Site Specific Flood Risk Assessment

Project:

Confey Lands LRD, Leixlip

Client:

Leixlip and Newbridge SPV Limited

Doc Ref. CHC-00-XX-RP-C-00002

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The information contained herein is current at date of issue in the Details, Control and Issue Log and may be subject to third part approvals for items such as connections, access arrangements and planning approvals.

The report addresses those items outlined only. In the event that there are items not covered within the report, the reader shall not infer that such extraneous items have been considered irrelevant or immaterial. Any items not covered within the report have not been investigated by the Authors and the reader should satisfy themselves that such items have been suitably investigated elsewhere.

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1.0 Introduction

1.1 Background

Corrigan Hodnett Consulting Limited (CHC) have been appointed by their Client, Leixlip and Newbridge SPV Limited, to prepare a Site-Specific Flood Risk Assessment (SSFRA) to supplement a planning application for a proposed residential development at Confey North, Leixlip, County Kildare. The applicant site lies within the area encompassed by the Confey Lands Masterplan, 13th Dec 2023. The site is identified within the Masterplan as 'R5' and is part of Phase 1a phasing aspect of the overall masterplan lands. The SSFRA has been prepared in accordance with the relevant guidelines, namely The Planning System and Flood Risk Management Guidelines, 2009, published by the OPW to comply with current planning legislation and forms part of the proposed planning submission for the subject development.

1.2 Purpose of Report

The purpose of the report is to identity and present the flood risks associated with the proposed development and, where necessary, propose appropriate flood risk mitigation and management measures to be implemented into the development to mitigate against any residual flood risk.

The SSFRA assesses the proposed development in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities', Nov 2009 published by the OPW[1] and then DOEHLG[2], hereinafter the Guidelines.

1.3 Site Specific Flood Risk Assessment Scope

The SSFRA relates solely to the subject site and immediately surrounding areas unless it is determined that a development generated flood risk impacts on extraneous areas, in which case the extents of any such remote impacts will also be assessed as appropriate. The extents of the assessment are as stated, and no extraneous areas are assessed unless expressly stated.

1.4 Site Location

The site is abutting and located to the immediate north of the Royal Canal, and to the immediate east of Confey GAA grounds. The northern boundary is the existing R149 regional road and the eastern boundary is applicant owned lands which are within Character 'R5' in Phase 1b and abutting OPW owned lands further to the east.

The overall applicant site area (redline boundary) amounts to **4.261 Hectares (42,608 square metres/ 10.53 Acres)** and is inclusive of a section of the Royal Canal tow path which is proposed to be upgraded

[1] Office of Public Works

[2] Department of Environment Health & Local Government, now DECLG (Department of Environment, Community & Local Government)

to facilitate pedestrian and cyclist access from the development site to Leixlip (Confey) train station to the west of the site. *Figure 1-1* and *Figure 1-2* following detail the location of the site in a regional and local context respectively.

Figure 1-1 Site Location; Regional Context[3]

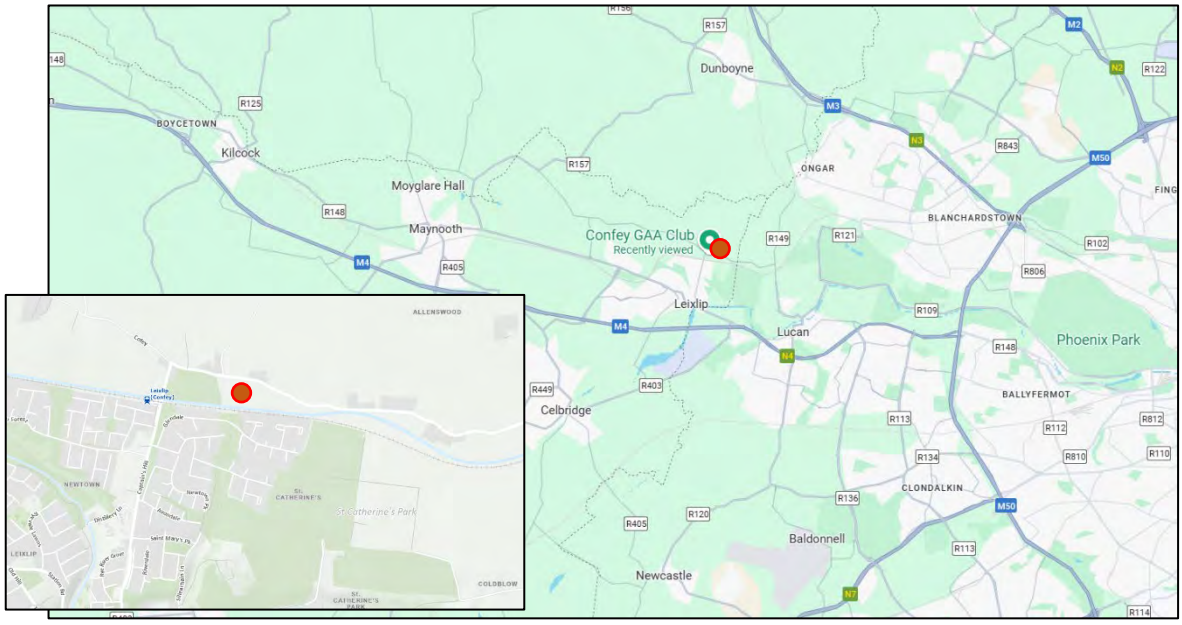
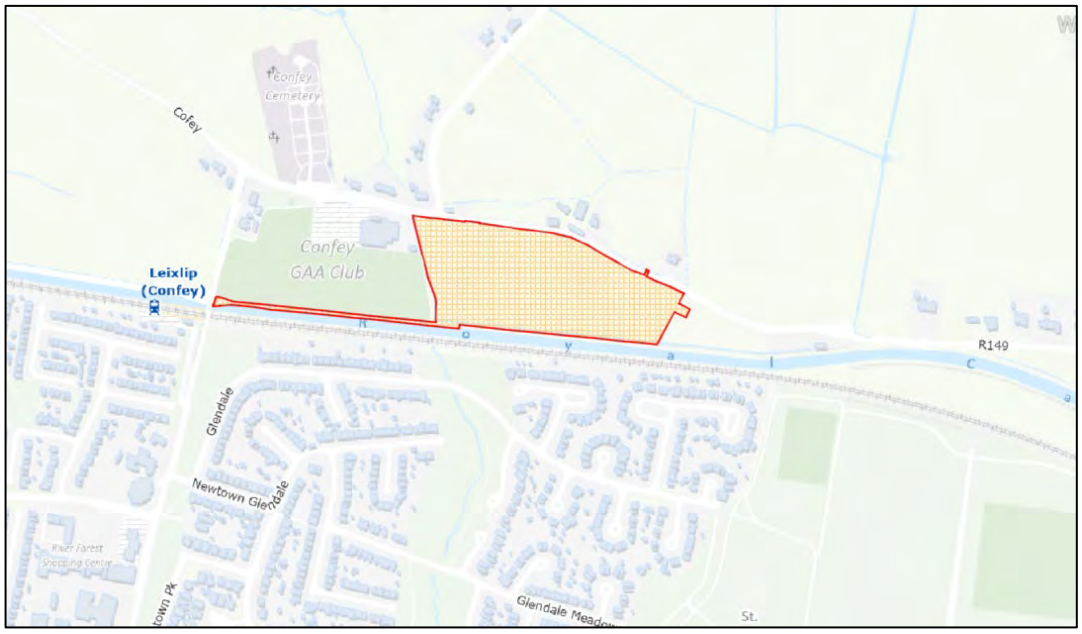


Figure 1-2 Site Location; Local Context[4]



The co-ordinates listed in *Table 1-1* following fall within the site boundary.

[3] Source – Táilte Éireann
[4] Indicative Site Location Map

Table 1-1 Site Co-ordinates

	X/Easting	Y/Northing
ITM co-ordinates	701250	737100
ING co-ordinates	301321	237074

1.5 Existing Land Use

The entirety of the subject lands are undeveloped and are currently in agricultural use as arable farmland and thus the site is classified as Greenfield.

The site is currently accessed directly off the R149 regional road by means of a single agricultural access. There is no public access permitted into the site.

The site falls under the authority of Kildare County Council for planning, road/access and stormwater services purposes. Uisce Éireann are the authority for potable water and wastewater in the area.

There is an existing watercourse (the Silleachain Stream) within the site running along the western boundary which runs beneath the Royal Canal and rail line and joins the River Liffey to the south in Leixlip. On the southern boundary a tributary runs parallel to the Royal Canal to the south and converges with the Silleachain Stream in the southwest corner of the site.

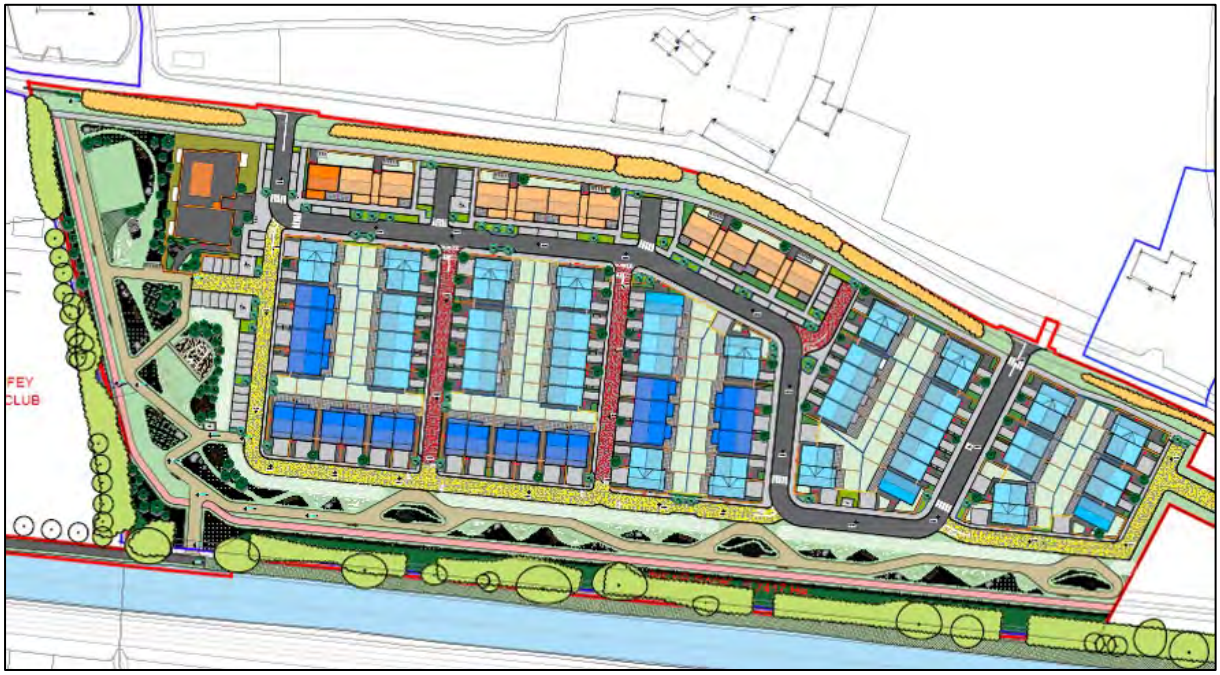
1.6 Proposed Development

The proposed development description is as follows;

> *'The proposed development provides a total of 125 residential units, comprising 81 no. houses, 22 no. duplex units and 22 no. apartments. The housing element consists of a mix of semi-detached and terraced dwellings, including 56 no. 3-bedroom houses and 25 no. 4-bedroom houses, ranging in height from 2 to 3 storeys. The development includes 22 no. duplex units within 11 duplex blocks, comprising 11 no. 2-bedroom and 11 no. 3-bedroom duplex homes, arranged over 3 storeys. The apartment element comprises 22 no. units within a single apartment block of up to 5 storeys in height, consisting of 5 no. 1-bedroom apartments and 17 no. 2-bedroom apartments.*
>
> *Provision of car, cycle and motorbike parking will be provided throughout the development.*
>
> *Vehicular, pedestrian, and cyclist access points will be provided from the north of the site via R149, with additional pedestrian and cyclist access provided from the south via the Royal Canal Greenway. The development will also provide landscaping, public and communal open spaces and all associated site development works to facilitate the project. These include boundary treatments, plant and waste management areas, and other service provisions.'*

Figure 1-3 following details the scheme layout of the proposed development.

Figure 1-3 Proposed Scheme Layout[5]



[5] Murphy & Sheanon Site Layout Plan

2.0 The Planning System and Flood Risk Management

2.1 Background and Objectives

'The Planning System and Flood Risk Management Guidelines for Planning Authorities', Nov 2009 (hereinafter 'the Guidelines') was published jointly by the OPW and the then DOELG. The primary purpose of the Guidelines is to *'introduce comprehensive mechanisms for the incorporation of flood risk identification, assessment and management into the planning process'*. The Guidelines set out a comprehensive process for identifying flood risk and carrying out flood risk assessment in a consistent manner for all developments nationally.

The Guidelines require specific actions from authorities at national, regional and county/city level to identify potential flood risks to inform the planning process and incorporate sustainable drainage solutions for developments in an effort to reduce future flood risk.

However, this SSFRA is being prepared in compliance with the planning permission application requirements detailed in the Guidelines which state;

> *'In the case of applications for planning permission and development consents to planning authorities and An Bord Pleanála, applicants and their agents are required to:*
>
> *12. Carefully examine their development proposals to ensure consistency with the requirements of these Guidelines including carefully researching whether there have been instances of flooding or there is the potential for flooding, on specific sites and declaring any known flood history in the planning application form as required under the Planning and Development Regulations 2006.*
>
> *13. Engage with planning authorities at an early stage, utilising the arrangements for pre-planning application consultation with regard to any flood risk assessment issues that may arise.*
>
> *14. Carry out a site-specific flood risk assessment, as appropriate, and comply with the terms and conditions of any grant of planning permission with regard to the minimisation of flood risk.'*[6]

As set out in the Guidelines, the core objectives of the Guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;

[6] The Guidelines, Page v

- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

2.2 The Sequential Approach

The Guidelines outline methodologies for the transparent consideration of flood risk at all levels of the planning process, ensuring a consistency of approach throughout the country. The Guidelines will contribute to the avoidance or minimisation of potential flood risk through a more systematic approach within a river catchment context.

The key principles of a risk-based sequential approach to managing flood risk in the planning system are;

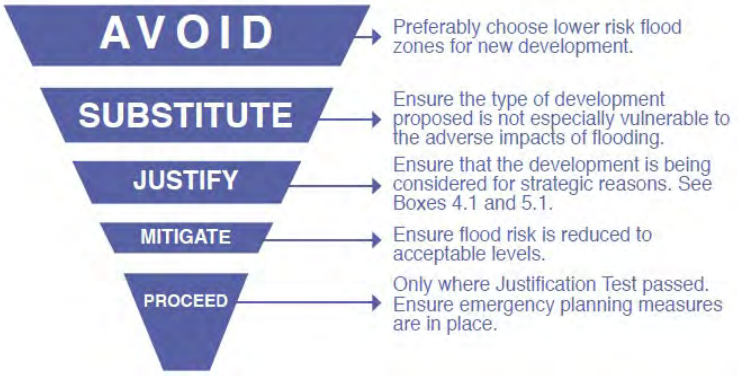
- **Avoid** development in areas at risk of flooding;

If this is not possible, consider substituting a land use that is less vulnerable to flooding.

Only when both avoidance and **substitution** cannot take place should consideration be given to **mitigation and management of risks**.

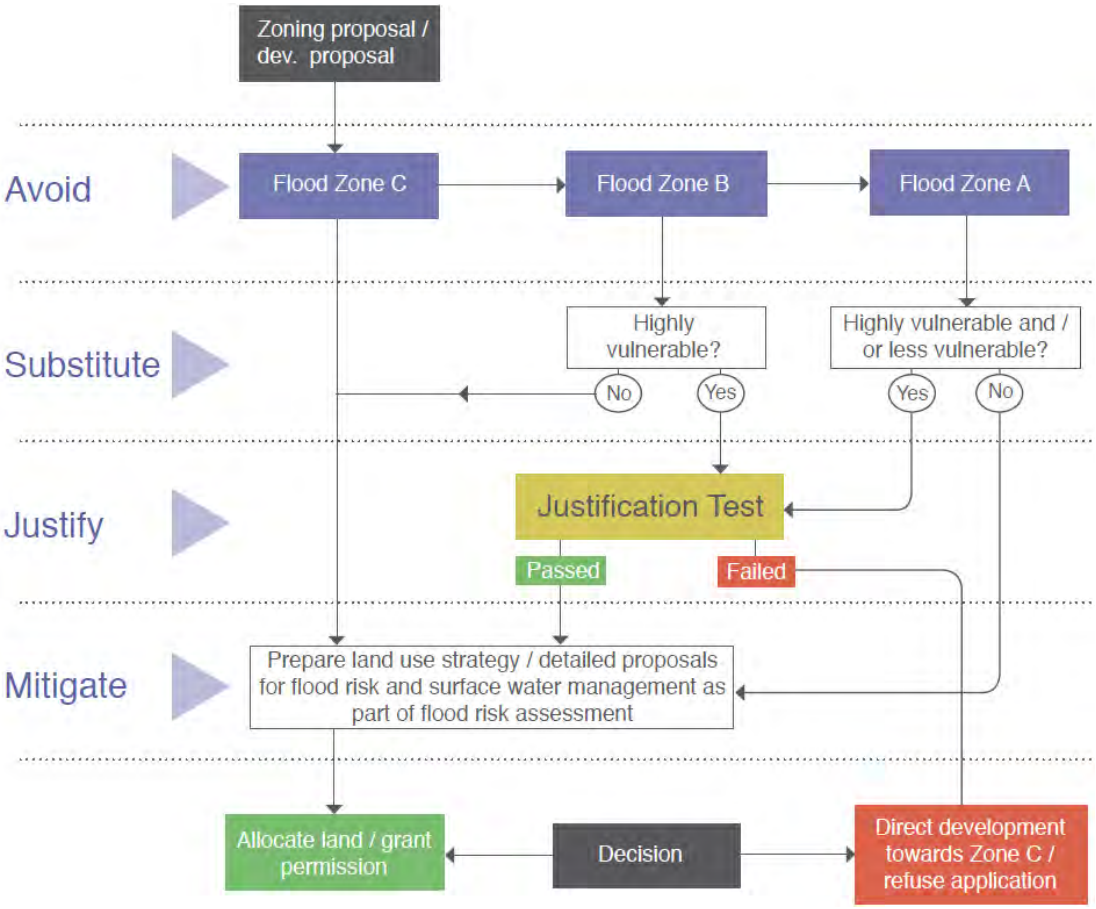
- Inappropriate types of development that would create unacceptable risks from flooding should not be planned for or permitted.
- **Exceptions** to the restriction of development due to potential flood risks are provided for through the use of a **Justification Test**, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated.

Figure 2-1 Sequential approach principles in flood risk management[7]



In instances where avoidance or substitution are not possible, the Guidelines require that a Justification Test is carried out and that processes are followed such to minimise flood risks to each development.

Figure 2-2 Sequential approach mechanisms in the planning process[8]



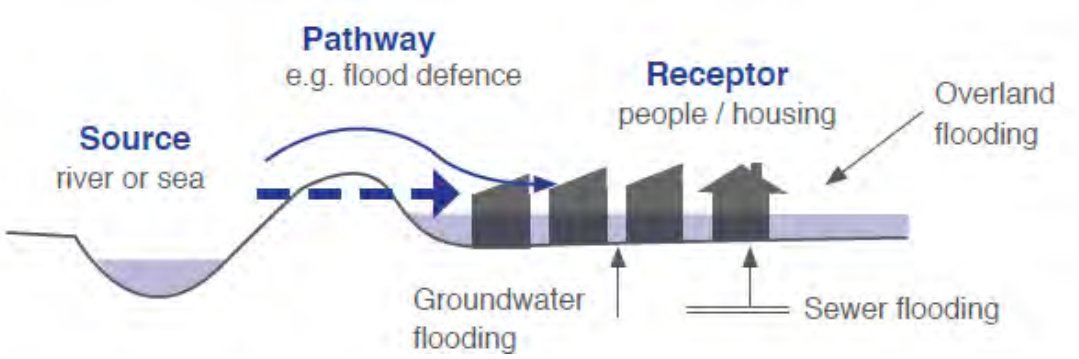
[7] Source – The Guidelines, '*Fig. 3.1: Sequential approach principles in flood risk management*'

[8] Source – The Guidelines, '*Fig. 3.2: Sequential approach mechanisms in the planning process*'

The sequential approach makes use of flood risk assessment and of prior identification of flood zones for river and coastal flooding and classification of the vulnerability to flooding of different types of development. It is essential that the risk potentially arising from other sources of flooding should also be taken into account in all areas and at all stages of the planning process.

The flood zones ignore the presence of defences. Areas that benefit from an existing flood relief scheme or flood defences have a reduced probability of flooding but can be particularly vulnerable due to the speed of flooding when overtopping or a breach or other failure takes place as exemplified in *Figure 2-3* following. Because this residual risk of flooding remains, the sequential approach and the Justification Test apply to such defended locations.

Figure 2-3 Source-Pathway-Receptor (S-P-R Model)[9]



2.3 Types & Causes of Flooding

There are two primary types of flooding, namely **Coastal flooding** and **Inland flooding**.

Coastal flooding is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and
- Wave action which is dependent on wind speed and direction, local topography and exposure.

[9] Source – The Guidelines, '*Fig. 2.2: Source-Pathway-receptor Model*'

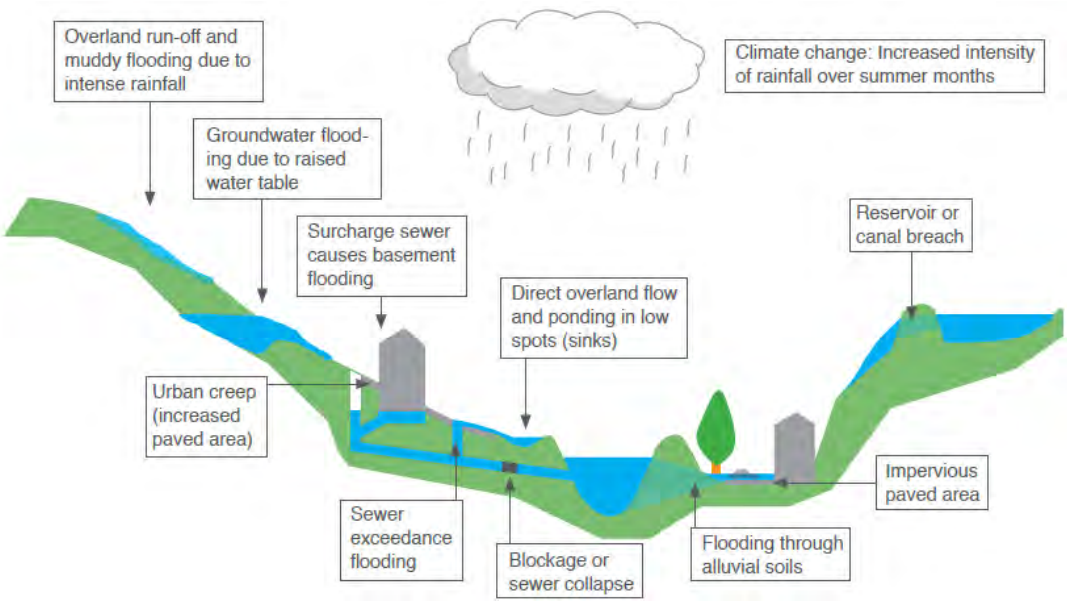
Inland flooding is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked, and / or cannot discharge due to a high water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.

Figure 2-4 Principal causes and types of flooding[10]



- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from

[10] Source – The Guidelines, '*Fig. 2.1: Principal causes and types of flooding*'

interactions of site-specific factors such as tidal variations. While water level may rise slowly, it may be in place for extended periods of time. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.

- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e. interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea tending to increase water levels inland, which may flood over river banks.

Flooding can also arise from the failure of infrastructure designed to store or carry water (e.g. the breach of a dam, a leaking canal, or a burst water main), or to protect an area against flooding (e.g. breach of a flood defence, failure of a flap valve or pumping station or blockage of a pipe or culvert). Because of the sudden onset, the impacts of this form of flooding can be severe and where appropriate should be assessed.

Increases in flood risk as a result of new development may be caused:

- Upstream by restricting the capacity and conveyance function of the watercourse and floodplain system; or

- Downstream by decreasing the volume available for flood storage on the floodplain, altering flow routes on the floodplain or by changes to the channel which can increase the flow discharged to downstream locations; and by increasing run-off due to changes in land management and introducing surfaces with reduced permeability, such as roads, roofs and car parks.

2.4 Flood Zones & Vulnerability Class

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. There are three types or levels of flood zones defined for the purposes of the Guidelines:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);

- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and

- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

The flood zones described above are indicative of river and coastal flooding only. They should not be used to suggest that any areas are free from flood risk, since they do not include the effects of other forms of flooding such as from groundwater, overland flows or artificial drainage systems.

The vulnerability of development to flooding depends on the nature of the development, its occupation and the construction methods used. A broad classification of vulnerability has been developed within the Guidelines. The classification of different land uses and types of development as '*highly vulnerable'*, *'less vulnerable'* and *'water-compatible'* is influenced primarily by the ability to manage the safety of people in flood events and the long-term implications for recovery of the function and structure of buildings.

Table 2-1 on the following page sets out the Vulnerability Class for different land uses and types of development.

In this case, the development under consideration is categorised as follows;

'Dwelling houses, student halls of residence and hostels'

As such, the proposed development is classified as ***'Highly Vulnerable Development'*** under the Guidelines.

Table 2-1 Classification of vulnerability of different types of development [11]

Vulnerability Class	Land uses and types of development which include: (Uses not listed here should be considered on their own merits)
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Each development type is assessed based on the vulnerability of the development type and which flood plain the site is located within. *Table 2-2* following is a matrix of vulnerability versus flood zone and will dictate the requirement, or not, for a justification test dependant on these factors.

[11] Source – The Guidelines, '*Table 3.1 Classification of vulnerability of different types of development*'

Table 2-2 Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[12]

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-compatible Development	Appropriate	Appropriate	Appropriate

2.5 Justification Test

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** and used at the development plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.

- The second is the **Development Management Justification Test** used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

2.6 Flood Risk Assessment Stages

FRAs are typically undertaken over a number of stages, with the need for progression to a more detailed stage dependent on the outcomes of the former stage until the level of detail of the FRA is appropriate to support the planning matter, be it a zoning proposal or a decision on an individual planning application, or it has been demonstrated that flooding is not a relevant issue for the area or site.

As outlined in chapter 3 of the Guidelines the stages of assessment are:

- **Stage 1 Flood risk identification** – to identify whether there may be any flooding or surface water management issues related to a plan area or proposed development site that may warrant further investigation;

[12] Source – The Guidelines, '*Table 3.2 Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.*'

- Stage 2 Initial flood risk assessment – to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. The extent of the risk of flooding should be assessed which may involve preparing indicative flood zone maps. Where existing river or coastal models exist, these should be used broadly to assess the extent of the risk of flooding and potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures; and

- Stage 3 Detailed risk assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model of the river or coastal cell across a wide enough area to appreciate the catchment wide impacts and hydrological processes involved.

3.0 Stage 1 Flood Risk Identification

3.1 Proposed Development Details

The proposed development is a residential development providing 125no. residential units comprised of 22no. apartments in a single block, 22.no. duplex units and 81no. houses. The development also includes all associated infrastructure in the form of access roads and services and landscaping.

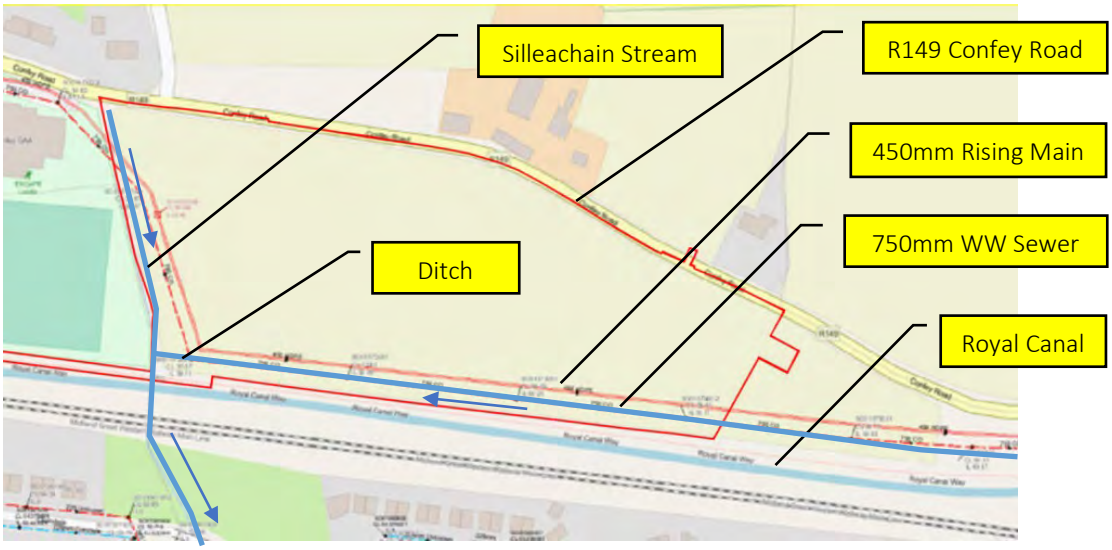
The site is located to the immediate east of the Confey GAA grounds, bounded to the south by the Royal Canal and to the north by the R149 Confey Road. The minimum elevation within the site is 54.00metres above Malin Head (Ordnance) Datum. The minimum proposed finished floor level within the site is 54.875m aOD.

There are two Uisce Éireann assets traversing the site, namely a 750mm diameter gravity wastewater sewer which is proposed to be the wastewater outfall for the development and a 450mm diameter wastewater rising main.

There is an existing watercourse (the Silleachain Stream) within the site running along the western boundary which runs beneath the Royal Canal and rail line and joins the River Liffey to the south in Leixlip. On the southern boundary a ditch runs parallel to the Royal Canal to the south and converges with the Silleachain Stream in the southwest corner of the site.

Figure 3-1 following shows the site outlined with the existing relevant features.

Figure 3-1 Site Location at Context Scale



3.2 Coastal Flood Risk

Coastal flooding results from sea levels which are higher than normal and result in sea water overflowing onto the land. Coastal flooding is influenced by the following three factors which often work in combination; high tide levels, storm surges and; wave action:

Given its remoteness to the Irish Sea, the closest point being some 19.5km at Sandymount; and the existing ground levels in the site, the lowest being 54.0metres above Malin Head Ordnance Datum, coastal flooding is not considered a risk in this instance. The development will not be impacted by coastal flooding.

3.3 Fluvial Flood Risk

Fluvial flooding Is the result of a river exceeding its capacity and excess water spilling out onto the adjacent floodplain. Due to the fact that there is an existing watercourse within the red line boundary of site fluvial flood risk must be investigated as part of this initial stage of the SSFRA.

3.4 Pluvial Flood Risk

Pluvial flooding is the result of rainfall generated overland flows which arise before runoff can enter a watercourse or sewer. It is usually associated with high intensity rainfall that typically occurs in the summer months.

3.5 Existing Flood Risk Information

The Stage 1 Flood Risk Identification process uses existing available information to assess whether there are potential flooding issues with the site which may require further investigation. If the Stage 1 process identifies potential flooding issues it will be necessary to progress to Stage 2 – Initial Flood Risk Assessment, and so on. *Table 3-1* following details the available information reviewed as part of this Stage 1 assessment.

Table 3-1 Review of available flood risk information

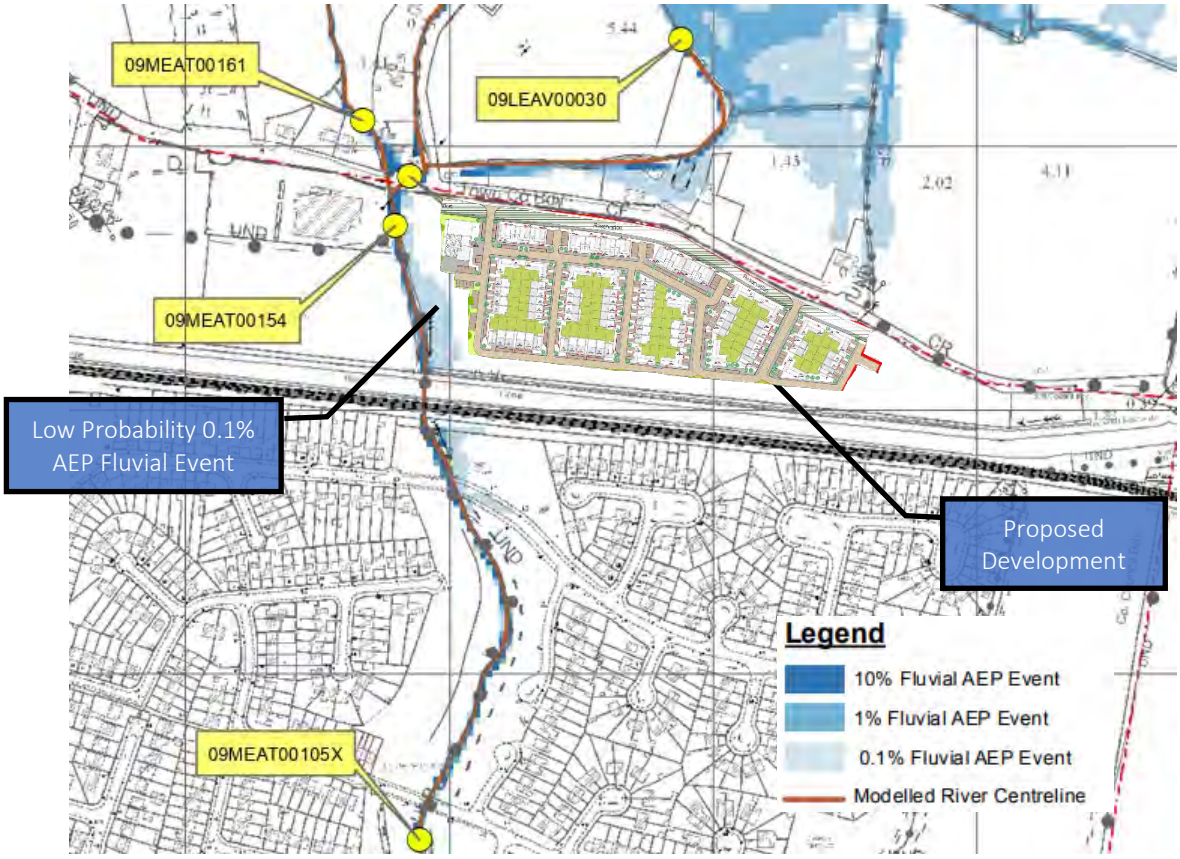
	Information Source	Coverage	Quality	Confidence	Identified Flood Risks/Comments	Identified Flood Risk
Primary Sources for flood risk information	Eastern Catchment Flood Risk Assessment & Management Study (CFRAMS);	National	High	High	Mapping confirms that the proposed buildings are not within the low probability 0.1% AEP flood extents areas for fluvial or coastal flooding.	No
	Irish Coastal Protection Strategy Study (ICPSS) flood and coastal erosion risk maps;	National	High	Low	Flood extents do not extend to the applicant site.	No
	Kildare County Council CDP 2023-2029 Strategic Flood Risk Assessment	Local	High	High	Mapping confirms that the proposed buildings are not within the low probability 0.1% AEP flood extents areas for fluvial or pluvial flooding.	No
Secondary Sources for Flood Risk Information	Predictive and historic flood maps, and Benefiting Lands Maps, such as those at http://www.floodmaps.ie;	National	Varies	Varies	Interrogation of the OPW's floodmaps.ie website confirms that there is are no records of flooding within or in the immediate vicinity of the site.	No
	Topographical survey maps, in particular digital elevation models produced by aerial survey or ground survey techniques;	Local	High	High	Inspection of the topographic surveys commissioned for the development and inspection of the proposed design levels confirm that the site is not at risk of flooding from overland flows or fluvial flooding.	No
	Alluvial deposit maps of the Geological Survey of Ireland;	National	Moderate	Low	Inspection of the GSI mapping shows that there is evidence of historical flooding but it does not extend to the proposed developed area.	No
	'Liable to flood' markings on the old '6 Inch' and '25 Inch' maps;	National	Low	Low	There are no 'Liable to flood' markings or marsh symbols on the old 6inch and 25inch maps.	No
	Walkover survey to assess potential sources of flooding, likely routes for flood waters and the site's key features, including flood defences, and their condition;	Local	Varies	Varies	The site inspection did not identify any sources of potential flooding to the site.	No
	Planning and Development Records.	Local	High	Varies	There are no previous planning applications of note on the site which would be relevant in this instance.	No
	Proposed Development	Local	High	High	The drainage design for the proposed development is compliant with the GDSDS and the Planning System & Flood Risk Management Guidelines for Planning Authorities. The SuDS measures incorporated into the design are compliant with the CDP and LAP recommendations.	No

3.5.1 OPW Eastern Catchment Flood Risk Assessment & Management Study

The Eastern CFRAM Study, 2017 identifies an area within the site on the western site boundary for potential fluvial flooding. The location identified is alongside the route of the existing ditch watercourse as shown in Figure 3-2 Extract from OPW Eastern CFRAMS Fluvial Extents Mapping, 2017.*Figure 3-2* following extracted from the Leixlip Fluvial Extents Map, ref. 09LEI_EXFCD_F2_08, a copy of which is

included in *Appendix A.1* to the rear of this report. The following figure has the proposed development superimposed on the flood map and it can be clearly seen that the fluvial flood extents do not extend to the proposed buildings, including the 0.1%AEP Event (1in1000year AEP Event). Based on the Eastern CFRAMS mapping, the development site is not subject to fluvial flooding for the 1.0% AEP Fluvial event (1in100year fluvial event).

Figure 3-2 Extract from OPW Eastern CFRAMS Fluvial Extents Mapping, 2017.



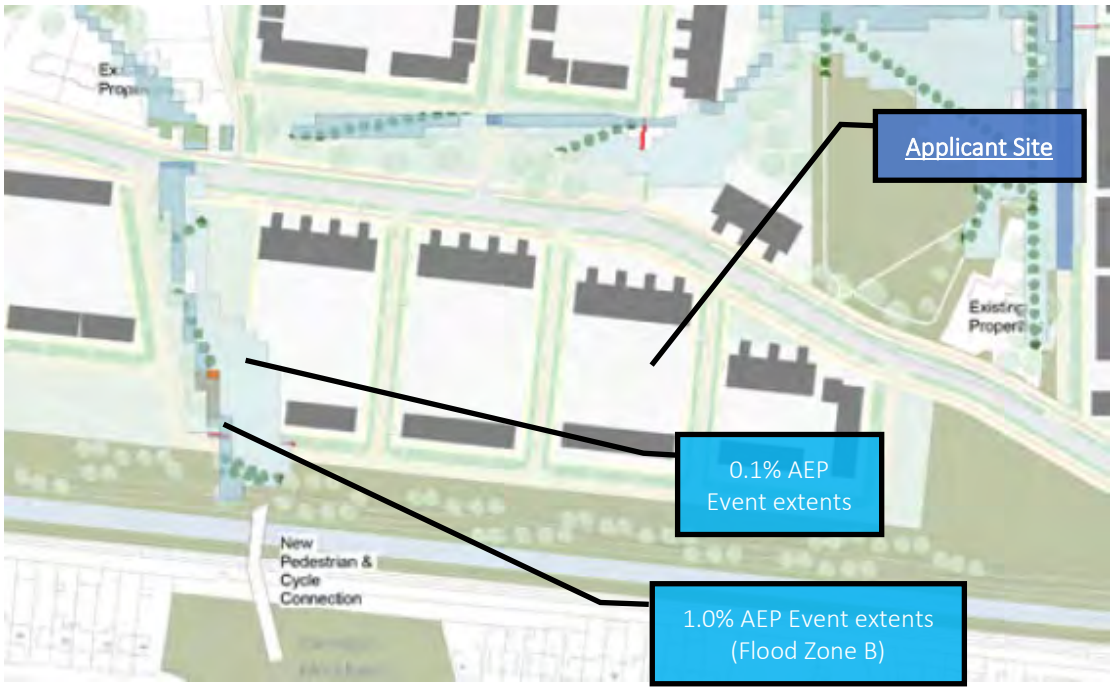
3.5.2 Confey Masterplan, 2023

The Confey Masterplan identifies a number of development strategies for the masterplan lands, including ensuring that no development is subject to inappropriate flood risk. The masterplan has been laid out in a way that all areas of Flood Zone A & B are either within zoned open space or have been designed to be areas of allocated public open space in the relevant lands avoiding the development of homes in all highlighted areas. The proposals ensure that the location of highly vulnerable uses (e.g. residential uses, schools or similar) are not located in Flood Zone A and B.

Figure 3-3 following is an extract from Section 3.6, Figure 1 of the masterplan showing the extent of out of stream flooding for the 0.1% AEP event. The masterplan also notes *'there are no built frontages with the Flood Zones A and B'*. It is however noted that the area shown as the potential flood extents is the

that of the 0.1% AEP event similar to that shown on the Eastern CFRAM Study flood extents mapping (refer *3.5.1* preceding).

Figure 3-3 Extract Confey Masterplan, Section 3.6 Flood Mitigation, Figure 31



Based on the masterplan mapping, fluvial flooding is not considered a constraint to development. While it is noted that there is an area within the site falling within Flood Zone B for Fluvial flooding, this area is limited to the watercourse channel area and is not proposed to be changed as part of the development and any potential flooding of this area will not impact the proposed development.

3.5.3 Pluvial Flooding

There are no surface water sewers within the vicinity of the site. In addition the topography of the immediate surrounding area would suggest that there is little risk of pluvial flooding to the site. In the event that the development network surcharges, the natural topography will direct any flood water towards the western boundary where it will enter into the existing watercourse (Silleachain Stream). As such, pluvial flooding is not considered to pose a constraint to development.

3.5.4 OPW Flood Records

As part of this assessment the OPW flood event database was interrogated. There are a total of 17 flood events recorded within the 2.5kilometre radius of the site – see *Figure 3-4* following extracted from the Summary Local Area Report. There are two events, namely Flood ID 1514 and 1517 close to the northwest corner of the site occurring on 14th/15th November 2002. Both of these events relate to flooding of the Allenswood Road on the opposite side of the R149 Confey Road from the site and were

reported on at the time by the Maynooth Area Engineer. Refer extract from scanned archive in *Figure 3-5*. A copy of the relevant generated Summary Local Area Report is included in *Appendix B.1*.

Figure 3-4 Extract from OPW floodmaps.ie generated Summary Local Area Report

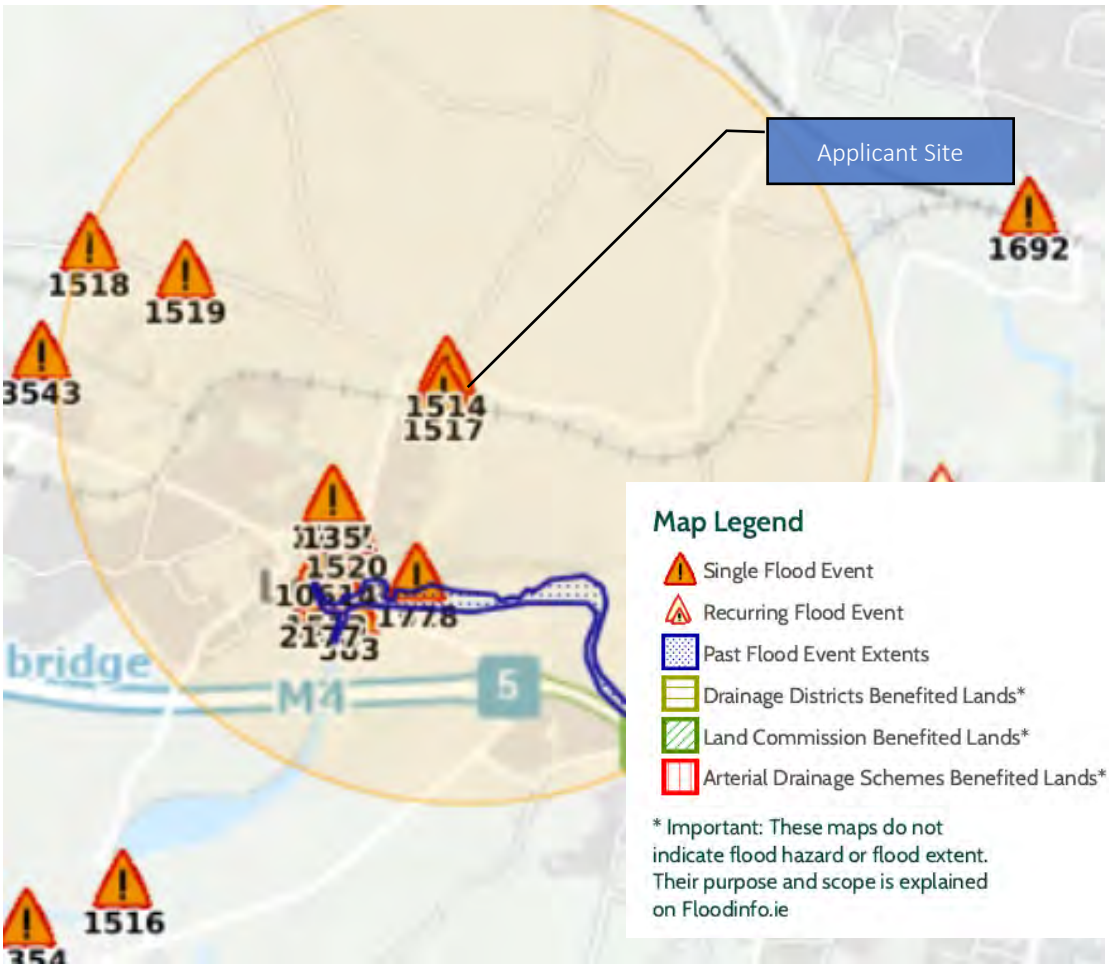


Figure 3-5 Extract from Flood Report Scanned Archive

Flooding on Thursday and Friday 14th/15th November 2002

Leixlip

L1. Mill Lane, Leixlip – Low lying land, road and 5 house were flooded
Flood Id = 1512
L2. Buckley's Lane, Leixlip – Ryewater overflowed its banks. Road was flooded but no houses
Flood Id = 1513
L3. Allenswood Road, Leixlip – Stream overflowed its banks and 2 houses were flooded
Flood Id = 1514
L4. Kellystown Lane, – Ryewater overflowed its banks due to insufficient bridge capacity. Road was flooded
Flood Id = 1515
L5. Barnhall Road Bridge – River Liffey overflowed its banks due to insufficient bridge capacity. Road was flooded
Flood Id = 1516
L6. Confey Junction with Allenswood Road – Same as L3
Flood Id = 1517
L7. Shaughlins Glenn – Surface water drainage pipe was broken. Road was flooded
Flood Id = 1518

3.5.5 Topographic Surveys

Inspection of the topographic survey commissioned for the site confirms that the site is not at risk of flooding from overland pluvial or fluvial flows. The proposed scheme includes extensive SuDS measures which will reduce surface water discharge and overland flow routes created within the development will ensure there is only limited risk of flooding as a result of a surface water network failure. Surface water from the development will be collected in green roofs areas, permeable paving surfaced areas, infiltration trenches, tree pits, and swales throughout the site. The development design mirrors the existing scenario regarding surface levels and existing overland flow routes will remain generally unchanged.

3.5.6 Geological Survey of Ireland (GSI) Mapping

The Geological Survey of Ireland provides a national database on a number of different geological characteristics nationally. The soil maps can show where there are alluvial mineral deposits which would indicate historical out of channel flows and inspection of the aquifer vulnerability in an area gives a general indication of the infiltration characteristics of the area.

Inspection of the Geological Survey of Ireland database and in particular the quaternary soils shows that the surface soil layer is categorised as *'Till derived from limestones'* which broadly correlates with the FRA SOIL Type of 4 for the site (BRE infiltration tests failed due to limited infiltration). There are no alluvium deposits along the route of the river through the site (although they are present upstream and downstream) which indicates that historic flows would have been within a narrow channel width and

not prone to flooding. An extract from the GSI mapping is shown in *Figure 3-6* following and the generated map is included in *Appendix C.1*.

Figure 3-6 GSI Quaternary Soils Maps

3.5.7 Inspection of 6 Inch and 25 Inch Mapping

Inspection of the OSI 6inch and 25inch mapping shows that there are no indications of flooding on the old 6inch and 25inch maps and there are no *'Liable to Flooding'* annotations or marsh symbols in the vicinity of the site. *Figure 3-7* and *Figure 3-8* following are extracts from the old 6inch and 25inch mapping from the OSI.ie website for the area in question.

Figure 3-7 Extract from OSI Historic Map 6 inch B&W (1837-1842)

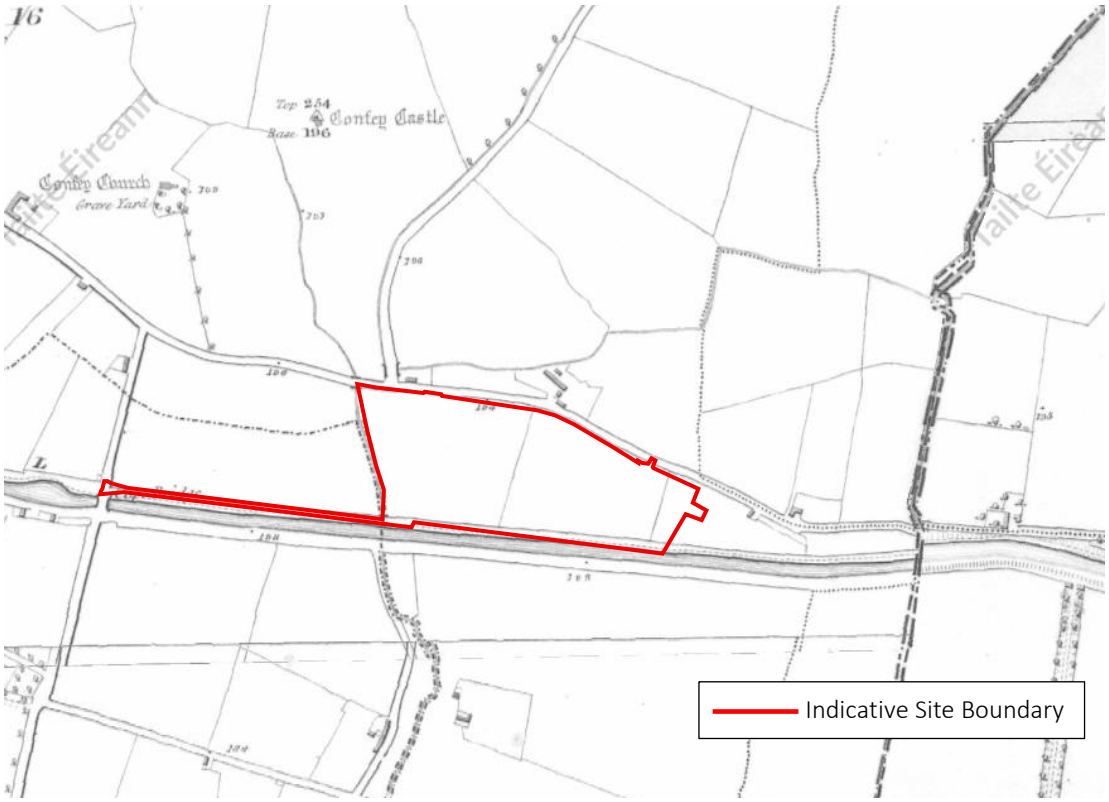
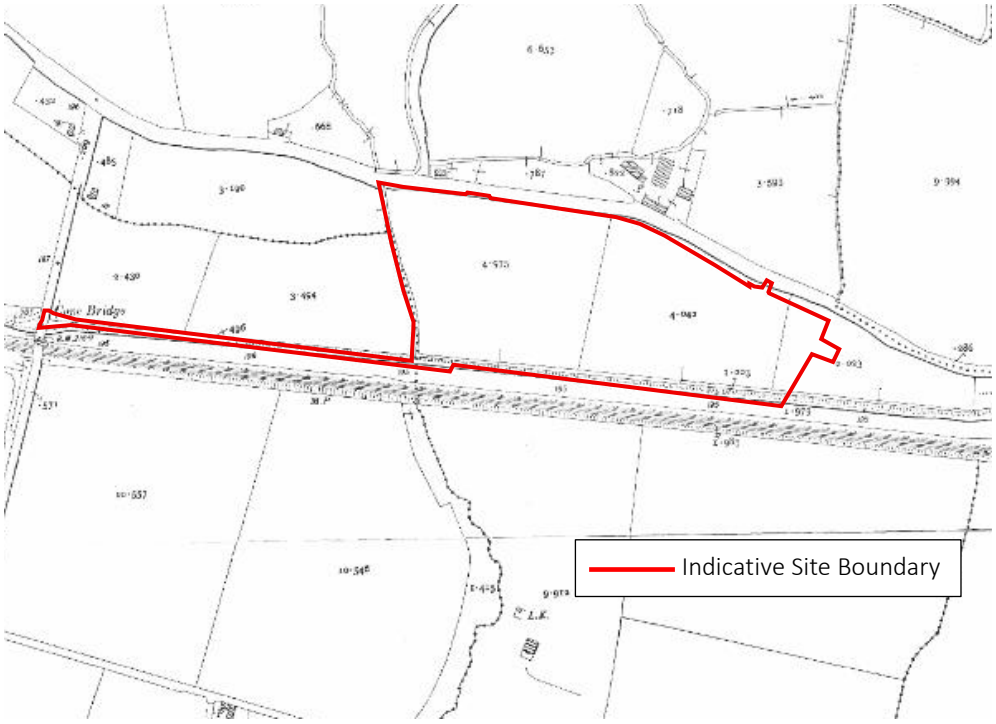


Figure 3-8 Extract from OSI Historic Map 25 inch (1888-1913)



3.5.8 Walkover Survey

A walkover survey of the site was carried out to assess potential sources of flooding and likely overland flow routes. Due to the location of the site, the surrounding area, and based on the previously discussed topography of the site, the likelihood of flooding from the existing lands to the east and west due to existing watercourses or the R149 Confey Road to the north or the Royal Canal to the south is considered extremely low.

Based on the walkover survey of the site, there is no apparent flood mechanisms which would impact on the developed area of the site.

3.5.9 Planning and Development Records

There are no records of any recent planning applications on the site. As such there is no evidence available from a planning perspective of any issues in relation to flooding which can be identified through this medium.

3.5.10 Proposed Development Design

The proposed development includes a number of SuDS measures which are designed to minimise flood risk to the subject site and upstream and downstream properties in accordance with the GDSDS. The surface water discharge for the development is limited to the calculated greenfield runoff rate ($QBAR_{RURAL}$) and the necessary attenuation storage is designed allowing for a 30% climate change factor and a 10% Urban Creep factor. The addition of a green roof to the apartment building, infiltration trenches, tree pits, a conveyance and retention swale and extensive areas of permeable paving areas, water butts, etc. further increases storage throughout the site and also increases the time of entry for discharge into the swale area, thereby further flattening the peak flow curves. The floor levels for all units are a minimum of 500mm above the modelled critical storm top water levels.

The proposed drainage layouts and the different drainage catchments (Permeable, impermeable, green roof, etc.) for the scheme are shown on the accompanying Corrigan Hodnett engineering drawings.

Details of the surface water model analysis results are included in *Appendix D.1* to the rear of this report for both the Design Year and Future (with 30% Climate Change and 10% Urban Creep factors applied).

3.6 Flood Risk Assessment

The Site Specific Flood Risk Assessment (SSFRA) has been prepared in accordance with the requirements of The Planning System and Flood Risk Assessment Guidelines for Planning Authorities (2009) and Circular PL02/2014 (OPW, 2014). As part of the assessment, potential flooding impacts on adjacent properties resulting from system failure, overland flows, etc. have been evaluated. The assessment has not identified any potential flooding issues and the proposed development is deemed *'Appropriate'*.

In accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities, there is no requirement to carry out a Stage 2 Flood Risk Assessment on the site.

4.0 Summary, Conclusions and Recommendations

4.1 Summary of Results

A flood risk assessment has been carried out for the proposed development at Whitehall Road, Churchtown. The flood risk assessment has been carried out in accordance with *'The Planning System and Flood Risk Management Guidelines for Planning Authorities'*, Nov 2009 and the Kildare County Development Plan 2023-2029. The following is the summary of the risk assessment:

- The proposed development is a residential scheme in the Confey Masterplan R5 lands providing 125no. residential units comprised of 22no. apartments in a single block, 22.no. duplex units and 81no. houses. The development also includes all associated infrastructure in the form of access roads and services and landscaping.

- The site is located in the townland of Confey North, at the northern extents of Leixlip. The site is abutting and located to the immediate north of the Royal Canal, and to the immediate east of Confey GAA grounds. The northern boundary is the existing R149 regional road and the eastern boundary is applicant owned lands which are within Character 'R5' in Phase 1b and abutting OPW owned lands further to the east.

- There are two Uisce Éireann assets traversing the site. There is an existing watercourse (the Silleachain Stream) within the site running along the western boundary which runs beneath the Royal Canal and rail line and joins the River Liffey to the south in Leixlip. On the southern boundary a tributary runs parallel to the Royal Canal to the south and converges with the Silleachain Stream in the southwest corner of the site.

- A new stormwater drainage network is to be constructed to service the development incorporating SuDS throughout with a discharge into the Silleachain Stream on the western boundary all in accordance with the CDP and GDSDS. The site is located circa. 5.68km from the Irish Sea at Blackrock.

- The OPW Eastern CFRAM Study fluvial flood extent mapping confirms that none of the proposed buildings are within the identified fluvial extents flooding for the low probability 0.1% AEP Fluvial event (1in1000year fluvial event) and in the limited area of Flood Zone B there are no changes proposed to the ground levels in this area.

- The Eastern CFRAMS mapping does not extend to the site for Coastal Flooding. The fact that the distance of the site from the Irish Sea is in excess of 19km and the fact that the levels within the site are in excess of 50metres above Ordnance Datum confirms that the site is not subject to Coastal Flooding.

- The Confey Masterplan flood extents mapping confirms that all of the buildings within the site fall within Flood Zone C for fluvial and pluvial flooding.

- The internal drainage for the scheme has been designed such that there is no risk of internal flooding to the properties in the event of a system failure. In the event of a total system failure within the development, surface water from the development will primarily flow towards the west and northwest of the site towards the Silleachain Stream mirroring the existing overland flow routes.

- On review of the OPW www.floodmaps.ie website there are no recorded flood events within the site. The closest recorded event is on the opposite side of the R149 Confey Road to the north of the site.

- Inspection of the topographic survey commissioned for the site confirms that the site is not at risk of flooding from overland pluvial flows. The proposed scheme includes extensive SuDS measures which will reduce surface water discharge and overland flow routes created within the development will ensure there is only limited risk of flooding as a result of a surface water network failure.

- The GSI mapping confirms that there are no visible alluvial deposits within the site which is indicative of the fact that all historical flows would have been within a confined channel width with little or no out of channel flooding for the extents of the watercourse within the site.

- Inspection of historical 6inch and 25inch mapping did not return any indications of areas 'liable to flooding' or marsh symbols in the vicinity of the site.

- The walkover survey of the site confirms that there are no further sources of flooding which need to be considered and verifies that the overland flow routes of the site and wider area do not pose a concern.

- The proposed development includes a number of SuDS measures which are designed to minimise flood risk to the subject site and upstream and downstream properties. The surface water discharge for the development is limited to the calculated Greefield runoff rate using the IH124 method. The surface water management regime focuses on nature based solutions insofar as possible and is designed allowing for a 30% climate change factor and a 10% Urban Creep factor. The addition of significant permeable paving, 15mm interception volume storage for the entirety of the paved areas within the development, including permeable paved areas, tree pits and green roofs, further increases storage throughout the site and also increases time of entry thereby further flattening the peak flows. The floor levels for the development are a minimum of 500mm above the modelled attenuation storage critical storm top water levels. The proposed surface water drainage solution for the development has been designed in accordance with the CDP drainage policies and The Greater Dublin Strategic Drainage Study and The Planning System and Flood Risk Management

Guidelines for Planning Authorities. The SuDS measures proposed are compliant with the SSFRA recommendations.

The Stage 1 – Flood Risk Identification element of the flood risk assessment has been carried out sequentially in accordance with *'The Planning System and Flood Risk Management Guidelines for Planning Authorities'*, Nov 2009 and the Dún Laoghaire-Rathdown County Development Plan 2022-2028. Based on the fact that the development proposals are located within Flood Zone C for all types of flooding and there have been no sources of flooding to impact the development, there is no requirements to progress to a Stage 2 Initial Flood Risk Assessment.

The proposed development is classified as 'Highly Vulnerable' and is located within Flood Zone C. Based on the Guidelines, the proposed development is deemed 'Appropriate' and no justification test is required.

4.2 Recommendations

In order to protect the building against potential flooding as a result of network failure within the site, the FFL have been set a minimum of 500mm above the critical storm events.

The existing ground levels within the identified flood area from the Eastern CFRAMS and the Confey Masterplan will not be compromised by changing any levels within the identified flood area which would result in a reduction of flood storage and cause potential flooding upstream or downstream of the proposed development.

A Climate Change Factor of 30% and an Urban Creep factor of 10% has been applied to the model simulation for the proposed drainage network which will attenuate and service the development.

SuDS measures in accordance with the CDP and the GDSDS have been incorporated into the surface water management and disposal designs for the development.

4.3 Impact of the proposed development on the existing flood regime of the area

The site area for drainage calculations (positively drained catchment areas) amounts to 18,120 square metres. Extensive SuDS infrastructure will be incorporated into the surface water management and disposal designs for the development in accordance with the CDP, GDSDS and best practice guidelines. Having regard to these extensive measures it is considered that the development will not have any effect noticeably detrimental effect on the existing flood regime of the area.

Flow control devices will be fitted to outfall manholes to achieve a controlled discharge in accordance with GDSDS requirements. The adopted discharge rate is calculated based on the IH124 method in accordance with GDSDS requirements. Details of the discharge rates for each individual catchment are

included in the modelled details in *Appendix D.1*. In addition, 15mm interception volume storage will also be provided for all areas including green roof areas and permeable paved areas without applying any reduction factor as a result of delayed time of entry, as well as a number of SuDS measures which provide treatment and storage benefits.

It is considered, based surface water management and disposal arrangements proposed, that the proposal will not adversely impact the existing flood regime of the area.

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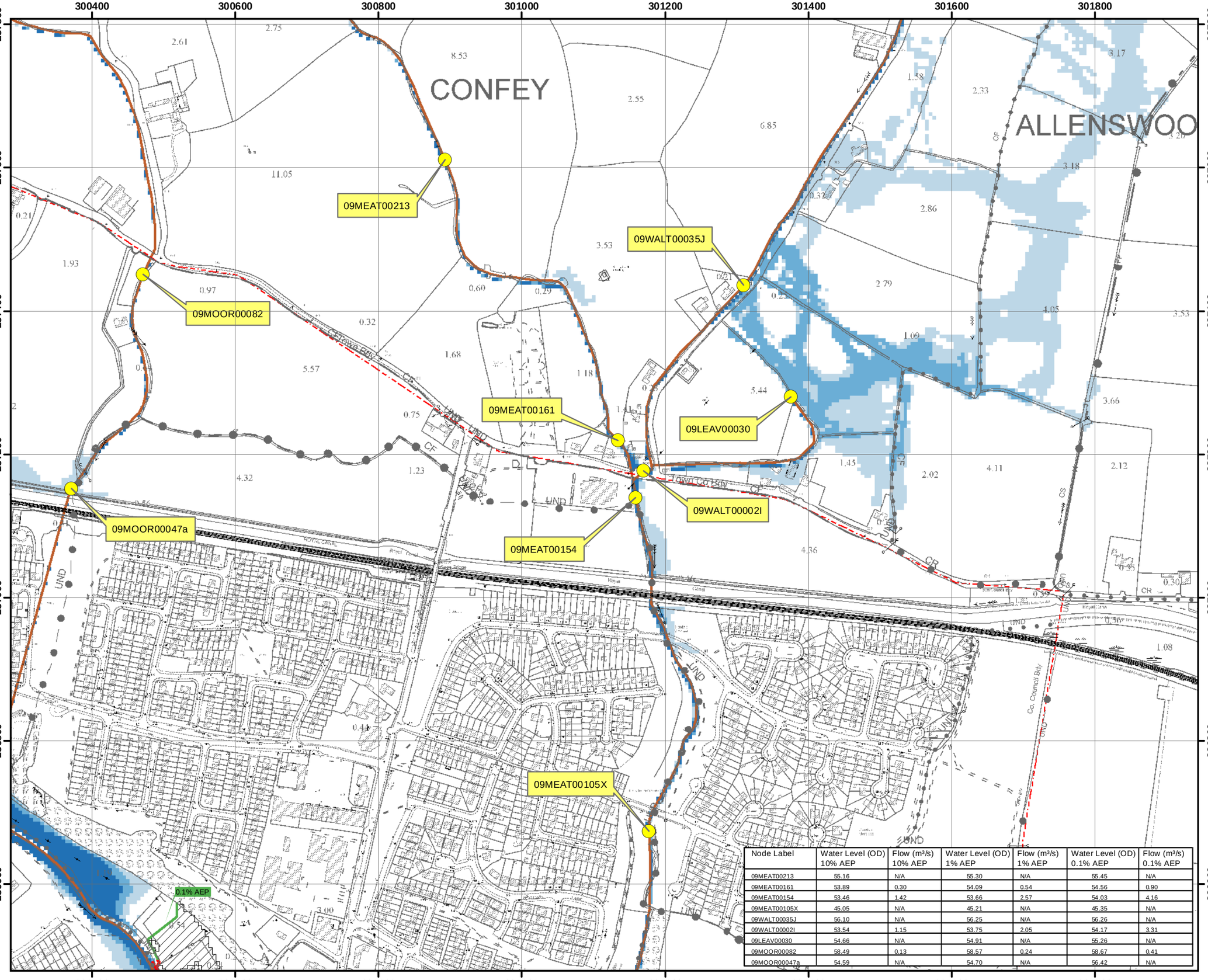
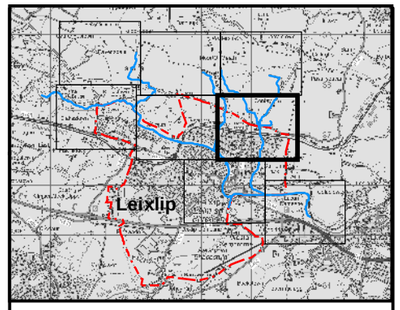
Appendix A

A.1 – Eastern CFRAM Study Leixlip Fluvial Flood Extents Map Figure E09LEI_EXFCD_F2_08



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09MEAT00213	55.16	N/A	55.30	N/A	55.45	N/A
09MEAT00161	53.89	0.30	54.09	0.54	54.56	0.90
09MEAT00154	53.46	1.42	53.66	2.57	54.03	4.16
09MEAT00105X	45.05	N/A	45.21	N/A	45.35	N/A
09WALT00035J	56.10	N/A	56.25	N/A	56.26	N/A
09WALT00002I	53.54	1.15	53.75	2.05	54.17	3.31
09LEAV00030	54.66	N/A	54.91	N/A	55.26	N/A
09MOOR00082	58.49	0.13	58.57	0.24	58.67	0.41
09MOOR00047a	54.59	N/A	54.70	N/A	56.42	N/A

0 50 100 200 300 400 500 Metres



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Embankment
- Wall
- Defended Area
- 1% AEP — Standard of Protection of Flood Defence (Walls / Embankments)
- Node Point
- Node ID — Node Label

FINAL

REV:	NOTE:	DATE:
02	Amendment to Flood Def SOP Label (Pg 8)	15/12/2017
REV:	NOTE:	DATE:
01	Amendment to Def. Area	16/11/2016

EASTERN CFRAM STUDY

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Map:
Leixlip Fluvial Flood Extents

Map Type:	**EXTENT**
Source:	**FLUVIAL**
Map Area:	**HPW**
Scenario:	**CURRENT**
Drawn By :	**F.M.C. Date : 15 December 2017**
Checked By :	**S.P. Date : 15 December 2017**
Approved By :	**G.G. Date : 15 December 2017**
Drawing No. :	**E09LEI_EXFCD_F2_08**
Map Series :	**Page 8 of 8**
Drawing Scale :	**1:5,000 @A3**

Appendix B

B.1 – OPW Summary Local Area Report

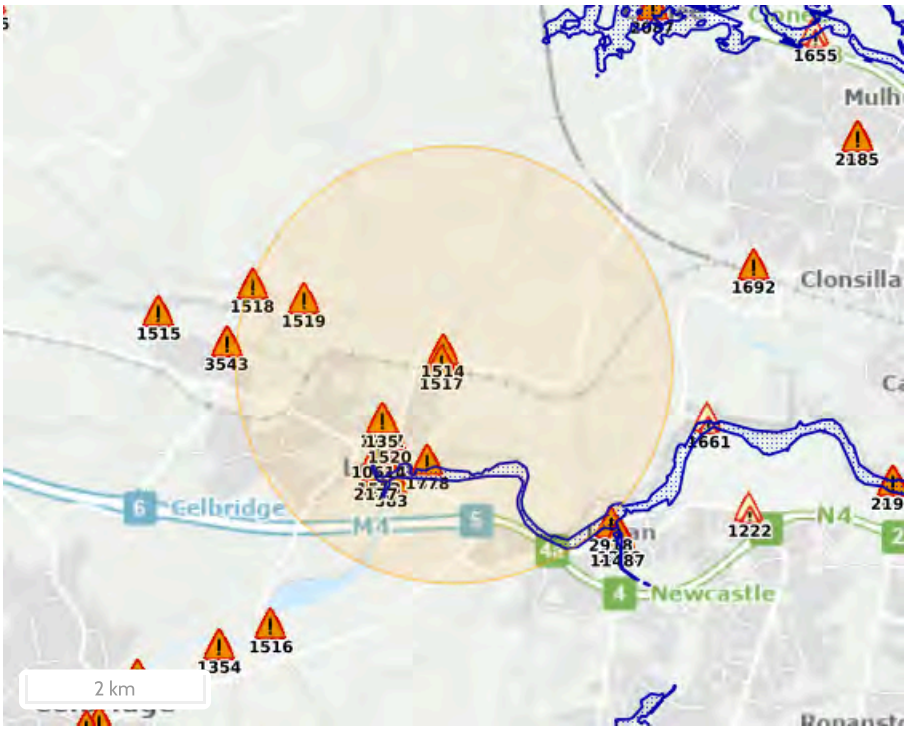
B.2 – Maynooth Area Engineer Report on Flood of Nov 2002

Past Flood Event Local Area Summary Report

OPW Oifig na nOibreacha Poiblí Office of Public Works

Report Produced: **4/9/2025 14:59**

This Past Flood Event Summary Report summarises all past flood events within 2.5 kilometres of the map centre.



Map Legend

- Single Flood Event
- Recurring Flood Event
- Past Flood Event Extents
- Drainage Districts Benefited Lands*
- Land Commission Benefited Lands*
- Arterial Drainage Schemes Benefited Lands*

* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained on Floodinfo.ie

17 Results

	Name (Flood_ID)	Start Date	Event Location
1.	Liffey Lower - Dec 1954 (ID-241) **Additional Information:** Reports (5) Press Archive (2)	08/12/1954	Area
2.	Silleachain Mill Lane Leixlip Nov 2000 (ID-1778) **Additional Information:** Reports (1) Press Archive (1)	05/11/2000	Approximate Point
3.	Ryewater Leixlip Bridge Dec 1954 (ID-2177) **Additional Information:** Reports (5) Press Archive (3)	08/12/1954	Exact Point
4.	Liffey Leixlip November 2000 (ID-8) **Additional Information:** Reports (2) Press Archive (9)	06/11/2000	Approximate Point
5.	Ryewater Leixlip Distillery Dec 1954 (ID-135) **Additional Information:** Reports (3) Press Archive (2)	08/12/1954	Approximate Point
6.	Liffey Nov 1965 (ID-323) **Additional Information:** Reports (4) Press Archive (0)	17/11/1965	Approximate Point

	Name (Flood_ID)	Start Date	Event Location
7.	Liffey Nov 1968 (ID-324) **Additional Information:** Reports (2) Press Archive (0)	31/10/1968	Approximate Point
8.	Silleachain Mill Lane Leixlip Nov 2002 (ID-1512) **Additional Information:** Reports (3) Press Archive (0)	14/11/2002	Approximate Point
9.	Ryewater Buckley's Lane, Leixlip Nov 2002 (ID-1513) **Additional Information:** Reports (3) Press Archive (1)	14/11/2002	Approximate Point
10.	Allenswood road, Leixlip Nov 2002 (ID-1514) **Additional Information:** Reports (3) Press Archive (0)	14/11/2002	Approximate Point
11.	Silleachain Confey/ Allenswood Road Nov 2002 (ID-1517) **Additional Information:** Reports (2) Press Archive (0)	14/11/2002	Approximate Point
12.	Shaughlin's Glen Nov 2002 (ID-1518) **Additional Information:** Reports (2) Press Archive (0)	14/11/2002	Approximate Point
13.	Confey Road Nov 2002 (ID-1519) **Additional Information:** Reports (2) Press Archive (1)	14/11/2002	Approximate Point
14.	Ryewater Dúncarraig, Leixlip Nov 2002 (ID-1520) **Additional Information:** Reports (4) Press Archive (0)	14/11/2002	Approximate Point
15.	Ryewater Leixlip Nov 2000 (ID-1777) **Additional Information:** Reports (4) Press Archive (2)	05/11/2000	Approximate Point
16.	Ryewater Leixlip 15 August 2008 (ID-10614) **Additional Information:** Reports (1) Press Archive (0)	14/08/2008	Approximate Point
17.	Ryewater Rye River Apartments Nov 2002 Leixlip (ID-1521) **Additional Information:** Reports (5) Press Archive (0)	14/11/2002	Approximate Point

MINUTES OF MEETING

Reference:	**P4D403A – F310 – 017 – 004-003**	**Page 1 of 3**
Project No.:	**P4D403A**	
Project Title:	**OPW Flood Hazard Mapping – Phase 1**	
Purpose of Meeting:	**Kildare County Council – Oral Report – Area Engineer – Maynooth**	
Participating:	**Area Engineer**	**Kildare County Council**
	Supervisor	**Kildare County Council**
	Search Manager	**ESBI**
Venue:	**Maynooth**	
Date of Meeting:	**04/04/05**	
Copies to:		
Compiled by:	**Search Manager ESBI**	
Status	**Draft**	
Approved for ESBI:		
Approved for Kildare County Council		
Date:		

Meeting with Area Engineer for Maynooth 04/04/05

The Area Engineer and his supervisor outlined 22 areas that are or were prone to flooding. These are: -

58. Greenfield – Meadowbrook River overflowed its banks in November 2000. M4 motorway was blocked
    Flood Id = 1511
59. Ballycurraghan – River overflows bank after heavy rain every year.
    Flood Id = 1536
60. Commons Upper – Low lying land floods after heavy rain every year.
    Flood Id = 1537

Flooding on Thursday and Friday 14th/15th November 2002

Leixlip

L1. Mill Lane, Leixlip – Low lying land, road and 5 house were flooded
    Flood Id = 1512
L2. Buckley's Lane, Leixlip – Ryewater overflowed its banks. Road was flooded but no houses
    Flood Id = 1513
L3. Allenswood Road, Leixlip – Stream overflowed its banks and 2 houses were flooded
    Flood Id = 1514
L4. Kellystown Lane, – Ryewater overflowed its banks due to insufficient bridge capacity. Road was flooded
    Flood Id = 1515
L5. Barnhall Road Bridge – River Liffey overflowed its banks due to insufficient bridge capacity. Road was flooded
    Flood Id = 1516
L6. Confey Junction with Allenswood Road – Same as L3
    Flood Id = 1517
L7. Shaughlins Glenn – Surface water drainage pipe was broken. Road was flooded
    Flood Id = 1518
L8. Confey Road – Low lying land and road was flooded.
    Flood Id = 1519
L9. Dúncarraig, Leixlip – Ryewater overflowed its banks. 4-6 houses and road was flooded.
    Flood Id = 1520
L10. Rye River Apartments, Leixlip – Ryewater overflowed its banks. Ground Floor Apartments and road was flooded.
    Flood Id = 1521

Maynooth

M1. Moyglare Road – Drain overflowed because it was blocked by debris. Drain has been cleaned out and flooding problem has been resolved. (Not mapped)
    Flood Id = 1522
M2. Dunboyne Road, Meath – Low Lying land and road was flooded
    Flood Id = 1523
M3. Kilcock Road – Low lying land and road was flooded. Flooding problem has been resolved (not mapped)
    Flood Id = 1524

M4. Laurence's Avenue – Low lying land and road was flooded. Surface water pipe blocked by tree root and inadequate drainage.
Flood Id = 1526

M4 Motorway

M1. Low lying stretches of the Motorway was flooded at 2 locations
Flood Id = 1527 , Flood Id = 1528

Straffan

S1. Straffan Village – Approximately 400 mm of water in Straffan Village. Road was flooded but no properties. (Consultants Report)
Flood Id = 1529

Celbridge

C1. Clane Road – Low lying land and road was flooded at 2 locations. No properties flooded
Flood Id = 1530, Flood Id = 1531
C2. Ardclough Road, Dangan– Low lying land and road was flooded at 2 locations. 1 house was flooded at Commons Upper (Flood Id = 1532)
Flood Id = 1532, Flood Id = 1533
C3. Oldtown Road Junction, Celbridge – Low lying area was flooded. Two premises in the mill were flooded
Flood Id = 1534

Appendix C

C.1 – Geological Survey of Ireland (GSI) Mapping

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

IE GSI Data Ireland

Legend

Quaternary Sediments
50k

- A, Alluvium
- GLs, Gravels derived from Limestones
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones
- Urban

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
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Snapshot Date: September 4, 2025

Appendix D

D.1 – Microdrainage SW Drainage Design and Simulation Results

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm A

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.200	Volumetric Runoff Coeff.	0.850	Min Design Depth for Optimisation (m)	0.450
Ratio R	0.275	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	150	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Storm A

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SA1.000	38.661	0.263	147.0	0.077	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SA1.000	62.55	4.60	54.536	0.077	0.0	0.0	0.0	1.08	42.8	14.8

Network Design Table for Storm A

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SA1.001	15.043	0.090	167.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SA1.002	13.539	0.648	20.9	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
SA2.000	25.974	0.153	169.8	0.131	4.00	0.0	0.600	o	225	Pipe/Conduit	
SA2.001	13.211	0.078	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SA2.002	15.558	0.259	60.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SA1.003	32.517	0.108	301.1	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
SA1.004	16.705	0.104	160.6	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SA1.001	61.38	4.85	54.273	0.077	0.0	0.0	0.0	1.01	40.1	14.8
SA1.002	61.03	4.93	54.183	0.103	0.0	0.0	0.0	2.88	114.3	19.3
SA2.000	63.36	4.43	54.024	0.131	0.0	0.0	0.0	1.00	39.8	25.5
SA2.001	62.29	4.65	53.871	0.131	0.0	0.0	0.0	1.00	39.8	25.5
SA2.002	61.57	4.81	53.794	0.131	0.0	0.0	0.0	1.69	67.2	25.5
SA1.003	58.46	5.53	53.460	0.284	0.0	0.0	0.0	0.90	63.7	51.0
SA1.004	57.57	5.75	53.352	0.296	0.0	0.0	0.0	1.24	87.5	52.3

Network Design Table for Storm A

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SA3.000	15.082	0.439	34.4	0.024	4.00	0.0	0.600	o	225	Pipe/Conduit	
SA1.005	23.499	0.078	301.3	0.056	0.00	0.0	0.600	o	300	Pipe/Conduit	
SA1.006	1.751	0.006	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SA3.000	64.99	4.11	53.762	0.024	0.0	0.0	0.0	2.24	89.0	4.8
SA1.005	63.35	4.43	53.248	0.000	0.7	0.0	0.0	0.90	63.7	0.7
SA1.006	63.19	4.47	53.170	0.000	0.7	0.0	0.0	0.90	63.8	0.7

Manhole Schedules for Storm A

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SA1	55.535	0.999	Open Manhole	1200	SA1.000	54.536	225				
SA2	55.116	0.843	Open Manhole	1200	SA1.001	54.273	225	SA1.000	54.273	225	
SA3	55.000	0.817	Open Manhole	1200	SA1.002	54.183	225	SA1.001	54.183	225	
SA4	55.474	1.450	Open Manhole	1200	SA2.000	54.024	225				
SA5	55.414	1.543	Open Manhole	1200	SA2.001	53.871	225	SA2.000	53.871	225	
SA6	55.241	1.447	Open Manhole	1200	SA2.002	53.794	225	SA2.001	53.794	225	
SA7	54.730	1.270	Open Manhole	1200	SA1.003	53.460	300	SA1.002	53.535	225	
								SA2.002	53.535	225	
SA8	54.536	1.184	Open Manhole	1200	SA1.004	53.352	300	SA1.003	53.352	300	
SA9	54.887	1.125	Open Manhole	1200	SA3.000	53.762	225				
SA10	54.500	1.252	Open Manhole	1200	SA1.005	53.248	300	SA1.004	53.248	300	
								SA3.000	53.323	225	
SA11	56.099	2.929	Open Manhole	1200	SA1.006	53.170	300	SA1.005	53.170	300	
SA12	53.508	0.344	Open Manhole	0		OUTFALL		SA1.006	53.164	300	

Manhole Schedules for Storm A

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SA1	701123.846	737175.329	701123.846	737175.329	Required	
SA2	701119.798	737136.881	701119.798	737136.881	Required	
SA3	701130.372	737126.182	701130.372	737126.182	Required	
SA4	701157.722	737176.944	701157.722	737176.944	Required	
SA5	701155.100	737151.103	701155.100	737151.103	Required	
SA6	701151.399	737138.421	701151.399	737138.421	Required	
SA7	701143.842	737124.822	701143.842	737124.822	Required	
SA8	701140.509	737092.476	701140.509	737092.476	Required	

Manhole Schedules for Storm A

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SA9	701162.512	737079.337	701162.512	737079.337	Required	
SA10	701147.563	737077.334	701147.563	737077.334	Required	
SA11	701145.159	737053.959	701145.159	737053.959	Required	
SA12	701144.980	737052.217			No Entry	

PIPELINE SCHEDULES for Storm A

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)
SA1.000	o	225	SA1	55.535	54.536	0.774	Open Manhole	1200
SA1.001	o	225	SA2	55.116	54.273	0.618	Open Manhole	1200
SA1.002	o	225	SA3	55.000	54.183	0.592	Open Manhole	1200
SA2.000	o	225	SA4	55.474	54.024	1.225	Open Manhole	1200
SA2.001	o	225	SA5	55.414	53.871	1.318	Open Manhole	1200
SA2.002	o	225	SA6	55.241	53.794	1.222	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SA1.000	38.661	147.0	SA2	55.116	54.273	0.618	Open Manhole	1200
SA1.001	15.043	167.1	SA3	55.000	54.183	0.592	Open Manhole	1200
SA1.002	13.539	20.9	SA7	54.730	53.535	0.970	Open Manhole	1200
SA2.000	25.974	169.8	SA5	55.414	53.871	1.318	Open Manhole	1200
SA2.001	13.211	170.0	SA6	55.241	53.794	1.222	Open Manhole	1200
SA2.002	15.558	60.2	SA7	54.730	53.535	0.970	Open Manhole	1200

PIPELINE SCHEDULES for Storm A

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)
SA1.003	o	300	SA7	54.730	53.460	0.970	Open Manhole	1200
SA1.004	o	300	SA8	54.536	53.352	0.884	Open Manhole	1200
SA3.000	o	225	SA9	54.887	53.762	0.900	Open Manhole	1200
SA1.005	o	300	SA10	54.500	53.248	0.952	Open Manhole	1200
SA1.006	o	300	SA11	56.099	53.170	2.629	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SA1.003	32.517	301.1	SA8	54.536	53.352	0.884	Open Manhole	1200
SA1.004	16.705	160.6	SA10	54.500	53.248	0.952	Open Manhole	1200
SA3.000	15.082	34.4	SA10	54.500	53.323	0.952	Open Manhole	1200
SA1.005	23.499	301.3	SA11	56.099	53.170	2.629	Open Manhole	1200
SA1.006	1.751	300.0	SA12	53.508	53.164	0.044	Open Manhole	0

Area Summary for Storm A

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.077	0.077	0.077
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.026	0.026	0.026
2.000	-	-	100	0.131	0.131	0.131
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.050	0.050	0.050
1.004	-	-	100	0.012	0.012	0.012
3.000	-	-	100	0.024	0.024	0.024
1.005	-	-	100	0.056	0.056	0.056
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.376	0.376	0.376

Network Classifications for Storm A

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
SA1.000	SA1	225	0.095	0.774	Unclassified	1200	0	0.774	Unclassified
SA1.001	SA2	225	0.052	0.618	Unclassified	1200	0	0.618	Unclassified
SA1.002	SA3	225	0.404	0.970	Unclassified	1200	0	0.592	Unclassified
SA2.000	SA4	225	1.225	1.404	Unclassified	1200	0	1.225	Unclassified
SA2.001	SA5	225	1.222	1.318	Unclassified	1200	0	1.318	Unclassified
SA2.002	SA6	225	0.970	1.222	Unclassified	1200	0	1.222	Unclassified
SA1.003	SA7	300	0.869	0.970	Unclassified	1200	0	0.970	Unclassified
SA1.004	SA8	300	0.884	1.077	Unclassified	1200	0	0.884	Unclassified
SA3.000	SA9	225	0.900	1.121	Unclassified	1200	0	0.900	Unclassified
SA1.005	SA10	300	0.952	2.629	Unclassified	1200	0	0.952	Unclassified
SA1.006	SA11	300	0.044	2.883	Unclassified	1200	0	2.629	Unclassified

Free Flowing Outfall Details for Storm A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SA1.006	SA12	53.508	53.164	0.000	0	0

Simulation Criteria for Storm A

Volumetric Runoff Coeff	0.850	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 1
Number of Online Controls 1	Number of Storage Structures 9	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.200	Cv (Summer)	0.850
Return Period (years)	5	Ratio R	0.275	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm A

Hydro-Brake® Optimum Manhole: SA10, DS/PN: SA1.005, Volume (m³): 3.1

Unit Reference	MD-SHE-0045-7000-0500-7000	Sump Available	Yes
Design Head (m)	0.500	Diameter (mm)	45
Design Flow (l/s)	0.7	Invert Level (m)	53.248
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	0.7	Kick-Flo®	0.329	0.6
Flush-Flo™	0.156	0.7	Mean Flow over Head Range	-	0.6

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)	Depth (m)	Flow (l/s)
0.100	0.7	0.600	0.8	1.600	1.2	2.600	1.5	5.000	2.0	7.500	2.4
0.200	0.7	0.800	0.9	1.800	1.2	3.000	1.6	5.500	2.1	8.000	2.5
0.300	0.6	1.000	0.9	2.000	1.3	3.500	1.7	6.000	2.2	8.500	2.6
0.400	0.6	1.200	1.0	2.200	1.4	4.000	1.8	6.500	2.2	9.000	2.6
0.500	0.7	1.400	1.1	2.400	1.4	4.500	1.9	7.000	2.3	9.500	2.7

Storage Structures for Storm A

Infiltration Trench Manhole: SA1, DS/PN: SA1.000

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.035	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	38.7		
Porosity	0.40	Slope (1:X)	147.0		

Infiltration Trench Manhole: SA2, DS/PN: SA1.001

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.816	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	15.0		
Porosity	0.40	Slope (1:X)	167.1		

Complex Manhole: SA3, DS/PN: SA1.002

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.700	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	13.5		
Porosity	0.40	Slope (1:X)	20.9		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.350	Depression Storage (mm)	5
Max Percolation (l/s)	36.1	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	26.0	Membrane Depth (mm)	0

Porous Car Park Manhole: SA4, DS/PN: SA2.000

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.824	Depression Storage (mm)	5
Max Percolation (l/s)	77.4	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	55.7	Membrane Depth (mm)	0

Infiltration Trench Manhole: SA5, DS/PN: SA2.001

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.898	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	4.0	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	4.0		
Porosity	0.40	Slope (1:X)	0.0		

Complex Manhole: SA7, DS/PN: SA1.003

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Safety Factor	2.0	Invert Level (m)	53.430
Infiltration Coefficient Side (m/hr)	0.03728	Porosity	0.40	Trench Width (m)	0.6

Infiltration Trench

Trench Length (m)	32.5	Cap Volume Depth (m)	0.000
Slope (1:X)	500.0	Cap Infiltration Depth (m)	0.000

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.430	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.6	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	2.6		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	53.930	Depression Storage (mm)	5
Max Percolation (l/s)	36.1	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	26.0	Membrane Depth (mm)	0

Complex Manhole: SA8, DS/PN: SA1.004

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.236	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	0.6	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	16.7		
Porosity	0.40	Slope (1:X)	97.3		

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.236	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	3.0		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	53.736	Depression Storage (mm)	5
Max Percolation (l/s)	29.4	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	21.2	Membrane Depth (mm)	0

Porous Car Park Manhole: SA9, DS/PN: SA3.000

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.237	Depression Storage (mm)	5
Max Percolation (l/s)	29.4	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	21.2	Membrane Depth (mm)	0

Complex Manhole: SA10, DS/PN: SA1.005

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Diameter/Width (m)	4.0
Safety Factor	2.0	Invert Level (m)	52.648	Length (m)	40.0

Infiltration Blanket

Cap Volume Depth (m) 0.575

Tank or Pond

Invert Level (m) 54.115

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	0.375	160.0

Manhole Headloss for Storm A

PN	US/MH Name	US/MH Headloss
SA1.000	SA1	0.500
SA1.001	SA2	0.500
SA1.002	SA3	0.500
SA2.000	SA4	0.500
SA2.001	SA5	0.500
SA2.002	SA6	0.500
SA1.003	SA7	0.500
SA1.004	SA8	0.500
SA3.000	SA9	0.500
SA1.005	SA10	0.500
SA1.006	SA11	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm A

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	1
Number of Online Controls	1	Number of Storage Structures	9	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	16.400	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.275	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	30, 30, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

Summary of Critical Results by Maximum Level (Rank 1) for Storm A

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status

PN	US/MH Name	Level Exceeded

Summary of Critical Results by Maximum Level (Rank 1) for Storm A

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SA1.000	SA1	120 Winter	100	+30%					54.578	-0.183	0.000	0.08		146
SA1.001	SA2	480 Winter	100	+30%					54.359	-0.139	0.000	0.03		200
SA1.002	SA3	480 Winter	100	+30%					54.359	-0.049	0.000	0.02		234
SA2.000	SA4	15 Winter	100	+30%	30/15 Summer				54.519	0.270	0.000	1.47		4
SA2.001	SA5	480 Winter	100	+30%	30/15 Summer				54.366	0.269	0.000	0.20		292
SA2.002	SA6	480 Winter	100	+30%	30/60 Winter				54.362	0.344	0.000	0.11		
SA1.003	SA7	480 Winter	100	+30%	30/30 Winter				54.358	0.598	0.000	0.15		259
SA1.004	SA8	480 Winter	100	+30%	30/30 Winter				54.356	0.704	0.000	0.12		324
SA3.000	SA9	480 Winter	100	+30%	30/60 Winter				54.354	0.367	0.000	0.02		123
SA1.005	SA10	480 Winter	100	+30%	1/360 Winter				54.355	0.807	0.000	0.02		
SA1.006	SA11	480 Winter	100	+30%					53.198	-0.271	0.000	0.02		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SA1.000	SA1	3.2	OK	
SA1.001	SA2	1.2	OK	
SA1.002	SA3	2.3	OK	
SA2.000	SA4	53.9	SURCHARGED	
SA2.001	SA5	6.8	SURCHARGED	
SA2.002	SA6	6.5	SURCHARGED	
SA1.003	SA7	8.7	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm A

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SA1.004	SA8	8.7	FLOOD RISK	
SA3.000	SA9	1.3	SURCHARGED	
SA1.005	SA10	1.0	FLOOD RISK	
SA1.006	SA11	1.0	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm B

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.200	Volumetric Runoff Coeff.	0.850	Min Design Depth for Optimisation (m)	0.450
Ratio R	0.275	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	150	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Storm B

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

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

Network Design Table for Storm B

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SB1.000	8.417	0.051	165.0	0.097	4.00	0.0	0.600	o	225	Pipe/Conduit	
SB2.000	8.052	0.196	41.1	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
SB1.001	4.803	0.029	165.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SB3.000	13.472	0.177	76.1	0.054	4.00	0.0	0.600	o	225	Pipe/Conduit	
SB1.002	77.543	0.465	166.8	0.239	0.00	0.0	0.600	o	300	Pipe/Conduit	
SB1.003	3.522	0.018	195.7	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SB1.000	64.86	4.14	54.452	0.097	0.0	0.0	0.0	1.01	40.4	19.3
SB2.000	65.24	4.07	54.597	0.020	0.0	0.0	0.0	2.05	81.4	4.0
SB1.001	64.45	4.22	54.401	0.117	0.0	0.0	0.0	1.01	40.3	23.1
SB3.000	64.80	4.15	54.549	0.054	0.0	0.0	0.0	1.50	59.7	10.7
SB1.002	59.48	5.28	54.297	0.410	0.0	0.0	0.0	1.21	85.9	74.8
SB1.003	59.26	5.33	53.832	0.439	0.0	0.0	0.0	1.12	79.2«	79.8

Network Design Table for Storm B

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SB1.004	20.799	0.069	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SB1.005	2.081	0.007	299.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SB1.004	63.60	4.38	53.814	0.000	0.8	0.0	0.0	0.90	63.8	0.8
SB1.005	63.41	4.42	53.745	0.000	0.8	0.0	0.0	0.90	63.8	0.8

Manhole Schedules for Storm B

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SB1	55.577	1.125	Open Manhole	1200	SB1.000	54.452	225				
SB2	55.722	1.125	Open Manhole	1200	SB2.000	54.597	225				
SB3	55.665	1.264	Open Manhole	1200	SB1.001	54.401	225	SB1.000	54.401	225	
								SB2.000	54.401	225	
SB4	55.674	1.125	Open Manhole	1200	SB3.000	54.549	225				
SB5	55.711	1.414	Open Manhole	1200	SB1.002	54.297	300	SB1.001	54.372	225	
								SB3.000	54.372	225	
SB6	55.176	1.344	Open Manhole	1200	SB1.003	53.832	300	SB1.002	53.832	300	
SB7	55.163	1.349	Open Manhole	1200	SB1.004	53.814	300	SB1.003	53.814	300	
SB8	56.089	2.344	Open Manhole	1200	SB1.005	53.745	300	SB1.004	53.745	300	
SB9	55.000	1.262	Open Manhole	0		OUTFALL		SB1.005	53.738	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SB1	701198.334	737151.346	701198.334	737151.346	Required	

Manhole Schedules for Storm B

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SB2	701207.529	737158.496	701207.529	737158.496	Required	
SB3	701206.707	737150.487	701206.707	737150.487	Required	
SB4	701224.887	737148.621	701224.887	737148.621	Required	
SB5	701211.485	737149.996	701211.485	737149.996	Required	
SB6	701203.775	737072.838	701203.775	737072.838	Required	
SB7	701203.425	737069.333	701203.425	737069.333	Required	
SB8	701201.586	737048.616	701201.586	737048.616	Required	
SB9	701201.379	737046.545			No Entry	

PIPELINE SCHEDULES for Storm B

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)
SB1.000	o	225	SB1	55.577	54.452	0.900	Open Manhole	1200
SB2.000	o	225	SB2	55.722	54.597	0.900	Open Manhole	1200
SB1.001	o	225	SB3	55.665	54.401	1.039	Open Manhole	1200
SB3.000	o	225	SB4	55.674	54.549	0.900	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SB1.000	8.417	165.0	SB3	55.665	54.401	1.039	Open Manhole	1200
SB2.000	8.052	41.1	SB3	55.665	54.401	1.039	Open Manhole	1200
SB1.001	4.803	165.6	SB5	55.711	54.372	1.114	Open Manhole	1200
SB3.000	13.472	76.1	SB5	55.711	54.372	1.114	Open Manhole	1200

PIPELINE SCHEDULES for Storm B

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)
SB1.002	o	300	SB5	55.711	54.297	1.114	Open Manhole	1200
SB1.003	o	300	SB6	55.176	53.832	1.044	Open Manhole	1200
SB1.004	o	300	SB7	55.163	53.814	1.049	Open Manhole	1200
SB1.005	o	300	SB8	56.089	53.745	2.044	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SB1.002	77.543	166.8	SB6	55.176	53.832	1.044	Open Manhole	1200
SB1.003	3.522	195.7	SB7	55.163	53.814	1.049	Open Manhole	1200
SB1.004	20.799	300.0	SB8	56.089	53.745	2.044	Open Manhole	1200
SB1.005	2.081	299.9	SB9	55.000	53.738	0.962	Open Manhole	0

Area Summary for Storm B

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.097	0.097	0.097
2.000	-	-	100	0.020	0.020	0.020
1.001	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.054	0.054	0.054
1.002	-	-	100	0.239	0.239	0.239
1.003	-	-	100	0.029	0.029	0.029
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.439	0.439	0.439

Network Classifications for Storm B

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
SB1.000	SB1	225	0.900	1.077	Unclassified	1200	0	0.900	Unclassified
SB2.000	SB2	225	0.900	1.039	Unclassified	1200	0	0.900	Unclassified
SB1.001	SB3	225	1.021	1.114	Unclassified	1200	0	1.039	Unclassified
SB3.000	SB4	225	0.900	1.114	Unclassified	1200	0	0.900	Unclassified
SB1.002	SB5	300	1.044	1.114	Unclassified	1200	0	1.114	Unclassified
SB1.003	SB6	300	1.044	1.147	Unclassified	1200	0	1.044	Unclassified
SB1.004	SB7	300	1.010	2.044	Unclassified	1200	0	1.049	Unclassified
SB1.005	SB8	300	0.962	2.272	Unclassified	1200	0	2.044	Unclassified

Free Flowing Outfall Details for Storm B

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SB1.005	SB9	55.000	53.738	0.000	0	0

Simulation Criteria for Storm B

Volumetric Runoff Coeff	0.850	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	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 6	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.200	Cv (Summer)	0.850
Return Period (years)	5	Ratio R	0.275	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm B

Hydro-Brake® Optimum Manhole: SB7, DS/PN: SB1.004, Volume (m³): 1.7

Unit Reference	MD-SHE-0044-8000-0790-8000	Sump Available	Yes
Design Head (m)	0.790	Diameter (mm)	44
Design Flow (l/s)	0.8	Invert Level (m)	53.814
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.790	0.8	Kick-Flo®	0.389	0.6
Flush-Flo™	0.193	0.7	Mean Flow over Head Range	-	0.7

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)	Depth (m)	Flow (l/s)
0.100	0.7	0.600	0.7	1.600	1.1	2.600	1.4	5.000	1.8	7.500	2.2
0.200	0.7	0.800	0.8	1.800	1.2	3.000	1.5	5.500	1.9	8.000	2.3
0.300	0.7	1.000	0.9	2.000	1.2	3.500	1.6	6.000	2.0	8.500	2.4
0.400	0.6	1.200	1.0	2.200	1.3	4.000	1.7	6.500	2.1	9.000	2.4
0.500	0.7	1.400	1.0	2.400	1.3	4.500	1.8	7.000	2.1	9.500	2.5

Storage Structures for Storm B

Complex Manhole: SB1, DS/PN: SB1.000

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.427	Depression Storage (mm)	5
Max Percolation (l/s)	38.4	Width (m)	2.4	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	57.6	Membrane Depth (mm)	0

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.927	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	3.0		
Porosity	0.40	Slope (1:X)	0.0		

Complex Manhole: SB2, DS/PN: SB2.000

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Max Percolation (l/s)	28.9	Porosity	0.40
Membrane Percolation (mm/hr)	1000	Safety Factor	1.0	Invert Level (m)	55.072

Porous Car Park

Width (m)	5.0	Slope (1:X)	100.0	Evaporation (mm/day)	3
Length (m)	20.8	Depression Storage (mm)	5	Membrane Depth (mm)	0

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.572	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.1	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	2.1		
Porosity	0.40	Slope (1:X)	0.0		

Infiltration Trench Manhole: SB4, DS/PN: SB3.000

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.524	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	3.0		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park Manhole: SB5, DS/PN: SB1.002

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.061	Depression Storage (mm)	5
Max Percolation (l/s)	113.3	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	81.6	Membrane Depth (mm)	0

Complex Manhole: SB6, DS/PN: SB1.003

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.026	Depression Storage (mm)	5
Max Percolation (l/s)	63.4	Width (m)	5.5	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	41.5	Membrane Depth (mm)	0

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.176	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.1	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	2.1		
Porosity	0.40	Slope (1:X)	0.0		

Complex Manhole: SB7, DS/PN: SB1.004

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.210	Cap Volume Depth (m)	0.600
Safety Factor	2.0	Diameter/Width (m)	4.0		
Porosity	0.40	Length (m)	50.0		

Tank or Pond

Invert Level (m) 54.688

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	0.375	200.0

Manhole Headloss for Storm B

PN	US/MH Name	US/MH Headloss
SB1.000	SB1	0.500
SB2.000	SB2	0.500
SB1.001	SB3	0.500
SB3.000	SB4	0.500
SB1.002	SB5	0.500
SB1.003	SB6	0.500
SB1.004	SB7	0.500
SB1.005	SB8	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm B

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	16.400	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.275	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	30, 30, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

Summary of Critical Results by Maximum Level (Rank 1) for Storm B

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status

PN	US/MH Name	Level Exceeded

Summary of Critical Results by Maximum Level (Rank 1) for Storm B

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SB1.000	SB1	600 Winter	100	+30%	30/15 Summer				55.012	0.335	0.000	0.12		269
SB2.000	SB2	600 Winter	100	+30%	30/240 Winter				55.010	0.188	0.000	0.01		277
SB1.001	SB3	600 Winter	100	+30%	30/15 Summer				55.013	0.387	0.000	0.14		
SB3.000	SB4	600 Winter	100	+30%	30/15 Winter				55.016	0.242	0.000	0.04		298
SB1.002	SB5	600 Winter	100	+30%	30/15 Summer				55.015	0.418	0.000	0.19		409
SB1.003	SB6	600 Winter	100	+30%	1/120 Winter				55.009	0.877	0.000	0.25		400
SB1.004	SB7	600 Winter	100	+30%	1/120 Winter				55.009	0.895	0.000	0.02		
SB1.005	SB8	600 Winter	100	+30%					53.773	-0.271	0.000	0.02		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SB1.000	SB1	3.7	SURCHARGED	
SB2.000	SB2	0.7	SURCHARGED	
SB1.001	SB3	4.2	SURCHARGED	
SB3.000	SB4	2.3	SURCHARGED	
SB1.002	SB5	15.3	SURCHARGED	
SB1.003	SB6	12.5	FLOOD RISK	
SB1.004	SB7	1.0	FLOOD RISK	
SB1.005	SB8	1.0	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm C

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.200	Volumetric Runoff Coeff.	0.850	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.275	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	150	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Storm C

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

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

Network Design Table for Storm C

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SC1.000	10.670	0.064	166.7	0.057	4.00	0.0	0.600	o	225	Pipe/Conduit	
SC2.000	8.277	0.252	32.8	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
SC3.000	12.369	0.074	167.1	0.074	4.00	0.0	0.600	o	225	Pipe/Conduit	
SC2.001	5.354	0.032	166.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SC1.001	76.706	0.384	199.8	0.249	0.00	0.0	0.600	o	300	Pipe/Conduit	
SC1.002	4.073	0.020	203.7	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SC1.000	64.66	4.18	54.741	0.057	0.0	0.0	0.0	1.01	40.1	11.3
SC2.000	65.27	4.06	54.418	0.020	0.0	0.0	0.0	2.29	91.1	4.0
SC3.000	64.51	4.20	54.540	0.074	0.0	0.0	0.0	1.01	40.1	14.7
SC2.001	64.06	4.29	54.166	0.094	0.0	0.0	0.0	1.01	40.2	18.5
SC1.001	58.79	5.45	54.059	0.400	0.0	0.0	0.0	1.11	78.4	72.2
SC1.002	58.54	5.51	53.675	0.447	0.0	0.0	0.0	1.10	77.6«	80.3

Network Design Table for Storm C

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SC1.003	21.070	0.088	240.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SC1.004	2.105	0.009	240.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SC1.003	63.78	4.35	53.655	0.000	0.8	0.0	0.0	1.01	71.4	0.8
SC1.004	63.61	4.38	53.567	0.000	0.8	0.0	0.0	1.01	71.4	0.8

Manhole Schedules for Storm C

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SC1	55.866	1.125	Open Manhole	1200	SC1.000	54.741	225				
SC2	55.843	1.425	Open Manhole	1200	SC2.000	54.418	225				
SC3	55.665	1.125	Open Manhole	1200	SC3.000	54.540	225				
SC4	55.791	1.625	Open Manhole	1200	SC2.001	54.166	225	SC2.000	54.166	225	
								SC3.000	54.466	225	300
SC5	55.808	1.749	Open Manhole	1200	SC1.001	54.059	300	SC1.000	54.677	225	543
								SC2.001	54.134	225	
SC6	55.199	1.524	Open Manhole	1200	SC1.002	53.675	300	SC1.001	53.675	300	
SC7	55.305	1.650	Open Manhole	1200	SC1.003	53.655	300	SC1.002	53.655	300	
SC8	55.800	2.233	Open Manhole	1200	SC1.004	53.567	300	SC1.003	53.567	300	
SC9	56.019	2.461	Open Manhole	0		OUTFALL		SC1.004	53.558	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SC1	701254.274	737145.605	701254.274	737145.605	Required	

Manhole Schedules for Storm C

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SC2	701271.067	737153.219	701271.067	737153.219	Required	
SC3	701281.253	737139.389	701281.253	737139.389	Required	
SC4	701270.222	737144.986	701270.222	737144.986	Required	
SC5	701264.889	737144.515	701264.889	737144.515	Required	
SC6	701257.046	737068.212	701257.046	737068.212	Required	
SC7	701256.629	737064.160	701256.629	737064.160	Required	
SC8	701254.558	737043.192	701254.558	737043.192	Required	
SC9	701254.351	737041.097			No Entry	

PIPELINE SCHEDULES for Storm C

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)
SC1.000	o	225	SC1	55.866	54.741	0.900	Open Manhole	1200
SC2.000	o	225	SC2	55.843	54.418	1.200	Open Manhole	1200
SC3.000	o	225	SC3	55.665	54.540	0.900	Open Manhole	1200
SC2.001	o	225	SC4	55.791	54.166	1.400	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SC1.000	10.670	166.7	SC5	55.808	54.677	0.906	Open Manhole	1200
SC2.000	8.277	32.8	SC4	55.791	54.166	1.400	Open Manhole	1200
SC3.000	12.369	167.1	SC4	55.791	54.466	1.100	Open Manhole	1200
SC2.001	5.354	166.6	SC5	55.808	54.134	1.449	Open Manhole	1200

PIPELINE SCHEDULES for Storm C

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)
SC1.001	o	300	SC5	55.808	54.059	1.449	Open Manhole	1200
SC1.002	o	300	SC6	55.199	53.675	1.224	Open Manhole	1200
SC1.003	o	300	SC7	55.305	53.655	1.350	Open Manhole	1200
SC1.004	o	300	SC8	55.800	53.567	1.933	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SC1.001	76.706	199.8	SC6	55.199	53.675	1.224	Open Manhole	1200
SC1.002	4.073	203.7	SC7	55.305	53.655	1.350	Open Manhole	1200
SC1.003	21.070	240.0	SC8	55.800	53.567	1.933	Open Manhole	1200
SC1.004	2.105	240.0	SC9	56.019	53.558	2.161	Open Manhole	0

Area Summary for Storm C

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.057	0.057	0.057
2.000	-	-	100	0.020	0.020	0.020
3.000	-	-	100	0.074	0.074	0.074
2.001	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.249	0.249	0.249
1.002	-	-	100	0.047	0.047	0.047
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.447	0.447	0.447

Network Classifications for Storm C

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
SC1.000	SC1	225	0.857	0.919	Unclassified	1200	0	0.900	Unclassified
SC2.000	SC2	225	1.200	1.400	Unclassified	1200	0	1.200	Unclassified
SC3.000	SC3	225	0.900	1.100	Unclassified	1200	0	0.900	Unclassified
SC2.001	SC4	225	1.364	1.449	Unclassified	1200	0	1.400	Unclassified
SC1.001	SC5	300	1.224	1.449	Unclassified	1200	0	1.449	Unclassified
SC1.002	SC6	300	1.224	1.355	Unclassified	1200	0	1.224	Unclassified
SC1.003	SC7	300	1.350	1.933	Unclassified	1200	0	1.350	Unclassified
SC1.004	SC8	300	1.933	2.161	Unclassified	1200	0	1.933	Unclassified

Free Flowing Outfall Details for Storm C

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SC1.004	SC9	56.019	53.558	0.000	0	0

Simulation Criteria for Storm C

Volumetric Runoff Coeff	0.850	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	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 4	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.200	Cv (Summer)	0.850
Return Period (years)	5	Ratio R	0.275	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm C

Hydro-Brake® Optimum Manhole: SC7, DS/PN: SC1.003, Volume (m³): 2.1

Unit Reference	MD-SHE-0041-8000-1077-8000	Sump Available	Yes
Design Head (m)	1.077	Diameter (mm)	41
Design Flow (l/s)	0.8	Invert Level (m)	53.655
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.077	0.8	Kick-Flo®	0.364	0.5
Flush-Flo™	0.180	0.6	Mean Flow over Head Range	-	0.6

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)	Depth (m)	Flow (l/s)
0.100	0.6	0.600	0.6	1.600	1.0	2.600	1.2	5.000	1.6	7.500	1.9
0.200	0.6	0.800	0.7	1.800	1.0	3.000	1.3	5.500	1.7	8.000	2.0
0.300	0.6	1.000	0.8	2.000	1.1	3.500	1.4	6.000	1.7	8.500	2.0
0.400	0.5	1.200	0.8	2.200	1.1	4.000	1.4	6.500	1.8	9.000	2.1
0.500	0.6	1.400	0.9	2.400	1.1	4.500	1.5	7.000	1.9	9.500	2.1

Storage Structures for Storm C

Porous Car Park Manhole: SC2, DS/PN: SC2.000

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.193	Depression Storage (mm)	5
Max Percolation (l/s)	28.9	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	20.8	Membrane Depth (mm)	0

Complex Manhole: SC3, DS/PN: SC3.000

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.515	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.1	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	2.1		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.015	Depression Storage (mm)	5
Max Percolation (l/s)	18.7	Width (m)	2.4	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	28.0	Membrane Depth (mm)	0

Complex Manhole: SC6, DS/PN: SC1.002

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.598	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.6	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	2.6		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	54.098	Depression Storage (mm)	5
Max Percolation (l/s)	178.8	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	128.7	Membrane Depth (mm)	0

Complex Manhole: SC7, DS/PN: SC1.003

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.024	Cap Volume Depth (m)	0.550
Safety Factor	2.0	Diameter/Width (m)	4.0		
Porosity	0.40	Length (m)	60.0		

Tank or Pond

Invert Level (m) 54.930

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	0.375	240.0

Manhole Headloss for Storm C

PN	US/MH Name	US/MH Headloss
SC1.000	SC1	0.500
SC2.000	SC2	0.500
SC3.000	SC3	0.500
SC2.001	SC4	0.500
SC1.001	SC5	0.500
SC1.002	SC6	0.500
SC1.003	SC7	0.500
SC1.004	SC8	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm C

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	4	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	16.400	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.275	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	30, 30, 30

WARNING: Half Drain Time has not been calculated as the structure is too full.

Summary of Critical Results by Maximum Level (Rank 1) for Storm C

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status

PN	US/MH Name	Level Exceeded

Summary of Critical Results by Maximum Level (Rank 1) for Storm C

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SC1.000	SC1	15 Winter	100	+30%	30/360 Winter				55.276	0.310	0.000	0.62		
SC2.000	SC2	15 Winter	100	+30%	30/15 Summer				55.234	0.591	0.000	0.12		5
SC3.000	SC3	15 Winter	100	+30%	30/15 Summer				55.256	0.491	0.000	1.09		4
SC2.001	SC4	15 Winter	100	+30%	1/480 Winter				55.231	0.840	0.000	1.53		
SC1.001	SC5	15 Winter	100	+30%	1/360 Winter				55.224	0.865	0.000	1.59		
SC1.002	SC6	720 Winter	100	+30%	1/120 Winter				55.153	1.178	0.000	0.24		444
SC1.003	SC7	720 Winter	100	+30%	1/120 Winter				55.152	1.197	0.000	0.01		
SC1.004	SC8	720 Winter	100	+30%					53.594	-0.273	0.000	0.02		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SC1.000	SC1	21.1	SURCHARGED	
SC2.000	SC2	8.3	SURCHARGED	
SC3.000	SC3	37.6	SURCHARGED	
SC2.001	SC4	45.6	SURCHARGED	
SC1.001	SC5	119.6	SURCHARGED	
SC1.002	SC6	11.8	FLOOD RISK	
SC1.003	SC7	0.9	FLOOD RISK	
SC1.004	SC8	0.9	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm D

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.200	Volumetric Runoff Coeff.	0.850	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.275	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	150	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Storm D

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SD1.000	8.841	0.053	166.8	0.048	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SD1.000	64.82	4.15	54.417	0.048	0.0	0.0	0.0	1.01	40.1	9.5

Network Design Table for Storm D

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SD2.000	6.204	0.051	121.6	0.055	4.00	0.0	0.600	o	225	Pipe/Conduit	
SD2.001	12.067	0.151	79.9	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
SD1.001	56.812	0.227	250.3	0.184	0.00	0.0	0.600	o	300	Pipe/Conduit	
SD1.002	21.486	0.086	249.8	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
SD1.003	1.649	0.007	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SD2.000	65.13	4.09	54.566	0.055	0.0	0.0	0.0	1.18	47.1	11.0
SD2.001	64.41	4.22	54.515	0.070	0.0	0.0	0.0	1.46	58.2	13.8
SD1.001	59.90	5.18	54.289	0.302	0.0	0.0	0.0	0.99	69.9	55.5
SD1.002	63.71	4.36	54.062	0.000	0.6	0.0	0.0	0.99	70.0	0.6
SD1.003	63.57	4.39	53.976	0.000	0.6	0.0	0.0	0.99	70.0	0.6

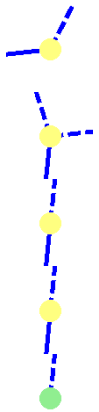
Manhole Schedules for Storm D

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SD1	55.842	1.425	Open Manhole	1200	SD1.000	54.417	225				
SD2	55.991	1.425	Open Manhole	1200	SD2.000	54.566	225				
SD3	55.941	1.426	Open Manhole	1200	SD2.001	54.515	225	SD2.000	54.515	225	
SD4	55.846	1.557	Open Manhole	1200	SD1.001	54.289	300	SD1.000	54.364	225	
								SD2.001	54.364	225	
SD5	55.681	1.619	Open Manhole	1200	SD1.002	54.062	300	SD1.001	54.062	300	
SD6	56.259	2.283	Open Manhole	1200	SD1.003	53.976	300	SD1.002	53.976	300	
SD7	56.469	2.500	Open Manhole	0		OUTFALL		SD1.003	53.969	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SD1	701311.716	737123.932	701311.716	737123.932	Required	
SD2	701329.204	737122.405	701329.204	737122.405	Required	

Manhole Schedules for Storm D

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SD3	701326.397	737116.872	701326.397	737116.872	Required	
SD4	701314.407	737115.510	701314.407	737115.510	Required	
SD5	701308.572	737058.999	701308.572	737058.999	Required	
SD6	701306.365	737037.626	701306.365	737037.626	Required	
SD7	701306.196	737035.986			No Entry	



PIPELINE SCHEDULES for Storm D

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)
SD1.000	o	225	SD1	55.842	54.417	1.200	Open Manhole	1200
SD2.000	o	225	SD2	55.991	54.566	1.200	Open Manhole	1200
SD2.001	o	225	SD3	55.941	54.515	1.201	Open Manhole	1200
SD1.001	o	300	SD4	55.846	54.289	1.257	Open Manhole	1200
SD1.002	o	300	SD5	55.681	54.062	1.319	Open Manhole	1200
SD1.003	o	300	SD6	56.259	53.976	1.983	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SD1.000	8.841	166.8	SD4	55.846	54.364	1.257	Open Manhole	1200
SD2.000	6.204	121.6	SD3	55.941	54.515	1.201	Open Manhole	1200
SD2.001	12.067	79.9	SD4	55.846	54.364	1.257	Open Manhole	1200
SD1.001	56.812	250.3	SD5	55.681	54.062	1.319	Open Manhole	1200
SD1.002	21.486	249.8	SD6	56.259	53.976	1.983	Open Manhole	1200
SD1.003	1.649	250.0	SD7	56.469	53.969	2.200	Open Manhole	0

Area Summary for Storm D

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.048	0.048	0.048
2.000	-	-	100	0.055	0.055	0.055
2.001	-	-	100	0.015	0.015	0.015
1.001	-	-	100	0.184	0.184	0.184
1.002	-	-	100	0.022	0.022	0.022
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.324	0.324	0.324

Network Classifications for Storm D

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
SD1.000	SD1	225	1.200	1.274	Unclassified	1200	0	1.200	Unclassified
SD2.000	SD2	225	1.200	1.205	Unclassified	1200	0	1.200	Unclassified
SD2.001	SD3	225	1.201	1.259	Unclassified	1200	0	1.201	Unclassified
SD1.001	SD4	300	1.118	1.319	Unclassified	1200	0	1.257	Unclassified
SD1.002	SD5	300	1.263	1.983	Unclassified	1200	0	1.319	Unclassified
SD1.003	SD6	300	1.983	2.200	Unclassified	1200	0	1.983	Unclassified

Free Flowing Outfall Details for Storm D

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SD1.003	SD7	56.469	53.969	0.000	0	0

Simulation Criteria for Storm D

Volumetric Runoff Coeff	0.850	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	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 3	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.200	Cv (Summer)	0.850
Return Period (years)	5	Ratio R	0.275	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm D

Hydro-Brake® Optimum Manhole: SD5, DS/PN: SD1.002, Volume (m³): 5.8

Unit Reference	MD-SHE-0035-6000-1103-6000	Sump Available	Yes
Design Head (m)	1.103	Diameter (mm)	35
Design Flow (l/s)	0.6	Invert Level (m)	54.062
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.103	0.6	Kick-Flo®	0.309	0.3
Flush-Flo™	0.155	0.4	Mean Flow over Head Range	-	0.4

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)	Depth (m)	Flow (l/s)
0.100	0.4	0.600	0.5	1.600	0.7	2.600	0.9	5.000	1.2	7.500	1.4
0.200	0.4	0.800	0.5	1.800	0.7	3.000	0.9	5.500	1.2	8.000	1.5
0.300	0.4	1.000	0.6	2.000	0.8	3.500	1.0	6.000	1.3	8.500	1.5
0.400	0.4	1.200	0.6	2.200	0.8	4.000	1.1	6.500	1.3	9.000	1.5
0.500	0.4	1.400	0.7	2.400	0.8	4.500	1.1	7.000	1.4	9.500	1.6

Storage Structures for Storm D

Porous Car Park Manhole: SD3, DS/PN: SD2.001

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.291	Depression Storage (mm)	5
Max Percolation (l/s)	158.8	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	114.3	Membrane Depth (mm)	0

Complex Manhole: SD4, DS/PN: SD1.001

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.696	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	1.5	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	1.5		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.196	Depression Storage (mm)	5
Max Percolation (l/s)	28.8	Width (m)	2.4	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	43.2	Membrane Depth (mm)	0

Complex Manhole: SD5, DS/PN: SD1.002

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.573	Cap Volume Depth (m)	0.375
Safety Factor	2.0	Diameter/Width (m)	4.0		
Porosity	0.40	Length (m)	60.0		

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.531	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Trench Length (m)	3.0		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.031	Depression Storage (mm)	5
Max Percolation (l/s)	451.8	Width (m)	4.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	406.6	Membrane Depth (mm)	0

Tank or Pond

Invert Level (m)	55.306

Tank or Pond

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	0.375	240.0

Manhole Headloss for Storm D

PN	US/MH Name	US/MH Headloss
SD1.000	SD1	0.500
SD2.000	SD2	0.500
SD2.001	SD3	0.500
SD1.001	SD4	0.500
SD1.002	SD5	0.500
SD1.003	SD6	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm D

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	16.400	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.275	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	30, 30, 30

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status

Summary of Critical Results by Maximum Level (Rank 1) for Storm D

PN	US/MH Name	Level Exceeded

Summary of Critical Results by Maximum Level (Rank 1) for Storm D

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SD1.000	SD1	600 Winter	100	+30%	1/360 Winter				55.603	0.961	0.000	0.07		
SD2.000	SD2	600 Winter	100	+30%	1/600 Winter				55.603	0.812	0.000	0.08		
SD2.001	SD3	600 Winter	100	+30%	1/480 Winter				55.602	0.862	0.000	0.05		241
SD1.001	SD4	600 Winter	100	+30%	1/360 Winter				55.602	1.013	0.000	0.17		315
SD1.002	SD5	600 Winter	100	+30%	1/180 Winter				55.597	1.235	0.000	0.01		417
SD1.003	SD6	600 Winter	100	+30%					54.002	-0.274	0.000	0.01		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SD1.000	SD1	2.4	FLOOD RISK	
SD2.000	SD2	2.7	SURCHARGED	
SD2.001	SD3	2.6	SURCHARGED	
SD1.001	SD4	11.6	FLOOD RISK	
SD1.002	SD5	0.7	FLOOD RISK	
SD1.003	SD6	0.7	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm E

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.200	Volumetric Runoff Coeff.	0.850	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.275	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	150	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for Storm E

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

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

Network Design Table for Storm E

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE1.000	49.008	0.294	166.7	0.219	4.00	0.0	0.600	o	225	Pipe/Conduit	
SE1.001	11.211	0.067	167.3	0.046	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE1.002	16.605	0.100	166.1	0.008	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE2.000	13.733	0.096	143.1	0.012	4.00	0.0	0.600	o	225	Pipe/Conduit	
SE2.001	21.601	0.130	166.2	0.073	0.00	0.0	0.600	o	225	Pipe/Conduit	
SE2.002	5.734	0.034	166.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
SE2.003	28.617	0.253	113.1	0.009	0.00	0.0	0.600	o	225	Pipe/Conduit	
SE1.003	3.575	0.021	166.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE1.000	61.56	4.81	54.591	0.219	0.0	0.0	0.0	1.01	40.2«	41.4
SE1.001	60.86	4.96	54.222	0.265	0.0	0.0	0.0	1.21	85.7	49.5
SE1.002	59.87	5.19	54.155	0.273	0.0	0.0	0.0	1.22	86.0	50.2
SE2.000	64.49	4.21	54.643	0.012	0.0	0.0	0.0	1.09	43.4	2.4
SE2.001	62.71	4.57	54.547	0.085	0.0	0.0	0.0	1.01	40.2	16.4
SE2.002	62.25	4.66	54.417	0.085	0.0	0.0	0.0	1.01	40.2	16.4
SE2.003	60.48	5.05	54.383	0.094	0.0	0.0	0.0	1.23	48.8	17.5
SE1.003	59.66	5.24	54.055	0.367	0.0	0.0	0.0	1.22	85.9	67.2

Network Design Table for Storm E

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
SE1.004	1.936	0.065	29.8	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE1.005	19.762	0.079	250.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
SE1.006	1.772	0.007	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

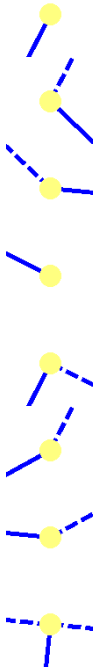
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
SE1.004	65.53	4.01	54.033	0.000	0.8	0.0	0.0	2.89	204.4	0.8
SE1.005	63.80	4.34	53.213	0.000	0.8	0.0	0.0	0.99	69.9	0.8
SE1.006	63.65	4.37	53.134	0.000	0.8	0.0	0.0	0.99	70.0	0.8

Manhole Schedules for Storm E

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SE1	56.016	1.425	Open Manhole	1200	SE1.000	54.591	225				
SE2	55.746	1.524	Open Manhole	1200	SE1.001	54.222	300	SE1.000	54.297	225	
SE3	55.853	1.698	Open Manhole	1200	SE1.002	54.155	300	SE1.001	54.155	300	
SE4	56.068	1.425	Open Manhole	1200	SE2.000	54.643	225				
SE5	55.972	1.425	Open Manhole	1200	SE2.001	54.547	225	SE2.000	54.547	225	
SE6	56.128	1.711	Open Manhole	1200	SE2.002	54.417	225	SE2.001	54.417	225	
SE7	56.161	1.779	Open Manhole	1200	SE2.003	54.383	225	SE2.002	54.383	225	
SE8	55.994	1.939	Open Manhole	1200	SE1.003	54.055	300	SE1.002	54.055	300	
								SE2.003	54.130	225	
SE9	56.143	2.110	Open Manhole	1200	SE1.004	54.033	300	SE1.003	54.033	300	
SE10	56.200	2.987	Open Manhole	1200	SE1.005	53.213	300	SE1.004	53.968	300	755
SE11	56.419	3.285	Open Manhole	1200	SE1.006	53.134	300	SE1.005	53.134	300	
SE12	56.629	3.502	Open Manhole	0		OUTFALL		SE1.006	53.127	300	

Manhole Schedules for Storm E

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SE1	701384.100	737107.933	701384.100	737107.933	Required	
SE2	701361.878	737064.253	701361.878	737064.253	Required	
SE3	701370.003	737056.528	701370.003	737056.528	Required	
SE4	701442.096	737067.924	701442.096	737067.924	Required	
SE5	701429.810	737074.060	701429.810	737074.060	Required	
SE6	701420.023	737054.803	701420.023	737054.803	Required	
SE7	701415.001	737052.036	701415.001	737052.036	Required	
SE8	701386.526	737054.879	701386.526	737054.879	Required	



Manhole Schedules for Storm E

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SE9	701386.171	737051.322	701386.171	737051.322	Required	
SE10	701385.978	737049.395	701385.978	737049.395	Required	
SE11	701384.015	737029.732	701384.015	737029.732	Required	
SE12	701383.839	737027.968			No Entry	

PIPELINE SCHEDULES for Storm E

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)
SE1.000	o	225	SE1	56.016	54.591	1.200	Open Manhole	1200
SE1.001	o	300	SE2	55.746	54.222	1.224	Open Manhole	1200
SE1.002	o	300	SE3	55.853	54.155	1.398	Open Manhole	1200
SE2.000	o	225	SE4	56.068	54.643	1.200	Open Manhole	1200
SE2.001	o	225	SE5	55.972	54.547	1.200	Open Manhole	1200
SE2.002	o	225	SE6	56.128	54.417	1.486	Open Manhole	1200
SE2.003	o	225	SE7	56.161	54.383	1.553	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SE1.000	49.008	166.7	SE2	55.746	54.297	1.224	Open Manhole	1200
SE1.001	11.211	167.3	SE3	55.853	54.155	1.398	Open Manhole	1200
SE1.002	16.605	166.1	SE8	55.994	54.055	1.639	Open Manhole	1200
SE2.000	13.733	143.1	SE5	55.972	54.547	1.200	Open Manhole	1200
SE2.001	21.601	166.2	SE6	56.128	54.417	1.486	Open Manhole	1200
SE2.002	5.734	166.6	SE7	56.161	54.383	1.554	Open Manhole	1200
SE2.003	28.617	113.1	SE8	55.994	54.130	1.639	Open Manhole	1200

PIPELINE SCHEDULES for Storm E

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)
SE1.003	o	300	SE8	55.994	54.055	1.639	Open Manhole	1200
SE1.004	o	300	SE9	56.143	54.033	1.810	Open Manhole	1200
SE1.005	o	300	SE10	56.200	53.213	2.687	Open Manhole	1200
SE1.006	o	300	SE11	56.419	53.134	2.985	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
SE1.003	3.575	166.6	SE9	56.143	54.033	1.810	Open Manhole	1200
SE1.004	1.936	29.8	SE10	56.200	53.968	1.932	Open Manhole	1200
SE1.005	19.762	250.2	SE11	56.419	53.134	2.985	Open Manhole	1200
SE1.006	1.772	250.0	SE12	56.629	53.127	3.202	Open Manhole	0

Area Summary for Storm E

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.219	0.219	0.219
1.001	-	-	100	0.046	0.046	0.046
1.002	-	-	100	0.008	0.008	0.008
2.000	-	-	100	0.012	0.012	0.012
2.001	-	-	100	0.073	0.073	0.073
2.002	-	-	100	0.000	0.000	0.000
2.003	-	-	100	0.009	0.009	0.009
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.044	0.044	0.044
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.411	0.411	0.411

Network Classifications for Storm E

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
SE1.000	SE1	225	1.185	1.224	Unclassified	1200	0	1.200	Unclassified
SE1.001	SE2	300	1.224	1.398	Unclassified	1200	0	1.224	Unclassified
SE1.002	SE3	300	1.398	1.639	Unclassified	1200	0	1.398	Unclassified
SE2.000	SE4	225	1.200	1.200	Unclassified	1200	0	1.200	Unclassified
SE2.001	SE5	225	1.200	1.486	Unclassified	1200	0	1.200	Unclassified
SE2.002	SE6	225	1.486	1.554	Unclassified	1200	0	1.486	Unclassified
SE2.003	SE7	225	1.553	1.639	Unclassified	1200	0	1.553	Unclassified
SE1.003	SE8	300	1.617	1.810	Unclassified	1200	0	1.639	Unclassified
SE1.004	SE9	300	1.810	1.932	Unclassified	1200	0	1.810	Unclassified
SE1.005	SE10	300	2.484	2.985	Unclassified	1200	0	2.687	Unclassified
SE1.006	SE11	300	2.985	3.202	Unclassified	1200	0	2.985	Unclassified

Free Flowing Outfall Details for Storm E

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
SE1.006	SE12	56.629	53.127	0.000	0	0

Simulation Criteria for Storm E

Volumetric Runoff Coeff	0.850	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	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 6	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.200	Cv (Summer)	0.850
Return Period (years)	5	Ratio R	0.275	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm E

Hydro-Brake® Optimum Manhole: SE9, DS/PN: SE1.004, Volume (m³): 2.6

Unit Reference	MD-SHE-0045-8000-0724-8000	Sump Available	Yes
Design Head (m)	0.724	Diameter (mm)	45
Design Flow (l/s)	0.8	Invert Level (m)	54.033
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.724	0.8	Kick-Flo®	0.398	0.6
Flush-Flo™	0.197	0.7	Mean Flow over Head Range	-	0.7

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)	Depth (m)	Flow (l/s)
0.100	0.7	0.600	0.7	1.600	1.1	2.600	1.4	5.000	1.9	7.500	2.3
0.200	0.7	0.800	0.8	1.800	1.2	3.000	1.5	5.500	2.0	8.000	2.4
0.300	0.7	1.000	0.9	2.000	1.3	3.500	1.6	6.000	2.1	8.500	2.5
0.400	0.6	1.200	1.0	2.200	1.3	4.000	1.7	6.500	2.2	9.000	2.5
0.500	0.7	1.400	1.1	2.400	1.4	4.500	1.8	7.000	2.2	9.500	2.6

Storage Structures for Storm E

Complex Manhole: SE2, DS/PN: SE1.001

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	0.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.096	Depression Storage (mm)	5
Max Percolation (l/s)	127.5	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	91.8	Membrane Depth (mm)	0

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	55.096	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	3.0		
Porosity	0.40	Slope (1:X)	0.0		

Complex Manhole: SE3, DS/PN: SE1.002

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Diameter/Width (m)	4.0
Safety Factor	1.0	Invert Level (m)	53.480	Length (m)	43.0

Infiltration Blanket

Cap Volume Depth (m) 0.675

Tank or Pond

Invert Level (m) 55.478

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	43.0	0.375	172.0

Infiltration Trench Manhole: SE5, DS/PN: SE2.001

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	54.822	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.03728	Trench Width (m)	2.1	Cap Infiltration Depth (m)	0.000
Safety Factor	1.0	Trench Length (m)	2.1		
Porosity	0.40	Slope (1:X)	0.0		

Porous Car Park Manhole: SE6, DS/PN: SE2.002

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.478	Depression Storage (mm)	5
Max Percolation (l/s)	35.1	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	25.3	Membrane Depth (mm)	0

Porous Car Park Manhole: SE8, DS/PN: SE1.003

Infiltration Coefficient Base (m/hr)	0.03728	Porosity	0.40	Slope (1:X)	100.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	55.344	Depression Storage (mm)	5
Max Percolation (l/s)	107.5	Width (m)	5.0	Evaporation (mm/day)	3
Safety Factor	1.0	Length (m)	77.4	Membrane Depth (mm)	0

Complex Manhole: SE9, DS/PN: SE1.004

Infiltration Blanket

Infiltration Coefficient Base (m/hr)	0.03728	Invert Level (m)	53.358	Cap Volume Depth (m)	0.675
Safety Factor	1.0	Diameter/Width (m)	4.0		
Porosity	0.40	Length (m)	43.0		

Tank or Pond

Invert Level (m) 55.768

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	43.0	0.375	172.0

Manhole Headloss for Storm E

PN	US/MH Name	US/MH Headloss
SE1.000	SE1	0.500
SE1.001	SE2	0.500
SE1.002	SE3	0.500
SE2.000	SE4	0.500
SE2.001	SE5	0.500
SE2.002	SE6	0.500
SE2.003	SE7	0.500
SE1.003	SE8	0.500
SE1.004	SE9	0.500
SE1.005	SE10	0.500
SE1.006	SE11	0.500

Summary of Critical Results by Maximum Level (Rank 1) for Storm E

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	6	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	16.400	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.275	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	2.5 Second Increment (Extended)	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, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	30, 30, 30

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status

Summary of Critical Results by Maximum Level (Rank 1) for Storm E

PN	US/MH Name	Level Exceeded

Summary of Critical Results by Maximum Level (Rank 1) for Storm E

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)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
SE1.000	SE1	15 Winter	100	+30%	30/15 Summer				55.921	1.105	0.000	2.08		
SE1.001	SE2	360 Winter	100	+30%	30/15 Summer				55.283	0.761	0.000	0.30		90
SE1.002	SE3	360 Winter	100	+30%	30/120 Summer				55.308	0.853	0.000	0.25		411
SE2.000	SE4	360 Winter	100	+30%	30/120 Winter				55.318	0.450	0.000	0.02		
SE2.001	SE5	360 Winter	100	+30%	30/120 Winter				55.318	0.546	0.000	0.17		152
SE2.002	SE6	360 Winter	100	+30%	30/120 Winter				55.328	0.686	0.000	0.21		168
SE2.003	SE7	360 Winter	100	+30%	30/120 Winter				55.334	0.726	0.000	0.15		
SE1.003	SE8	360 Winter	100	+30%	30/120 Summer				55.336	0.981	0.000	0.49		199
SE1.004	SE9	360 Winter	100	+30%	30/120 Summer				55.342	1.009	0.000	0.02		425
SE1.005	SE10	360 Winter	100	+30%					53.237	-0.276	0.000	0.02		
SE1.006	SE11	360 Winter	100	+30%					53.162	-0.272	0.000	0.02		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SE1.000	SE1	79.9	FLOOD RISK	
SE1.001	SE2	19.4	SURCHARGED	
SE1.002	SE3	18.2	SURCHARGED	
SE2.000	SE4	0.9	SURCHARGED	
SE2.001	SE5	6.2	SURCHARGED	
SE2.002	SE6	6.2	SURCHARGED	
SE2.003	SE7	6.9	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm E

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
SE1.003	SE8	25.1	SURCHARGED	
SE1.004	SE9	1.0	SURCHARGED	
SE1.005	SE10	1.0	OK	
SE1.006	SE11	1.0	OK	

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