	6.000	20.0	9.000	24.3
0.600	8.9	1.800	11.3	3.500	15.4	6.500	20.8	9.500	24.9

Time Area Diagram for Existing

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.227	4-8	0.145

Total Area Contributing (ha) = 0.372

Total Pipe Volume (m^3) = 426.833

Existing Network Details for Existing

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
E30.000	99.200	0.198	501.0	0.186	4.00	0.0	0.600	o	600	Pipe/Conduit
E30.001	21.700	0.024	904.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
E30.002	18.000	0.020	900.0	0.186	0.00	0.0	0.600	[]	-13	Pipe/Conduit
E30.003	24.200	0.060	403.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
E30.000	76.922	0.186	0.0	1.08	305.7
E30.001	76.724	0.186	0.0	0.80	226.7
E30.002	76.700	0.372	0.0	1.82	39350.5
E30.003	76.680	0.372	0.0	1.01	160.0

Conduit Sections for Existing

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-13	[]	18000	1200	90.0		2.250	21.600

PIPELINE SCHEDULES for Existing

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
E30.000	o	600	E1	78.800	76.922	1.278	Open Manhole	1500
E30.001	o	600	E2	78.000	76.724	0.676	Open Manhole	1500
E30.002	[]	-13	E3	78.000	76.700	0.100	Open Manhole	18725
E30.003	o	450	E4	78.000	76.680	0.870	Open Manhole	1500

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)
E30.000	99.200	501.0	E2	78.000	76.724	0.676	Open Manhole	1500
E30.001	21.700	904.2	E3	78.000	76.700	0.700	Open Manhole	18725
E30.002	18.000	900.0	E4	78.000	76.680	0.120	Open Manhole	1500
E30.003	24.200	403.3	E	78.000	76.620	0.930	Open Manhole	0

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
30.000	-	-	100	0.186	0.186	0.186
30.001	-	-	100	0.000	0.000	0.000
30.002	-	-	100	0.186	0.186	0.186
30.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.372	0.372	0.372

Free Flowing Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
E30.003	E	78.000	76.620	0.000	0	0

Simulation Criteria for Existing

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.300	Winter Storms	No
Return Period (years)	2	D3 (1km)	0.243	Cv (Summer)	0.750
Site Location		E (1km)	0.302	Cv (Winter)	0.840
C (1km)	-0.026	F (1km)	2.496	Storm Duration (mins)	30
D1 (1km)	0.319	Summer Storms	Yes		

Online Controls for Existing

Hydro-Brake Optimum® Manhole: E4, DS/PN: E30.003, Volume (m^3): 172.7

Unit Reference	MD-SHE-0064-2000-1200-2000
Design Head (m)	1.200
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	64
Invert Level (m)	76.680
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.0	Kick-Flo®	0.573	1.4
Flush-Flo™	0.282	1.8	Mean Flow over Head Range	-	1.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.5	0.800	1.7	2.000	2.5	4.000	3.5	7.000	4.5
0.200	1.7	1.000	1.8	2.200	2.6	4.500	3.7	7.500	4.7
0.300	1.8	1.200	2.0	2.400	2.7	5.000	3.9	8.000	4.8
0.400	1.7	1.400	2.1	2.600	2.8	5.500	4.0	8.500	5.0
0.500	1.6	1.600	2.3	3.000	3.0	6.000	4.2	9.000	5.1
0.600	1.5	1.800	2.4	3.500	3.3	6.500	4.4	9.500	5.2

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.319	E (1km)	0.302	Cv (Winter)	0.840
Site Location		D2 (1km)	0.300	F (1km)	2.496		
C (1km)	-0.026	D3 (1km)	0.243	Cv (Summer)	0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E30.000	E1	2880 Summer	1	+0%	1/2880 Summer				77.531
E30.001	E2	2880 Summer	1	+0%	1/2880 Summer				77.531
E30.002	E3	2880 Summer	1	+0%					77.531
E30.003	E4	2880 Summer	1	+0%	1/2160 Winter	1/2160 Winter			77.531

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E30.000	E1	0.009	0.000	0.00		1.3	SURCHARGED	
E30.001	E2	0.207	0.000	0.02		2.5	SURCHARGED	
E30.002	E3	-0.369	0.000	0.00		24.6	OK	
E30.003	E4	0.401	28.511	0.01		1.8	FLOOD	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km) 0.319	E (1km) 0.302	Cv (Winter)	0.840
Site Location		D2 (1km) 0.300	F (1km) 2.496		
C (1km)	-0.026	D3 (1km) 0.243	Cv (Summer) 0.750		

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	1, 30, 100, 200
Climate Change (%)	0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E30.000	E1	2880 Winter	30	+0%	1/2880 Summer				77.492
E30.001	E2	2880 Winter	30	+0%	1/2880 Summer				77.492
E30.002	E3	2880 Winter	30	+0%					77.492
E30.003	E4	2880 Winter	30	+0%	1/2160 Winter	1/2160 Winter			77.492

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E30.000	E1	-0.030	0.000	0.01		1.8	OK	
E30.001	E2	0.168	0.000	0.02		2.6	SURCHARGED	
E30.002	E3	-0.408	0.000	0.00		24.3	OK	
E30.003	E4	0.362	0.000	0.01		1.8	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	**US/MH Name**	**Storm**	**Return Period**	**Climate Change**	**First (X) Surcharge**	**First (Y) Flood**	**First (Z) Overflow**	**Overflow Act.**	**Water Level (m)**
E30.000	E1	2160 Winter	100	+40%	1/2880 Summer				77.802
E30.001	E2	2160 Winter	100	+40%	1/2880 Summer				77.802
E30.002	E3	2160 Winter	100	+40%					77.802
E30.003	E4	2160 Winter	100	+40%	1/2160 Winter	1/2160 Winter			77.802

PN	**US/MH Name**	**Surcharged Depth (m)**	**Flooded Volume (m³)**	**Flow / Cap.**	**Overflow (l/s)**	**Pipe Flow (l/s)**	**Status**	**Level Exceeded**
E30.000	E1	0.280	0.000	0.01		4.1	SURCHARGED	
E30.001	E2	0.478	0.000	0.03		4.0	FLOOD RISK	
E30.002	E3	-0.098	0.000	0.00		6.3	FLOOD RISK	
E30.003	E4	0.672	0.000	0.01		1.9	FLOOD RISK	

200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.319 E (1km) 0.302 Cv (Winter) 0.840
Site Location D2 (1km) 0.300 F (1km) 2.496
C (1km) -0.026 D3 (1km) 0.243 Cv (Summer) 0.750

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years) 1, 30, 100, 200
Climate Change (%) 0, 0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
E30.000	E1	4320 Winter	200	+40%	1/2880 Summer				77.755
E30.001	E2	4320 Winter	200	+40%	1/2880 Summer				77.755
E30.002	E3	4320 Winter	200	+40%					77.755
E30.003	E4	4320 Winter	200	+40%	1/2160 Winter	1/2160 Winter			77.754

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
E30.000	E1	0.233	0.000	0.01		2.7	SURCHARGED	
E30.001	E2	0.431	0.000	0.02		2.6	FLOOD RISK	
E30.002	E3	-0.145	0.000	0.00		14.2	FLOOD RISK	
E30.003	E4	0.624	0.000	0.01		1.9	FLOOD RISK	

Pre-Planning Assessment Report

Towcester Road, Blisworth

Section 1: Proposed Development

Thank you for submitting a pre-planning enquiry. This has been produced for Hydrock. Your reference number is **00019009**. If you have any questions upon receipt of this report, please contact Mark Rhodes on 01733 414690 or email planningliaison@anglianwater.co.uk.

The response within this report has been based on the following information which was submitted as part of your application:

List of Planned Developments	
Type of Development	No. Of Units
B8 Storage or Dist.	13

- The grid reference for the site is SP7306754825.
- The site currently does not have planning permission and is located on a greenfield site.

Section 2: Assets Affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below. Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair and this should be taken into consideration when planning your site layout.

Water and Used Water Easement Information		
Asset Type	Pipe Size (mm)	Total Easement Required (m)
Public Foul Sewer	300	3.0 m either side of the centre line
Water Mains	125	2.25 m either side of the centre line
Water Mains	90	2.25 m either side of the centre line

If it is not possible to avoid our assets then the water main/sewer may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). We have a duty to divert our sewerage infrastructure if requested to do so although this would be at your expense. You will need to make a formal application if you would like a diversion to be considered. A copy of the section 185 diversion application form can be found at www.anglianwater.co.uk/developers

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3: Water Recycling Services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and influent quality arising from your development.

Water Recycling Centre

The foul drainage from this development is in the catchment of Great Billing Water Recycling Centre, which currently does not have capacity to treat the flows from your development site. Anglian Water are obligated to accept the foul flows from your development with the benefit of planning consent and would therefore take the necessary steps to ensure that there is sufficient treatment capacity should the planning authority grant planning permission.

Used Water Network

Anglian Water has assessed your proposals and a desktop study has indicated that a direct connection to the public foul sewerage system is likely to have a detrimental effect on the existing sewerage network. Therefore further hydraulic modelling work is required to enable Anglian Water to provide you with a solution for draining the foul flows from the proposed development. There is no additional charge for this work.

Max Shone, our Senior Growth Planning Engineer for this area, will be responsible for undertaking this additional work. Max will contact you shortly to discuss the timescales and to obtain any further information required. For your reference, Max can be contacted on 07712876139 or at mshone@anglianwater.co.uk.

If this modelling work confirms your development will have a detrimental effect on the existing sewerage network, the drainage strategy will be detailed within the pre-planning addendum report. This will be issued to you under separate cover within the timescales advised by Max. This will include a no detriment foul drainage solution which will encompass a connection point, details of any upgrades or work required and indicative budgetary costs.

If an alternative drainage solution is required following the work undertaken for the pre-planning addendum report, any additional hydraulic modelling work will be at the cost of the developer. A cost and timescale is available upon request.

Please note that Anglian Water will request a suitably worded condition at planning application stage to ensure the strategy is implemented to mitigate the risk of flooding.

Surface Water Disposal

There are no public surface water sewers within the vicinity of the proposed development. Therefore Anglian Water will be unable to provide the site with a feasible solution of surface water disposal within the current assets. Alternative methods of surface water disposal will need to be investigated such as infiltration techniques or a discharge to a watercourse in accordance with the surface water management hierarchy as outlined in Building Regulations Part H.

The alternative is that a new surface water sewer is constructed which is used to convey your surface water to a watercourse or as part of a SuDs scheme, where appropriate. Subject to the sewer being designed in accordance with the current version of Sewers For Adoption, the sewer can be put forward for adoption by Anglian Water under Section 104 of the Water Industry Act 1991. If the outfall is to a watercourse, the applicant will be required to obtain consent to discharge via the appropriate body.

If your site has no means of drainage due to third party land then you may be able to requisition Anglian Water, under Section 98, to provide a connection to the public sewer for domestic drainage purposes. As part of this option, you may wish to enter into a works agreement in accordance with Section 30 of the Anglian Water Authority Act 1977. This will allow you to design and construct the public sewer using Anglian Waters' statutory powers in accordance with Section 159/168 of the Water Industry Act 1991.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our website at http://www.anglianwater.co.uk/developers/suds.aspx. We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating than the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our website at: http://www.anglianwater.co.uk/developers/suds.aspx

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

It has been assumed that the onsite used water network will be provided under a section

104 Water Industry Act application. It is recommended that you also budget for both infrastructure charges and connection costs. The 2016/17 charges are:

Infrastructure Charge	£354.00 per connection

Please note that we offer alternative types of connections depending on your needs and these costs are available in our annual charges booklet, which can be downloaded from www.anglianwater.co.uk/developers/charges.

Section 4: Useful Information

Water

Water Industry Act – Key Water Sections:

- Section 41: This provides you with the right to requisition a new water main for domestic purposes to connect your site to the public water network.
- Section 45: This provides you with the right to have a connection for domestic purposes from a building or part of a building to the public water main.
- Section 51A: This provides you with the right to provide the water main or service connection yourself and for us to vest them into our company.
- Section 55: This applies where you request a supply of water for non domestic premises.
- Section 185: This provides you with the right to make a reasonable request to have a public water main, sewer or public lateral drain removed or altered, at your expense. Details on how to make an application and the s185 form is available on our website at http://www.anglianwater.co.uk20/developers or via our Developer Services team on 08457 60 66 087.

Details on how you can make a formal application for a new water main, new connection or diversion are available on from our Developer Services team on 08457 60 66 087 or via our website at www.anglianwater.co.uk/developers

If you have any other queries on the rights to requisition or connect your housing to the public water and sewerage infrastructure then please contact our developer services team at: Developer Services, Anglian Water, PO Box 495, Huntingdon, PE29 6YY or Telephone: 0845 60 66 087 or Email: developerservices@anglianwater.co.uk

Water pressure and flow rate: The water pressure and consistency that we must meet for your site is laid out in the Water Industry Act (1991). This states that we must supply a flow rate of 9 litres per minute at a pressure of 10 metres of head to the external stop tap. If your water pressure requirements exceed this then you will need to provide and maintain any booster requirements to the development site.

Self Lay of Water Mains: A list of accredited Self Lay Organisations can be found at www.lloydsregister.co.uk/schemes/WIRS/providers-list.aspx.

Used Water

Water Industry Act – Key Used Water Sections:

- Section 98: This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

- Section 102: This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.
- Section 104: This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.
- Section 106: This provides you with the right to have your constructed sewer connected to the public sewer.
- Section 185: This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website at www.anglianwater.co.uk/developers or via our Developer Services team on 08457 60 66 087.

Sustainable Drainage Systems:
Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. Therefore our preferred method of surface water disposal is through the use of Sustainable Drainage Systems (SuDS). SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website at http://www.anglianwater.co.uk/developers/suds.aspx
We also recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for the area to discuss your application.

Private Sewer Transfers: Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

- Surface water sewers and lateral drains that did not discharge to the public sewer, e.g. those that discharged to a watercourse.
- Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.
- Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

Encroachment: Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our website at http://anglianwater.co.uk/developers/encroachment.aspx

Locating our assets: Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from www.digdat.co.uk. All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge. We have more information on our website at: www.anglianwater.co.uk/developers/our-assets/

Summary of charges: A summary of this year's water and used water connection and infrastructure charges can be found at
http://www.anglianwater.co.uk/developers/charges/

Disclaimer: The information provided within this report is based on the best data currently recorded, recorded within the last 12 months or provided by a third party. The position must be regarded as approximate. If there is further development in the area or for other reasons the position may change.

The accuracy of this report is therefore not guaranteed and does not obviate the need to make additional appropriate searches, inspections and enquiries. You are advised therefore to renew your enquiry should there be a delay in submitting your application for water supply/sewer connection to re-confirm the situation.

Any cost calculations provided within the report are estimated only and may be subject to change.

The responses made in this report are based on the presumption that your proposed development obtains planning permission. Whilst this report has been prepared to help assess the viability of your proposal, it must not be considered in isolation. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework (NPPF). As a spatial planning statutory consultee, we assist planning authorities in the preparation of a sustainable local plan on the basis of capacity within our water and water recycling (formerly referred to as wastewater) infrastructure. Consequently, any infrastructure needs identified in this report must only be considered in the context of up to date, adopted or emerging local plans. Where local plans are absent, silent or out of date these needs should be considered against the definition of sustainability set out in the NPPF as a whole.

No liability whatsoever including liability for negligence is accepted by Anglian Water Services Limited for any error or inaccuracy or omission including the failure to accurately record or record at all, the location of any water main, discharge pipe, sewer, or drain or disposal main or any item of apparatus.

Drainage Impact Assessment

Project Title:

Towcester Road, Blisworth (Rail Central)

Anglian Water Services contact:

Max Shone
Senior Growth Planning Engineer
Thorpe Wood House
Thorpe Wood
Peterborough
PE3 6WT
Mobile Number: 07712876139

Our reference number: 19009
20th March 2017

1. Summary

This report has been undertaken in response to an enquiry from Hydrock to determine the impact of flows from the site at Towcester Road, Blisworth on the performance of the existing foul sewer network. It should be read in conjunction with the pre-planning report dated 5th January 2017, which indicated that a direct connection to the public foul sewer system is likely to have a detrimental effect on the existing sewerage network. Further hydraulic modelling is required to enable Anglian Water to provide a solution for draining the foul flows from the proposed development.

The analysis has been performed on the foul system only. There has been no consideration of the surface water flows as this is not within the scope of the study.

The additional foul flows from the development site comprising large commercial units employing 6,900 people working in 3 shifts (warehouse 690,000m^2) were modelled connecting to manhole reference no. SP72559501 (Grid ref: SP7295555562).

The study concludes that the development will cause detriment to the capacity of the sewer system and will result in increased flood risk downstream of the proposed connection point.

In order to mitigate the impact of the proposed development upon the network the following option is recommended:

1. Provide offline storage of 102m^3 at proposed connection point of development in green area.

The predicted total capital scheme cost for the required mitigation solution is £374,533 with an indicative developer contribution of £31,567. The predicted total embodied carbon is 52tCO_2e. The predicted water footprint is 37m^3H_2Oe.

The topography of the site indicates that a pumped regime is required at rate of 29 l/s. Due to the proximity of the site to the connection point it is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network.

The contents of this report and costs supplied are an estimate based on a solution generated by a desktop hydraulic model. These are estimated figures which are not to be relied upon without further detailed investigations.

2. Hydraulic Modelling and Solutions

The proposed development site is located at Towcester Road, Blisworth (also referred to as Rail Central) to the south-west of Northampton (see Figure 1). Foul flows from the site drain to Great Billing Water Recycling Centre (WRC) located to the east of the town. The proposed development comprises a large commercial development site employing up to 6,900 staff working across three shifts.

To enable the analysis to be performed the existing hydraulic model for Great Billing was used.

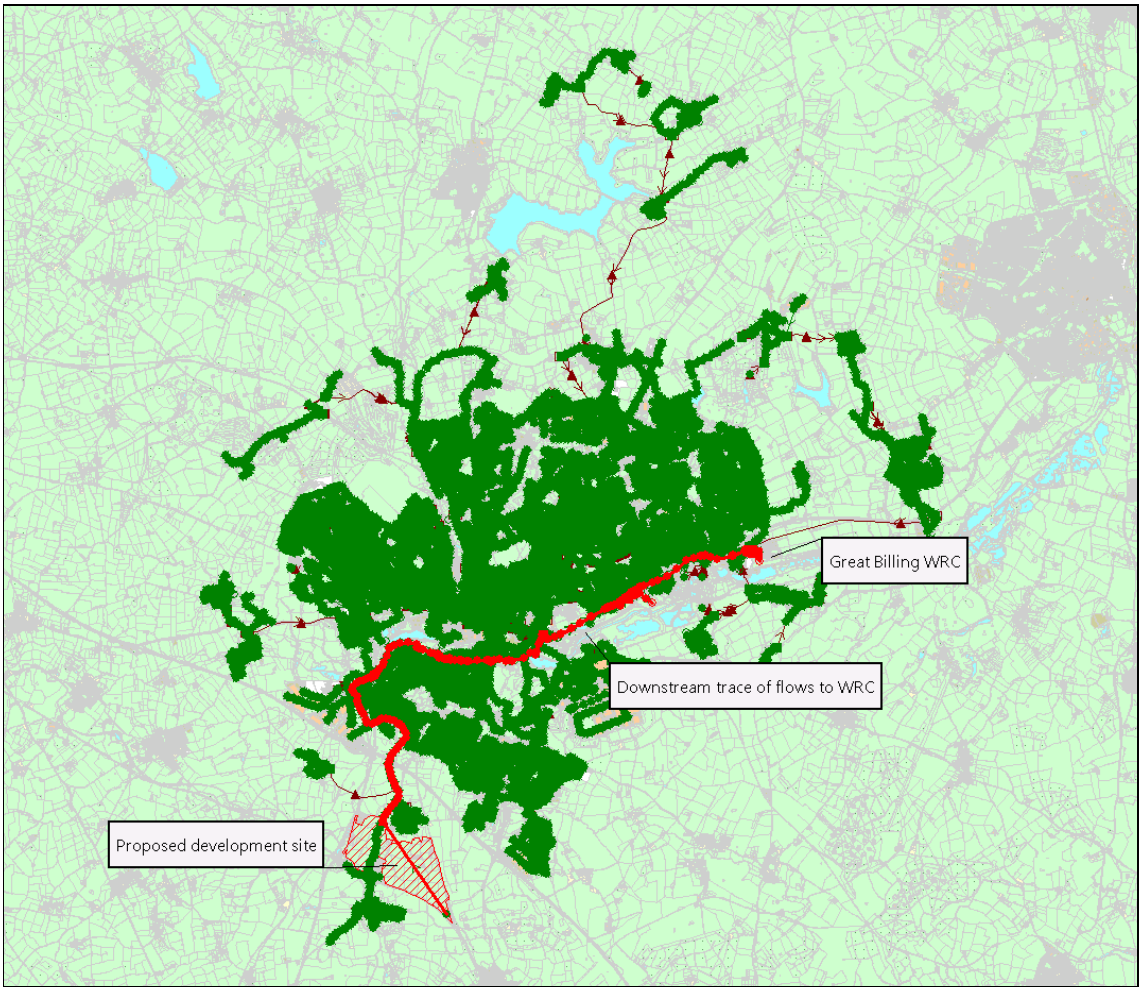

Figure 1: Showing the location of the proposed site and the downstream trace to the WRC

Proposed connection point

The proposed connection point for the development is manhole SP72559501 (Grid ref: SP7295555562) located north of the proposed development (see Figure 2 and Figure 3). The diameter of the sewer to which the proposed development will connect is 300mm. A review of the site topography indicates that a gravity connection is not feasible.

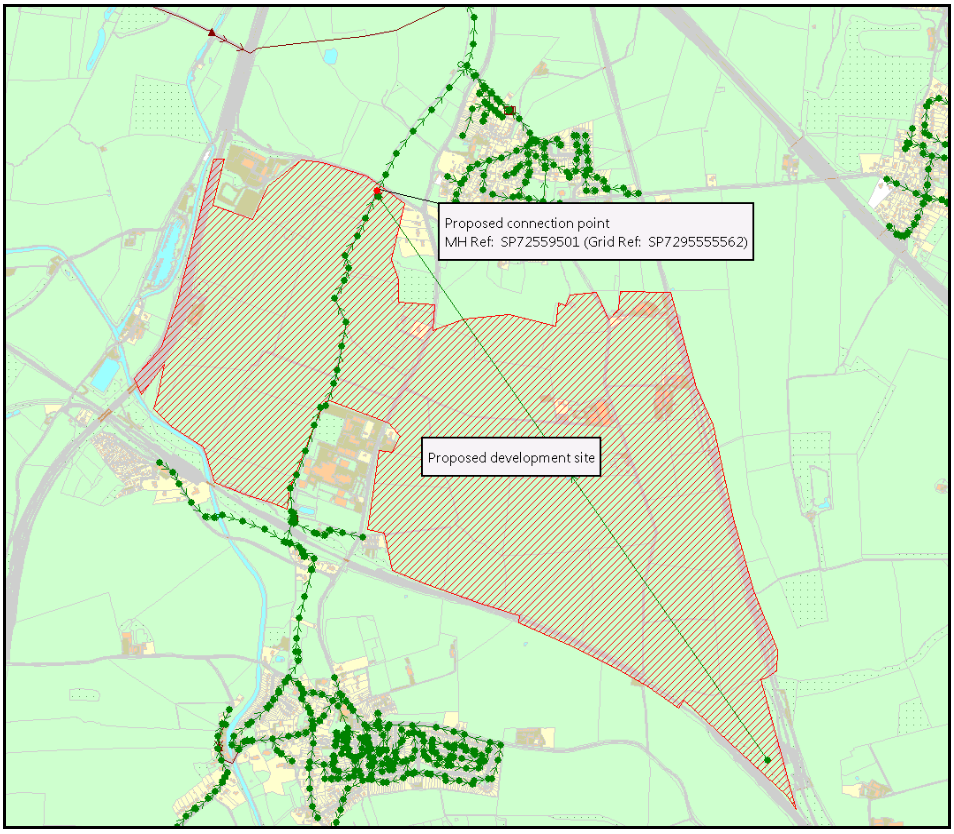

Figure 2: Showing the proposed connection point

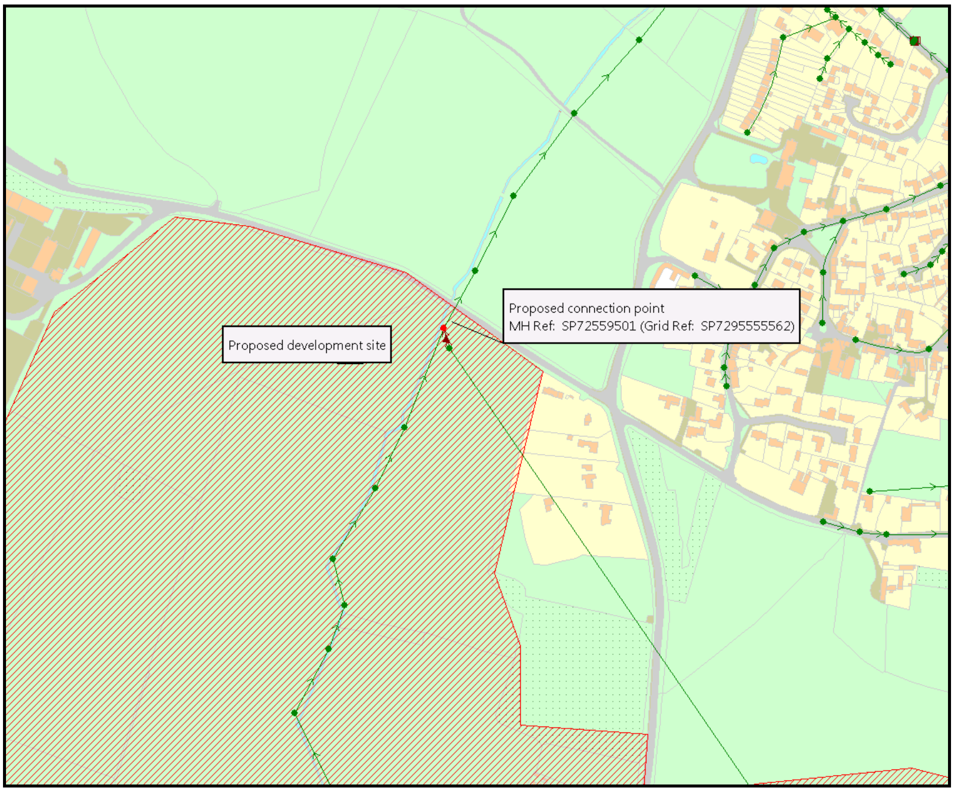

Figure 3: Showing a close-up of the connection point

Hydraulic modelling

The hydraulic model was run to determine the existing sewer performance during a 1 in 20 year critical duration storm. The model was then re-run with the estimated flows from the site connecting to manhole SP72559501, via a pumped connection.

The model predicts a significant increase in flooding at four manholes of which all are located directly downstream of the proposed development (see Figure 4). Surcharging is also predicted in the network due to the additional flows from the development (see Figure 5). There is also an increase in the spill volume at Abington overflow and the overflow at Bedford Road pumping station.

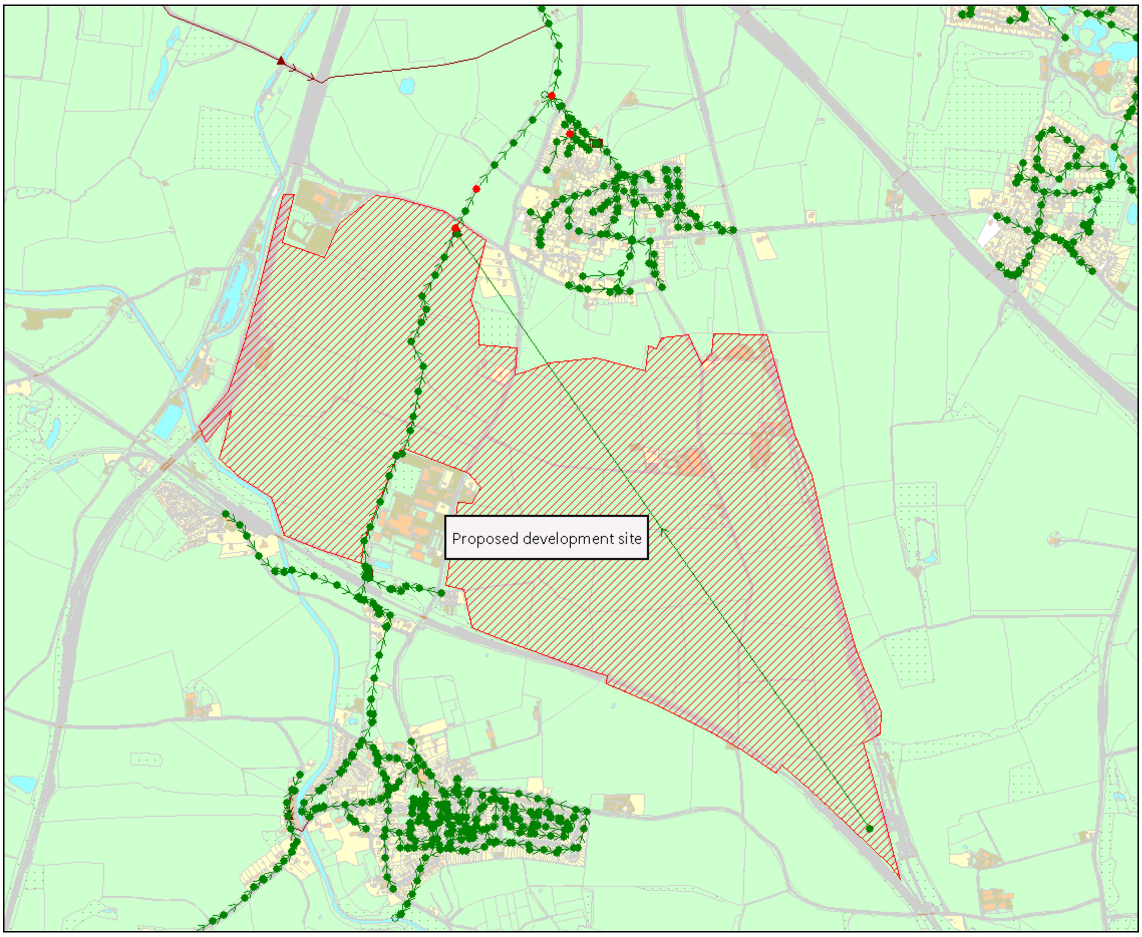

Figure 4: Showing the predicted flooding locations (in red) due to the additional flows from the development

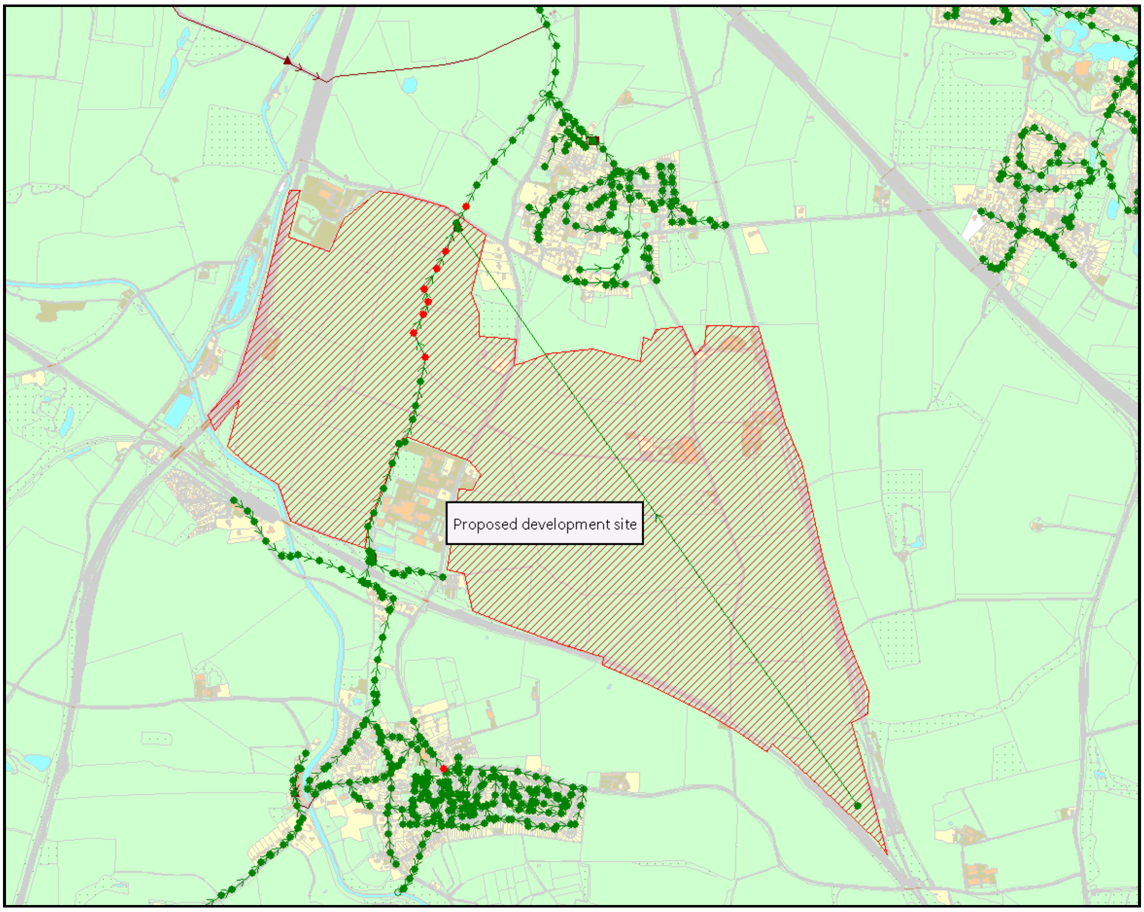

Figure 5: Showing the predicted surcharge locations (in red) due to the increased flow from the development site

The level of detriment predicted due to the additional flows from the development means that a mitigation solution will be required to allow the site to connect to the existing sewerage system.

Mitigation Solution

Mitigation solutions are designed to prevent detriment to the existing sewerage network performance during a 1 in 30 year critical duration storm event.

The proposed mitigation solution comprises (see Figure 6):

1. $102m^3$ of off-line storage close to the proposed connection point of the development in the adjacent undeveloped space.

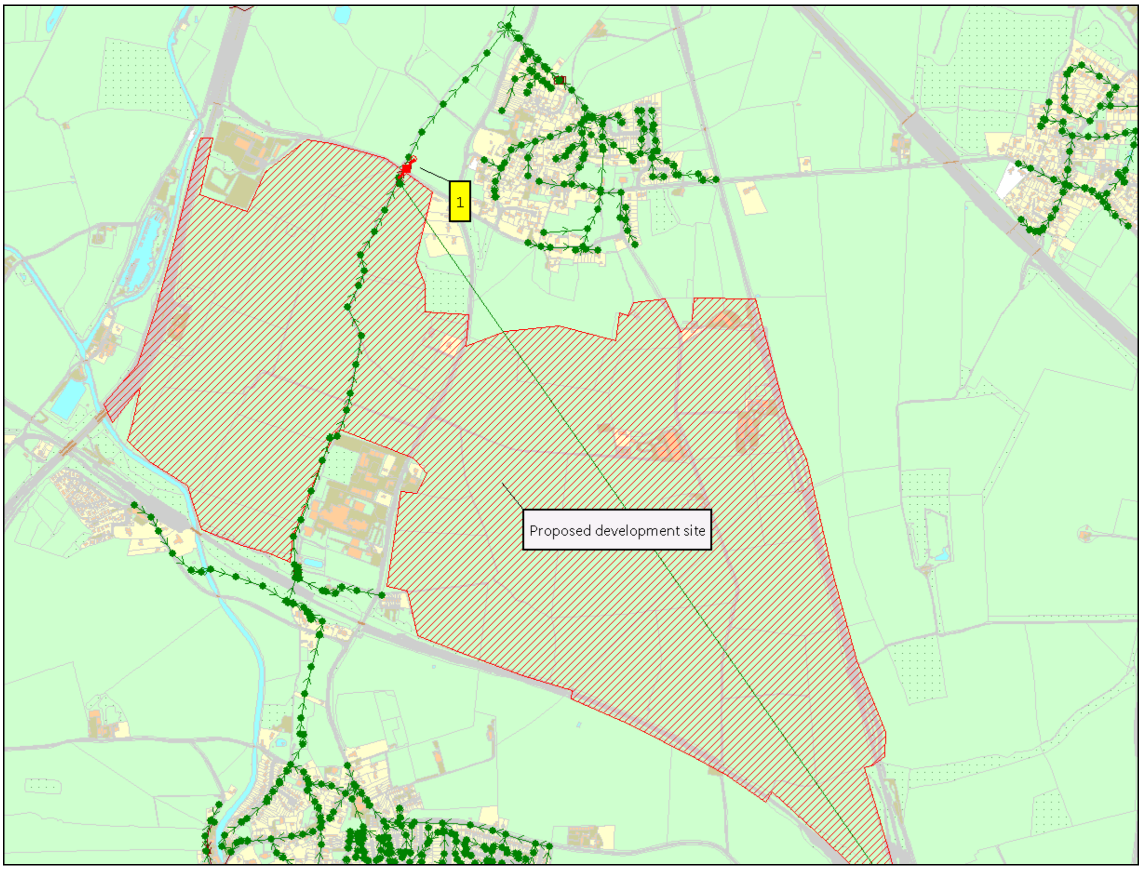

Figure 6: Showing the location of the proposed mitigation solution

This is a feasible solution for planning application purposes. A detailed design would be required to investigate the solution further.

Alternative Solutions

At detailed design stage alternative solutions may also be considered:

- Since a pumped solution is proposed, there may be scope for incorporating the storage into the site and avoiding the offsite reinforcement costs.

3. Summary of Cost Estimates

The estimated cost for the proposed off-site reinforcement solution is £374,533.

The Water Industry Act enables the developer to benefit from any wastewater revenue generated from the houses they have built. In simplified terms, future revenue from the new dwellings is offset from the developer's contribution. Instead of paying the full contribution the developer pays the difference between their capital contribution and the future revenue. This is calculated on an annual basis for 12 years (see Appendix 2). The developer has the option of paying this annually (relevant deficit) or upfront as a commuted sum (discounted aggregate deficit).

The indicative cost chargeable to the developer for the required mitigation following the offsetting of expected future revenue is predicted to be £31,567. This future revenue has been calculated based on the flows from the site increasing linearly until the maximum is achieved in year 12. 13 meters have been added to represent one meter per building (see Table 1). It has also been assumed at this stage that the site is operating for eight hours per day. This is for indicative purposes only. A more robust figure will be provided once detailed design has been undertaken and build rates are fully understood.

Table 1: Showing the predicted developer contribution to an estimated capital cost of £374,533

Year	Cumulative Number of Meters	Cumulative Domestic Flows M3 per annum	Revenue Now	Projected Future Revenue	Total Projected Future Revenue	Annual Repayments of the Loan	Projected Relevant Deficit	Discount Factor	Commuted Sum
1	3	8,392	£12,930	£12,930	£12,930	£35,962	£23,031	0.9780	£22,524
2	6	16,784	£25,861	£26,507	£26,507	£35,962	£9,454	0.9565	£9,043
3	9	25,176	£38,791	£40,755	£40,755	£35,962	£0	0.9354	£0
4	12	33,568	£51,722	£55,699	£55,699	£35,962	£0	0.9148	£0
5	13	41,960	£64,558	£71,260	£71,260	£35,962	£0	0.8947	£0
6	13	50,352	£77,347	£87,512	£87,512	£35,962	£0	0.8750	£0
7	13	58,744	£90,137	£104,531	£104,531	£35,962	£0	0.8558	£0
8	13	67,136	£102,926	£122,347	£122,347	£35,962	£0	0.8369	£0
9	13	75,528	£115,716	£140,988	£140,988	£35,962	£0	0.8185	£0
10	13	83,920	£128,505	£160,485	£160,485	£35,962	£0	0.8005	£0
11	13	92,312	£141,294	£180,869	£180,869	£35,962	£0	0.7829	£0
12	13	100,704	£154,084	£202,171	£202,171	£35,962	£0	0.7657	£0
TOTAL							£32,486		£31,567

Conveyancing costs

The connection point is close to the site boundary. It has been assumed that the developer will provide the infrastructure to convey the flows from the site to the connection point. Consequently, this report does not include any costs for the conveyance of flows.

The contents of this report and costs supplied are an estimate based on a solution generated by a desktop hydraulic model. These are estimated figures which are not to be relied upon without further detailed investigations.

4. Summary and recommendation

Assumed flows from the site at Blisworth, Towcester Road, Northampton have been modelled connecting via pump to the existing foul drainage system to manhole reference no. SP72559501 and detriment to the existing performance has been predicted. To mitigate against this, a feasible foul drainage solution is proposed comprising:

1. $102m^3$ off-line storage at proposed connection point of development in the adjacent undeveloped area.

Embodied carbon cost

The embodied carbon predicted in this solution is $55TCO_2e$ (see Table 2).

Water footprinting

The predicted water footprint for this solution is $37m^3H_2O$ (see Appendix 3).

Conveyance of flows

It is assumed that the developer will provide the infrastructure to convey flows to the network.

Table 2: Showing a summary of the scheme costs

Proposed pre-planning solution	Estimated Capital Cost	Predicted Developer Contribution	Predicted Total Embodied Carbon (tCO2e)	Predicted water footprint (m^3H_2O)
• **$102m^3$ offline storage**	£374,533	£31,567	53	37

This is a feasible solution for planning application purposes.

5. Next steps

To proceed with this option, it is recommended that an application is made under Section 98 of the Water Industry Act. This will enable a detailed design and robust cost to be generated and the scheme to be delivered. An application form is available on our web site at www.anglianwater.co.uk/developers/sewer-connection/new-sewer.aspx.

Underwriting detailed design

Detailed design commences on receipt of an underwriting agreement. Payment is only sought from the developer if it chooses to abort the work. Otherwise, it is incorporated into the total scheme cost. For this scheme, an underwriting of £26,000 will provide detailed options from which a preferred option may be chosen. A cumulative underwriting of £47,000 will take the preferred option to a level of design where it is ready for construction. Typically this takes an estimated 44-52 weeks but may increase depending on the complexity of the scheme. At this stage a robust cost for the scheme can be provided.

Further work required for a section 104 or section 106 application

Please note, it would be deemed premature by Anglian Water to submit a Section 106 or Section 104 application under the Water Industry Act 1991 to Developer Services prior to a Legal Agreement being signed under Section 98 of the same act ensuring the provision of the necessary upgrade works as identified within this report.

Anglian Water supports sustainable development as set out in the NPPF

The responses made in this report are based on the presumption that your proposed development obtains planning permission. Whilst this report has been prepared to help assess the viability of your proposal, it must not be considered in isolation. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework (NPPF). As a spatial planning statutory consultee, we assist planning authorities in the preparation of a sustainable local plan on the basis of capacity within our water and water recycling (formerly referred to as wastewater) infrastructure. Consequently, any infrastructure needs identified in this report must only be considered in the context of up to date, adopted or emerging local plans. Where local plans are absent, silent or out of date these needs should be considered against the definition of sustainability set out in the NPPF as a whole.

APPENDIX 1. - Development details

Proposed Connection				
Proposed connection location		North site proposed development		
Connection sewer or node reference (incl. X&Y)		GIS ID: SP72559501, MH Ref: SP72559501, Grid Ref: SP7295555562, (X= 472955,Y= 255562)		
Connection sewer diameter		300mm		
Connection relative to the development		North		
Discharge regime		Pumped		
Pump discharge rate		29 l/s		
Creep& Storage				
Total creep (5 m^2 per property)		0		
Total development storage (m^3)		1580		
Pump storage volume, m^3		207		
Highest Point of development (mAOD)		114.1		
Lowest Point of development (mAOD)		73.8		
DWF Calculations				
	Attribute	**Value**	**Totals**	**Unit / Calculation**
	Development size	263		Ha (Digitised Sub-catchment area)
	Residential			
A	Residential dwellings	0		No.
B	Residential occupancy	2.35		No.
C	Residential population (P)	0		No. (A x B)
D	Residential PCC (G)	125		l/h/d
$E_{(avg)}$	*Residential demand - Average*		**0**	l/s (C x D)/86400
$E_{(peak)}$	*Residential demand - Peak*		**0**	l/s ($E_{(avg)}$ x 2.12)
F	**Infiltration**		**0**	l/s (0.25 x $E_{(avg)}$)
	Industrial/Trade			
G	Industrial/trade area	0		Ha
H	Industrial/trade discharge per ha	0		l/s/ha
I	Industrial/trade domestic element per ha	0		l/s
$J_{(avg)}$	*Commercial/trade - Average*		**0**	l/s (GxH+GxI)
$J_{(peak)}$	*Commercial/trade- Peak*		**0**	l/s($J_{(avg)}$ x 3)
	Commercial Units			
K	PCC	120		l/h/d
L	Occupancy	6900		No.
$M_{(avg)}$	*demand - Average*		**5.58**	l/s (K x L)/86400
$M_{(peak)}$	*demand - Peak*		**28.75**	l/s ($M_{(avg)}$ x 3)
	Other			
$N_{(avg)}$	*Other demand - Average*		**0.00**	l/s
$N_{(peak)}$	*Other demand - Peak*		**0.00**	l/s
$O_{(avg)}$	**Total Discharge - Average**		**9.58**	l/s ($E_{(avg)}+J_{(avg)}+M_{(avg)}+N_{(avg)}$)
$O_{(peak)}$	**Total Discharge - Peak**		**28.75**	l/s ($E_{(peak)}+J_{(peak)}+M_{(peak)}+N_{(peak)}$)
	DWF Total - Average		**9.58**	l/s($O_{(avg)}$ + F)
	DWF Total - Peak		**28.75**	l/s($O_{(peak)}$ + F)

APPENDIX 2.- Calculation of relevant deficit and discounted aggregate deficit.

The financial propositions that are available in the Water Industry Act (WIA) are:

- Relevant Deficit (WIA section 100)
- Discounted Aggregate Deficit (WIA section 100A)

Under each option, the cost of installing the required infrastructure is calculated. This cost is then translated into a notional 'loan' to fund the installation. The revenue is then offset over a period of 12 years, taking into account inflation. If the cost of financing the loan exceeds the revenue in any year, then this deficit is charged to the developer.

A2.1 Relevant Deficit

This option takes the actual cost of providing the infrastructure as the basis for a notional loan. On an annual basis (for 12 years) the actual revenue we receive in respect of the infrastructure is then offset against the cost of the annual repayments of the notional loan. The deficit is paid annually by the developer for a period of up to 12 years. This is shown in Figure A2.1 below.

The developer will need to provide an undertaking to pay the deficit each year and also provide security for the estimated annual deficits either in the form of a cash deposit or a bond.

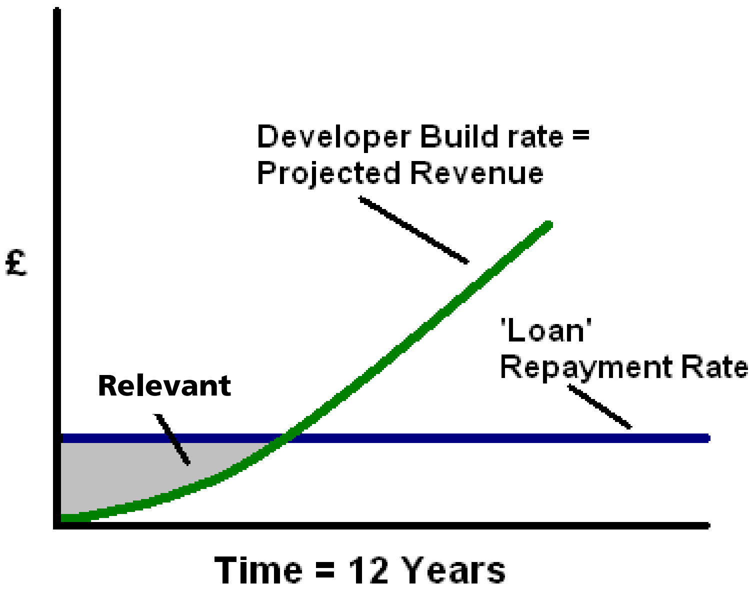

Figure A2.1 – Graphical imagery of a typical Relevant Deficit over 12 years

A2.2 Discounted Aggregate Deficit

This follows the same principles as the Relevant Deficit payment method, except that the deficit will be paid as a single payment and the revenue is estimated from the build rate rather than from the actual revenue.

The yearly relevant deficit is calculated across the 12 years and a discount factor is applied to bring the deficit to its net present value. The deficit is normally reconciled against the security (see below) within 12 months of completing the infrastructure and is payable as a single commuted sum. This can be seen in Figure A2.2.

The developer will need to provide an undertaking to pay the full deficit after reconciliation and a security amount for the estimated deficit either in the form of a cash deposit or a bond. The deficit itself is payable on completion of the water mains following the reconciliation.

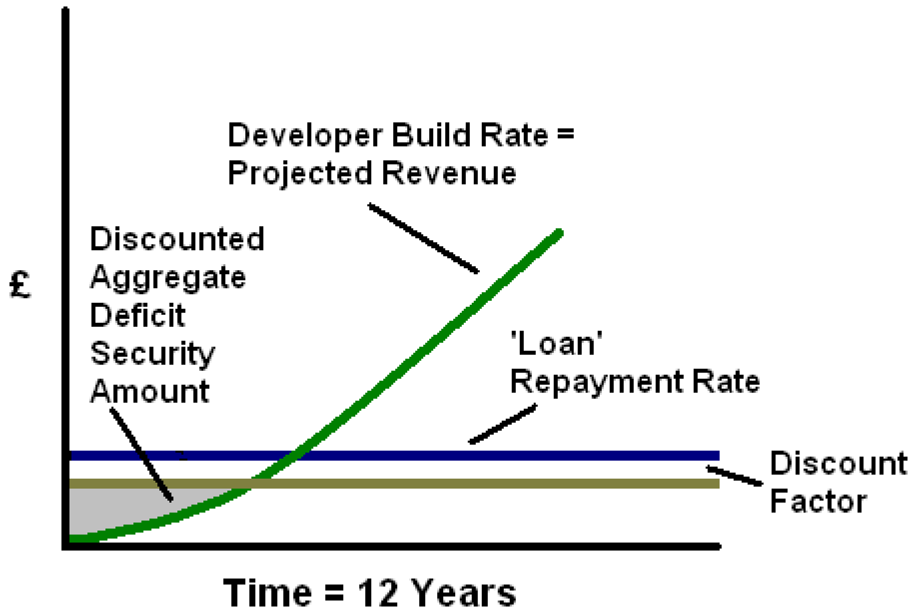

Figure A2.2 – Graphical imagery of a typical Discounted Aggregate Deficit over 12 years

APPENDIX 3.– Embodied carbon and water footprinting

Carbon footprint

In 2006 Anglian Water recognised the impacts of changing climate as one of the most significant challenges facing the organisation. In response we have developed and implemented a strategy of measure, manage and reduce our carbon emissions. We have set ourselves goals to halve our overall greenhouse emissions by 2035 (from 2010 levels).

Water footprinting

Water is our most precious resource and at present we do not fully understand how sustainable each litre of water we supply to our customers is over our full supply chain. In response, we are implementing a strategy of 'water footprinting'.

Primarily water footprinting assesses the impact of human activity on the water environment. The process measures the volumes and scarcity of freshwater consumption including geographical and temporal components in producing a product or service. This is followed by an assessment defining actions required to achieve sustainable and equitable water use especially in water scarcity 'hot spots'.