Kishoge Part 10 Application

Site 3 - Flood Risk Assessment

KSG3-DBFL-XX-XX-RP-C-0004

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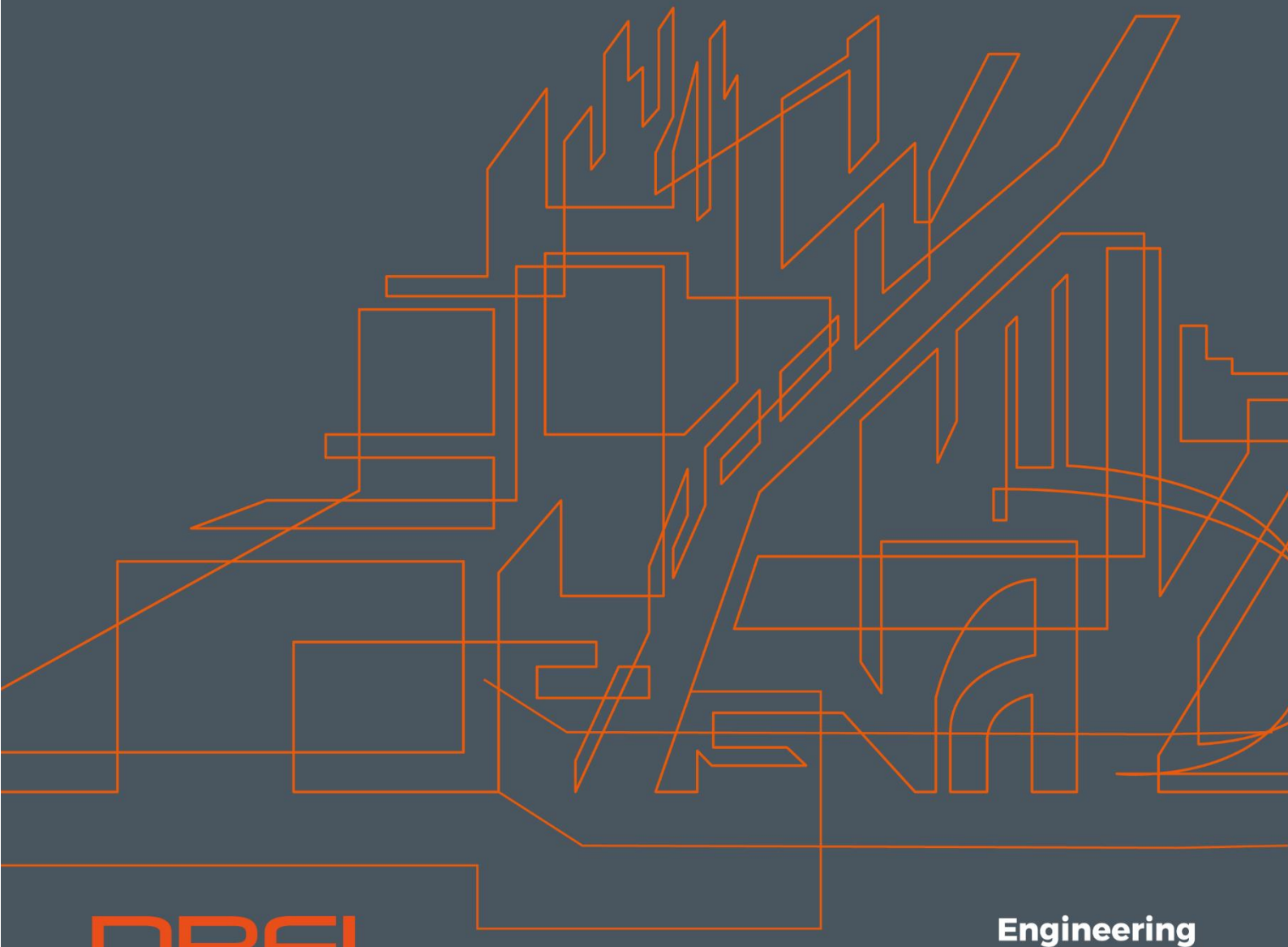

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Engineering Sustainable Futures

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1 INTRODUCTION

DBFL Consulting Engineers have been appointed as the civils design team by South Dublin County Council (SDCC) for the design, build and commissioning of (a social and Affordable Housing Development) within the Clonburris Strategic Development Zone (SDZ) lands. The proposed development site is predominantly undeveloped lands referred to as Kishoge Site 3 (area c. 11.3 ha) adjoining the R136, Adamstown Avenue, Dublin-Cork railway line, and existing housing developments to the north and west.

As part of the National Planning Framework's 2019 Regional Spatial and Economic Strategy, a Strategic Flood Risk Assessment (SFRA) was carried out for the Clonburris Strategic Development Zone (SDZ) to inform the preparation of land-use zoning, policies and objectives. This SFRA was prepared in accordance with the recommendations outlined in OPWs 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' (2009). In this SFRA it was recommended that "At site specific level, all development proposals, regardless of location, will require an appropriately detailed flood risk assessment." A similar recommendation was also made in a separate SFRA carried out as part of the South Dublin County Council's County Development Pan (CDP) 2022 – 2028.

This report outlines the site-specific Flood Risk Assessment of the proposed new social and affordable housing development, at the site referred to as Kishoge Site 3, within the Clonburris Strategic Development Zone (SDZ). This site-specific assessment examines the potential flooding risks to the proposed development from nearby watercourses, in particular, the Camac River, Griffeen River and Grand Canal. This study assesses any impacts of the existing flooding/hydrological regimes of these watercourses, and adjacent lands & properties.

1.1 The Planning System and Flood Risk Management Guidelines

1.1.1 Flood Risk

Understanding flood risk is a key step in managing the impacts of flooding. Flood risk is a combination of the likelihood of flooding and the potential consequences arising:

Flood Risk = (Likelihood of flooding) x (Consequences of flooding)

The likelihood of flooding is defined as the percentage probability of a flood of a given magnitude or severity occurring or being exceeded in any given year. The consequences of flooding depend

on the hazards associated with the flooding and the vulnerability of people, property and the environment potentially affected by a flood.

1.1.2 Likelihood of Flooding (Flood Zones)

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 of flood zones defined for the purposes of flood risk planning guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 years 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);

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.

1.1.3 Consequences of Flooding (Flood Hazards and Development Vulnerability)

The Guidelines provide three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure, emergency service facilities and electricity power stations or sub-stations.
- Less vulnerable, such as retail and commercial and local transport infrastructure
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

1.1.4 Sequential Approach

A sequential approach to the development process is essential when managing flood risk. This involves five principles in the management of flood risk: Avoidance, Substitution, Justification, Mitigation and Proceeding with the development. Figure 1.1 and Figure 1.2 below, extracted from Section 3.1 of the Guidelines, sets out the broad principles and approach underpinning the sequential approach in flood risk management.

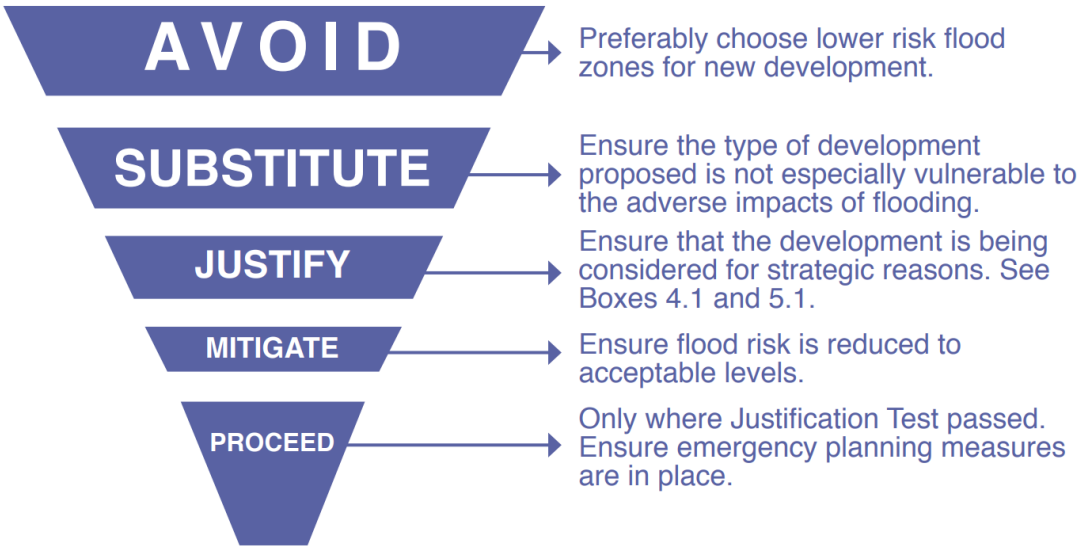

Figure 1.1 Sequential approach principles in flood risk management

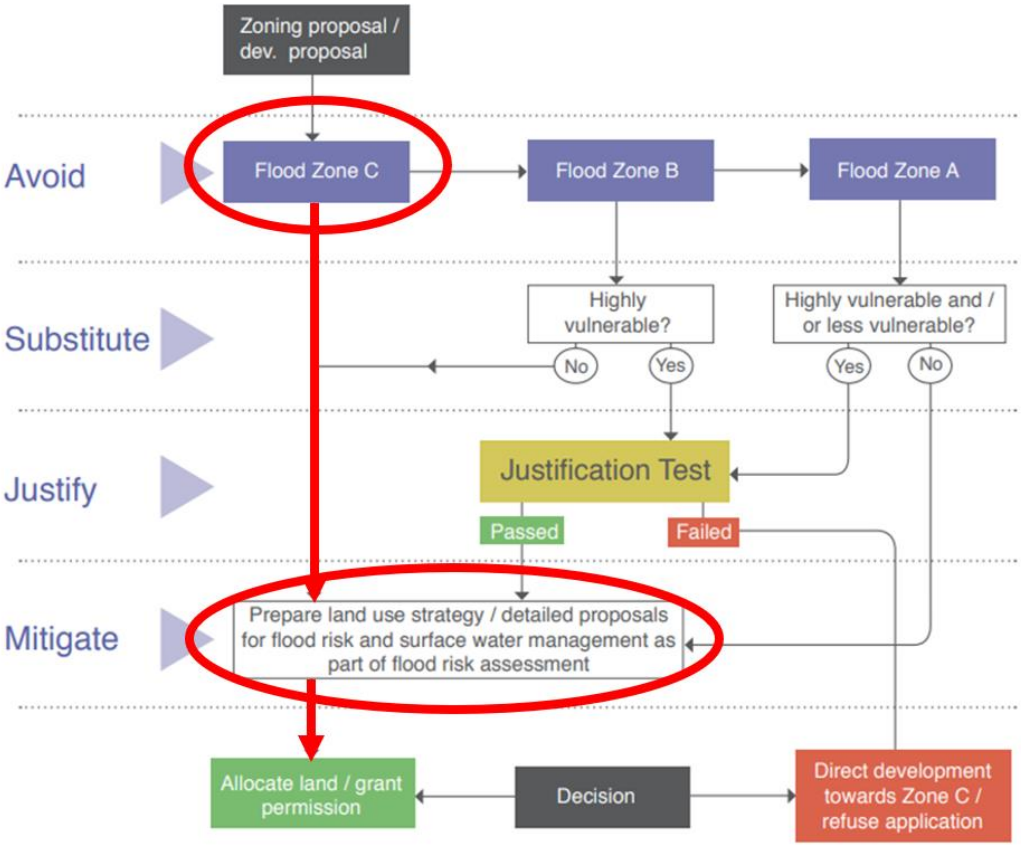

Figure 1.2 Sequential approach in the planning process

1.1.5 Justification test

The Justification Test may be required where a development is considered vulnerable and is located within Flood Zone A or B. The test has been designed to assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk.

Table 1.1 Matrix of vulnerability versus flood zone

	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

1.1.6 Flood Risk Assessment Stages

The Flood Risk Management Guidelines also outlines that a staged approach should be adopted when carrying out a flood risk appraisal or assessment. The stages of appraisal are:

Stage 1 Flood Risk Identification - to identify whether there may be any flooding or surface water management issues related to either the area of regional planning guidelines, development plans and LAP's or a proposed development site that may warrant further investigation at the appropriate lower-level plan or planning application levels.

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 scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed. In addition, the requirements of the detailed assessment should be scoped.

Stage 3 Detailed Flood 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 or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

This site-specific Flood Risk Assessment comprises Stages 1, 2 and 3 involving identification, initial assessment, and a more detailed assessment of flood risk.

2 BACKGROUND

2.1 Site Location

The proposed development site referred to as Kishoge Site 3 is located within the Clonburris SDZ planning scheme boundary. The R136 runs along the eastern boundary of the site, the Cork-Kildare railway line to the south, and existing residential developments to the north and west. The existing Adamstown Avenue bisects the site.

The overall site covers an area of approximately 11.3 Ha and is split into 3 segments by the existing Adamstown Avenue and by the proposed Clonburris Northern Link Street (CNLS) as shown in Figure 2.1.

A series of ESB overhead lines run across the site from east/west and there is an existing ESB substation within the northwest segment of the site.

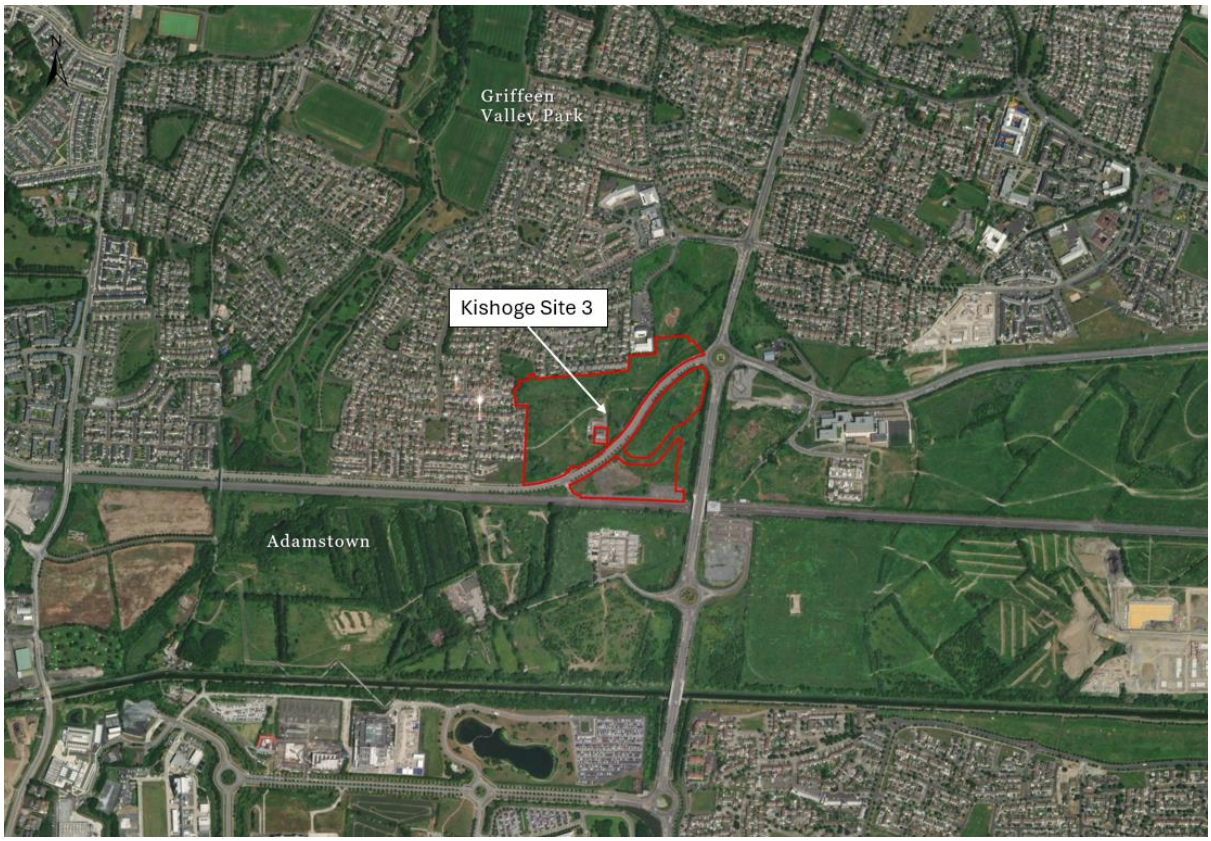

Figure 2.1 Proposed site location

2.2 Proposed Development

The proposed development comprises 580no. residential units in a mix of house, apartment, duplex and triplex units comprising 1-bedroom, 2-bedroom and 3-bedroom typologies; 2-storey

childcare facility; All associated and ancillary site development and infrastructural works including surface level car parking, bicycle parking, hard and soft landscaping and boundary treatment works, including public, communal and private open space, public lighting, bin stores and foul and water services. Vehicular access to the site will be from Adamstown Avenue and the Northern Link Street, proposed under concurrent application Reg. Ref. SDZ24A/0033W.

The finished floor levels of the proposed development to the southeast of Adamstown Avenue ranges from 59.20m to 60.90m AOD. Due to the significant level differences between the exiting site ground and both Adamstown Avenue and the proposed Clonburris Northern Link Street (CNLS), ground levels are proposed to be raised by approximately +1.5m in some locations.

The finished floor levels of the proposed development to the northwest of Adamstown Avenue ranges from 56.29m to 58.60m AOD. Ground levels are proposed to be raised by +0.5m in some areas.

Figure 2.2 Layout of Proposed Development

3 EXISTING SITE CHARACTERISTICS

3.1 Hydrology & Drainage

The proposed development site lies within Hydrometric Area 09 – Liffey and Dublin Bay and is located within the Griffeen River catchment area. The Grand Canal's nearest bank is located approximately 450m South of the site and the Griffeen River flows approximately 650m to the west of the site. The Griffeen River is a tributary of the River Liffey and rises on Saggart Hill in South Dublin and flows towards Lucan until it reaches Griffeen Valley Park. It flows under the Grand Canal through a siphon system and passes through several housing estates, Lucan Village Park and Vessey Park before reaching Griffeen Valley Park. After leaving the park, it flows past Lucan house and demesne and enters the River Liffey at the Lucan Weir.

Figure 3.1 shows the location of the proposed site relative to the nearby watercourses.

Figure 3.1 Watercourses in the vicinity of the proposed site

The Griffeen River has an approximate catchment area of 38 km^2. The main river channel of Griffeen River is relatively steep with a S1085 value of 8.86m/km and has a long-term average annual rainfall total of 754mm.

3.2 Site Topography and Existing Surface Water Drainage

Site topography is an important factor in terms of understanding and assessing the flood risk associated with the site.

The existing ground levels to the northwest of Adamstown Avenue generally range between 55.50m to 58m AOD sloping from southeast to northwest. An existing vegetated embankment forming a boundary between the northeast section of the site and Adamstown Avenue reaches a maximum level of 60.50m AOD. This part of the development is bounded by Adamstown Avenue to the southeast and existing residential developments to the north and west. The proposed road levels of Adamstown Avenue after upgrade works is to range between 57.6m and 60.7m AOD.

The existing site levels to the southeast of Adamstown Avenue generally ranges between 57.50 to 60.00m AOD. There are two soil mounds in the southeast section with a maximum level of 62.50m AOD. An existing vegetated embankment with forms a boundary between the east of the site and Grange Castle Road reaches a maximum level of 67.00m AOD. This part of the development is bounded by Adamstown Avenue to the northwest, the R136 to the east, and the Dublin-Cork railway line to the south. The existing road levels of the R136 ranges approximately from 60.00m and 67.00m AOD. See Figure 3.2 for the existing site topography and levels.

There are no existing surface water drainage networks within the proposed development site. See Figure 3.3 for the existing drainage systems in the vicinity of the proposed development site.

Figure 3.2 Existing topography of proposed site

Figure 3.3 Existing drainage systems in the vicinity of the proposed site

3.3 Geology

The EPA National Soils maps classify the site and surrounding area as a low sub-soil permeability. Despite the low permeability, groundwater vulnerability of the site is classed as "High" as presented in Figure 3.4. This indicates that the underlying aquifer could become contaminated because of activities on the land surface as the topsoil and subsoil layer is thin. Much of the South Dublin region including the subject site is classified as 'LI – Locally Important Aquifer', which signifies bedrock which is moderately productive only in local zone according to GSI Aquifer maps.

The GSI Bedrock 100K map, illustrates that the proposed site is underlain by the Lucan Formation. The formation comprises dark grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. These are rare dark coarser grained calcarenite limestones, sometimes graded, and embedded dark-grey calcar.

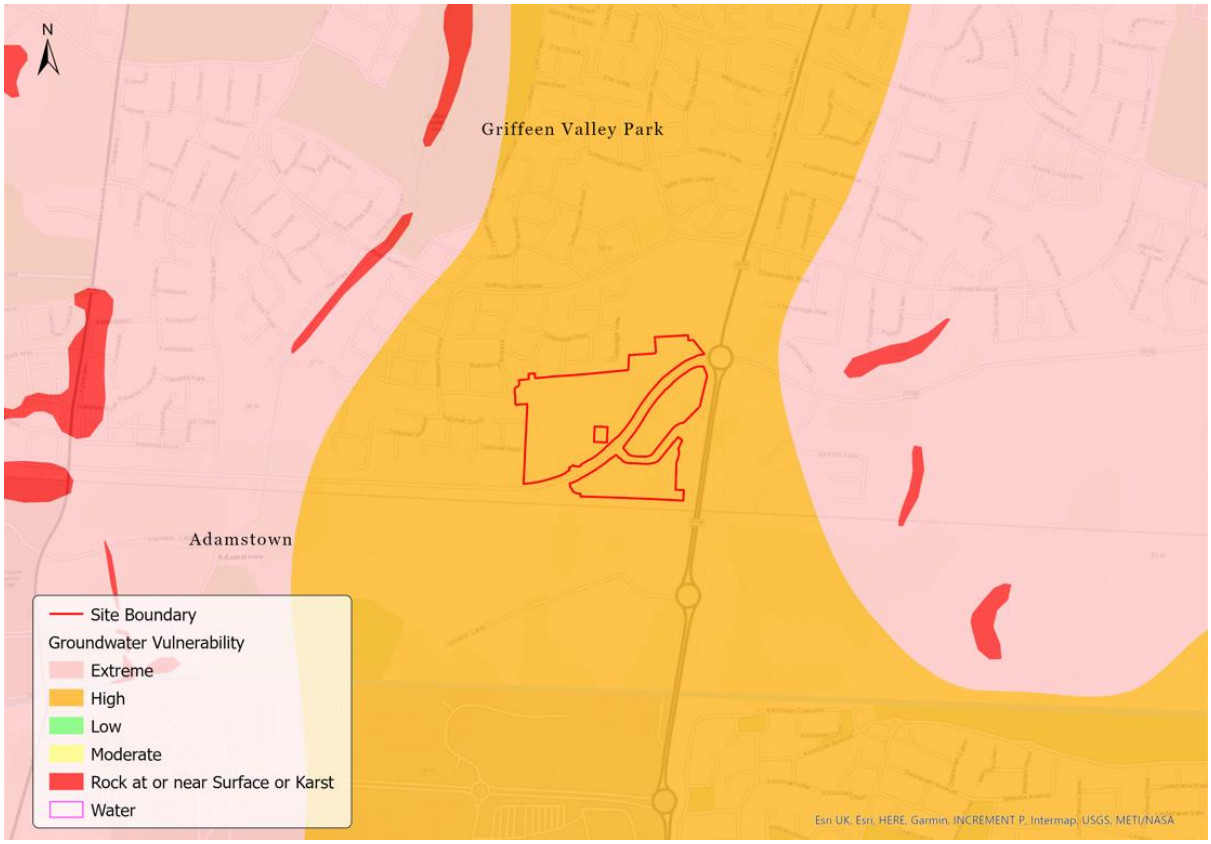

Figure 3.4 GSI Groundwater Vulnerability

3.4 Land Zoning – South Dublin County Development Plan

In the SDCC County Development Plan (CDP) 2022-2028, the Proposed Development site is a part of Clonburris Strategic Development Zone (SDZ), with zoning of residential development, open space and general enterprise featuring in the area as seen in Figure 3.5.

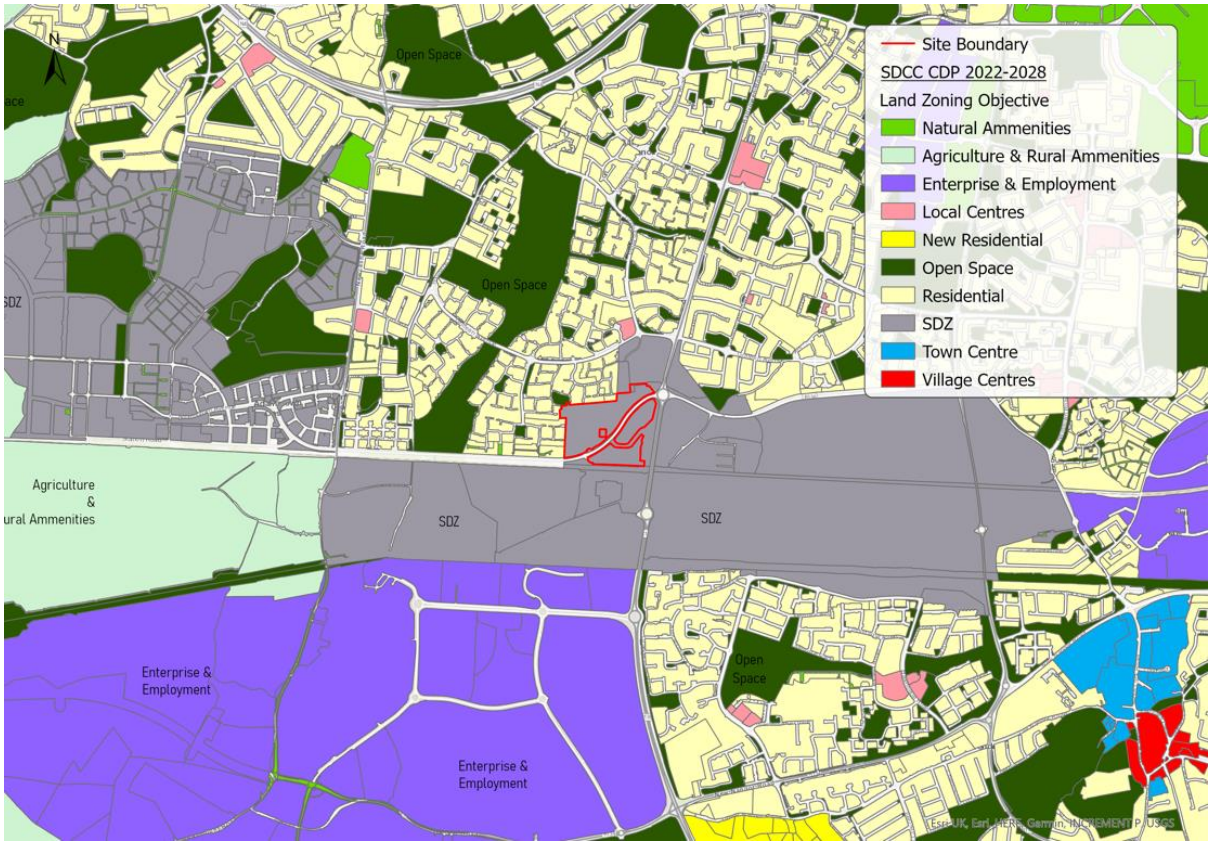

Figure 3.5 SDCC CDP 2022-2028 Land Use Zoning map extract

3.5 Policies in SDCC County Development Plan (CDP) 2022-2028

Flood management policies outlined in the SDCC County Development Plan (CDP) 2022-2028, are as follows:

GI1: Protect, enhance and further develop a multifunctional GI network, using an ecosystem services approach, protecting, enhancing and further developing the identified interconnected network of parks, open spaces, natural features, protected areas, and rivers and streams that provide a shared space for amenity and recreation, biodiversity protection, water quality, flood management and adaptation to climate change.

GI3: Protect and enhance the natural, historical, amenity and biodiversity value of the County's watercourses. Require the long-term management and protection of these watercourses as significant elements of the County's and Region's Green Infrastructure Network and liaise with relevant Prescribed Bodies where appropriate. Accommodate flood waters as far as possible during extreme flooding events and enhance biodiversity and amenity through the designation of riparian corridors and the application of appropriate restrictions to development within these corridors.

IE3: Manage surface water and protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.

IE4: Ensure the continued incorporation of Flood Risk Management into the spatial planning of the County, to meet the requirements of the EU Floods Directive and the EU Water Framework Directive and to promote a climate resilient County

4 FRA STAGE I – FLOOD RISK IDENTIFICATION

This section outlines existing information relevant to flood risks at the proposed development site. The information used to inform this assessment includes previous predictive flood studies and historical mapping.

4.1 Flooding History

4.1.1 OPW Past Flood Events

The OPW Flood Mapping website www.floodinfo.ie provides information about the locations of previously known flood events in Ireland, showing reports, photos and articles about the individual floods. The nearest recorded recurring flood events are approximately 1.5km away from the proposed site. The nearest recorded single flood event occurred approximately 500m to the west of the proposed site location as shown in Figure 4.1.

Table 4.1 shows a summary of flood events recorded within an approximate 2.5km radius to the subject development site. The OPW recorded flood events around this area show that there had been several historical flood events along the floodplains of Camac and Griffeen Rivers in 1982, 1993 and 2000. The main causes of flooding were the sustained heavy rainfall and inadequate capacity of Griffeen and Camac Rivers. It should be noted that during these flood events, the subject development site was not flooded.

Table 4.1 OPW Historic flood event summary

Flood ID	Location	Recorded date of occurrence	Frequency	Source	Description
ID-1183	Beech Row Ronanstown	N/A	Recurring	null	Flooding due to heavy rainfall
ID-1184	Cappaghmore Ronanstown	N/A	Recurring	null	Flooding due to heavy rainfall
ID-487	Camac Clondalkin	11/06/1993	Single	Camac River	Flooding occurred due to Camac River overtopping its banks
ID-2138	Camac Cherrywood	05/11/1982	Single	Camac River	Flooding occurred due to overflow of the River Camac in several areas adjoining the existing housing development.

ID-1237	Griffeen River	05/11/2000	Single	Griffeen River	Severe flooding occurred in the Griffeen Valley, north of the Dublin-Cork Railway line, in the vicinity of the new housing areas of Old Forge and Grange Manor.

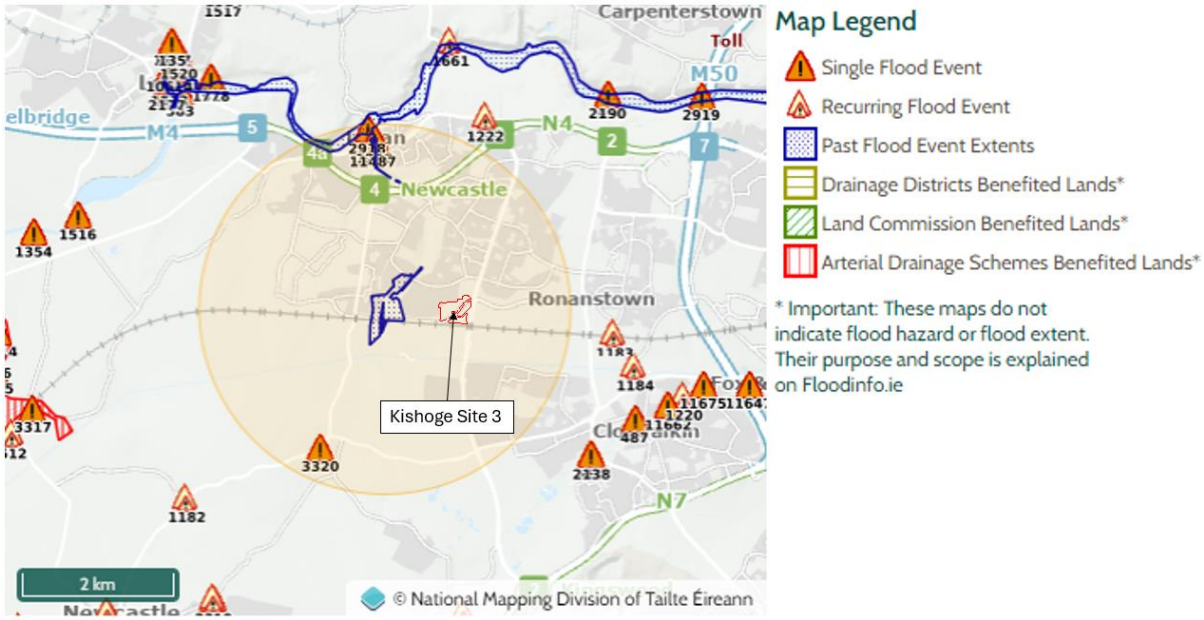

Figure 4.1 OPW Historic flood events

4.1.2 OSi Historical Mapping

Historical maps from Ordnance Survey Ireland (OSi) have been investigated, with none of the maps showing any historical flooding within the proposed development site. Figure 4.2 illustrates an extract from the Osi historic maps for the proposed development site and surrounding areas.

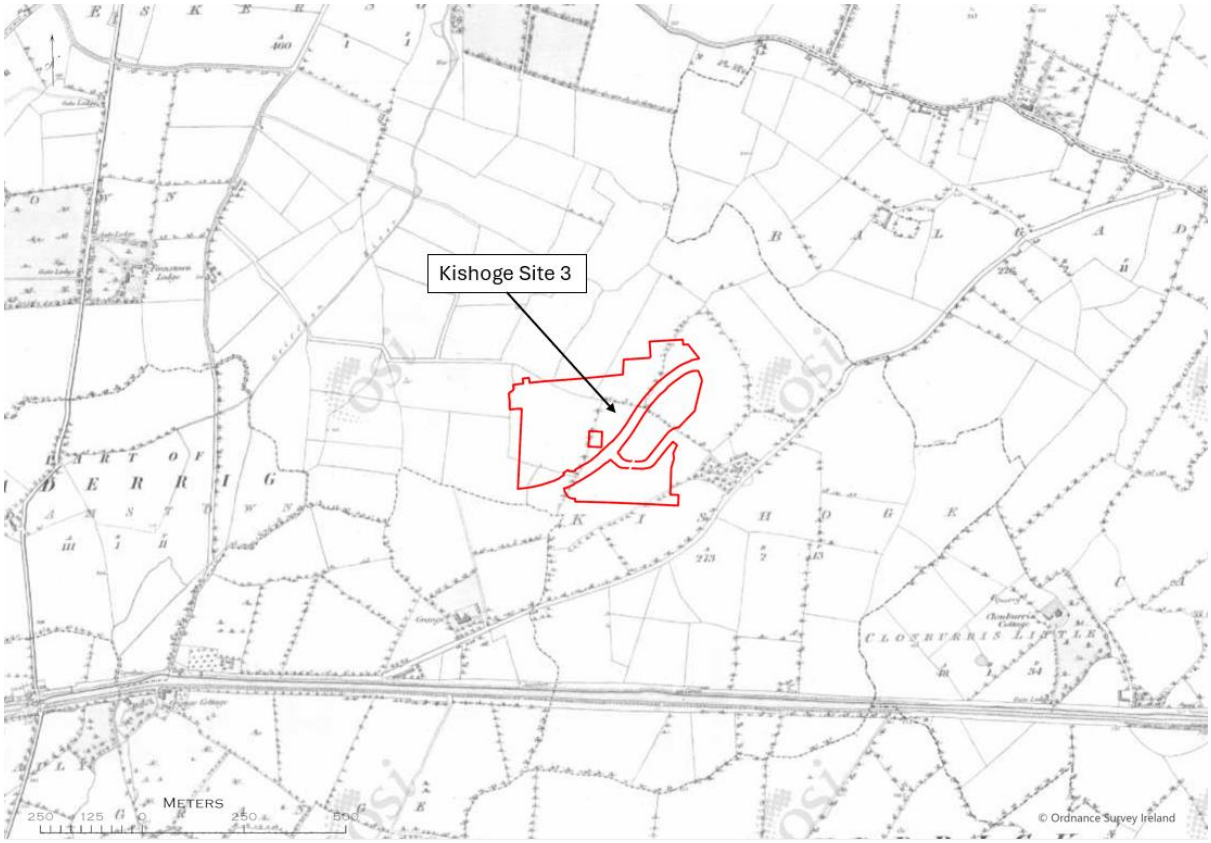

Figure 4.2 OSi Historical map

4.1.3 GSI Historical Groundwater Flooding

There was no historical groundwater flooding identified in the vicinity of the proposed development site.

4.1.4 Pluvial Flooding

There was no pluvial flooding events reported within the proposed development site, although there was an historical event recorded approximately 500m to the west of the proposed site boundary. (See section 4.1.1 above).

4.2 Predictive Flooding

4.2.1 OPW Catchment Flood Risk and Management (CFRAM) Predictive Surface Water Flooding

The Camac and Griffeen Rivers are included in the Eastern CFRAM Study, with flood maps produced. The nearby Royal Canal was not modelled as part of the CFRAM study. The flood maps prepared within this study are 'predictive flood maps' showing the areas predicted to be submerged during a certain 'design' flood event with an estimated probability of occurrence, rather than information for recorded actual floods that have occurred in the past.

The risk of fluvial flooding in the 'present day' scenario to the site is very low as seen in Figure 4.3, as the proposed site boundary lies outside of the predicted 1-in-1000-year fluvial flooding events (Annual Exceedance Probability of 0.1%).

The Mid-Range Future Scenario (MRFS) refers to current day flood extents plus a 20% increase in peak flood flows. The subject site is also shown not to be liable to flooding under this future MRFS scenario (see Figure 4.4).

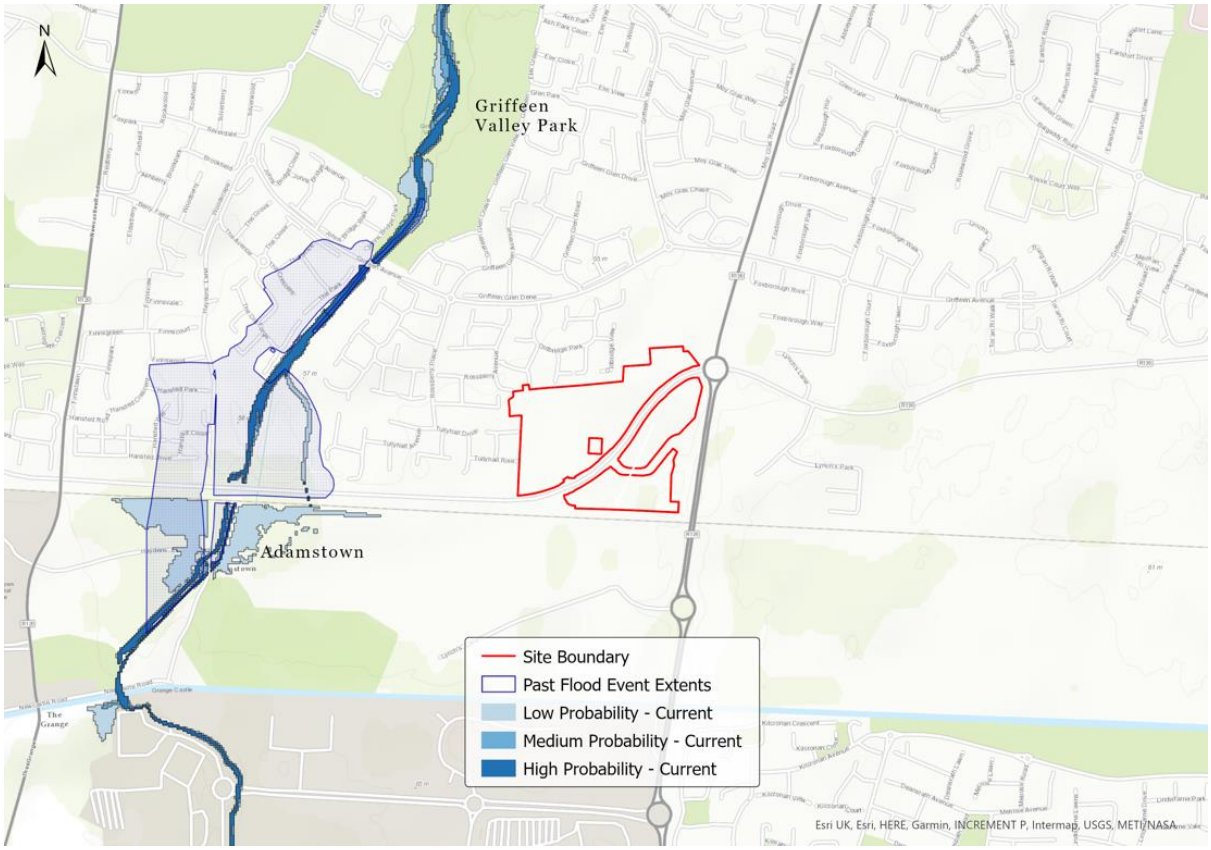

Figure 4.3 OPW CFRAM Predicted river flooding – Present day scenario

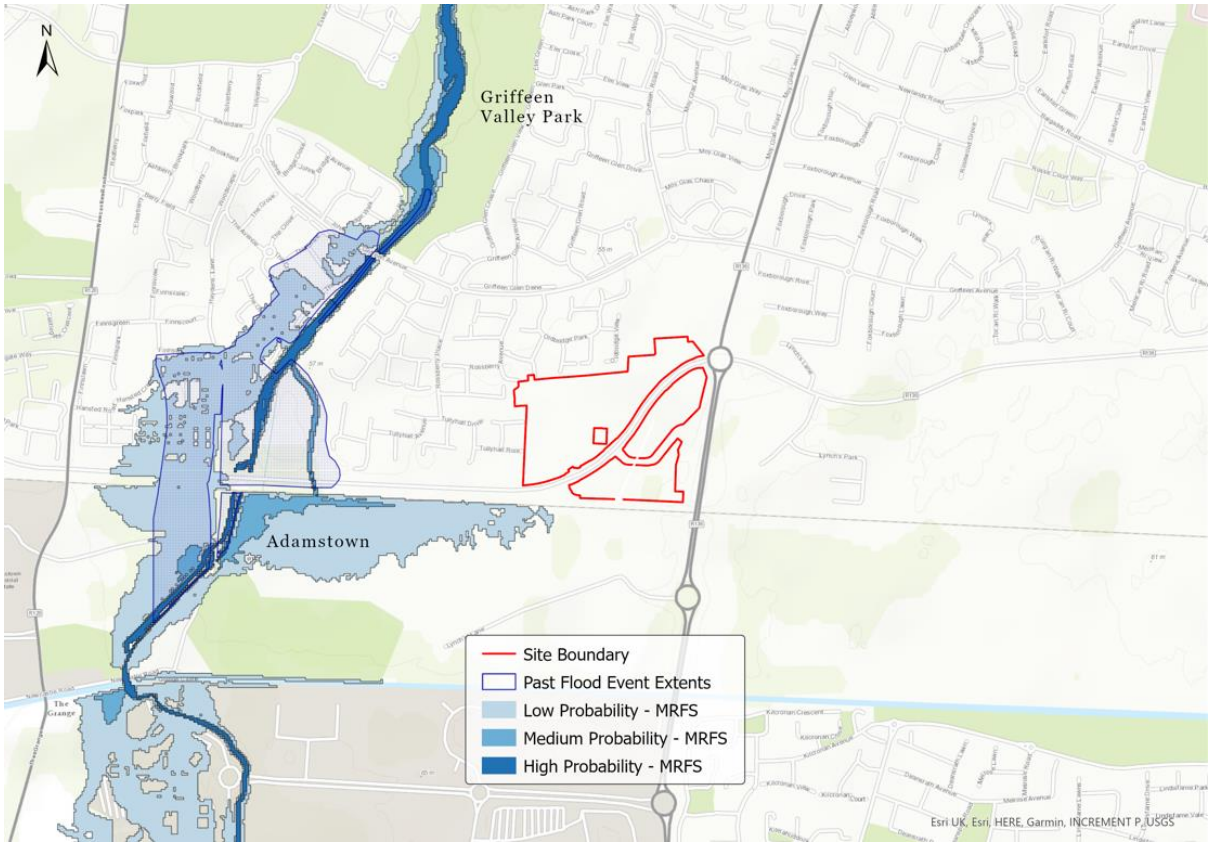

Figure 4.4 OPW CFRAM Predicted river flooding – Medium Range Future Scenario (MRFS)

4.2.2 CFRAM Coastal Hazard Mapping

There is no predicted coastal flooding risk identified at the subject development site in the CFRAM study.

4.2.3 OPW National Indicative Fluvial Mapping (NIFM)

As the location of the proposed development site is included within the CFRAM Study, it is therefore not included within NIFM flood mapping.

4.2.4 GSI GWFlood Predictive Groundwater Flooding

The predictive Groundwater Flood Maps prepared in the Geological Survey of Ireland (GSI) carried out under the GWFlood project (2016-2019) identified no groundwater flooding within the proposed subject site and its immediate vicinity.

4.2.5 Pluvial Flooding

Pluvial flooding is a direct result of extreme rainfall and can occur when the amount of rainfall exceeds the capacity of storm drainage or the ground to absorb it. This excess water flows overland, ponding in natural or man-made hollows and low-lying areas or behind obstructions. Currently, there is no information available on OPW for the proposed development site.

4.2.6 Strategic Flood Risk Assessment (SFRA)

A Strategic Flood Risk Assessment (SFRA) was undertaken as part of the South Dublin County Development Plan (2022-2028). Figure 4.5 and Figure 4.6 displays extracts of the flood zone maps prepared in SDCC SFRA for the land areas in the vicinity of the proposed development site. The flood zone maps show that the proposed development site lies within Flood Zone C (ie. Outside of Flood Zones A & B), where the probability of flooding from rivers is low (less than 1-in-1000 year return period or 0.1% AEP). Refer to section 1.1.2 for further details of various categories of flood zones specified in the Planning Guidelines.

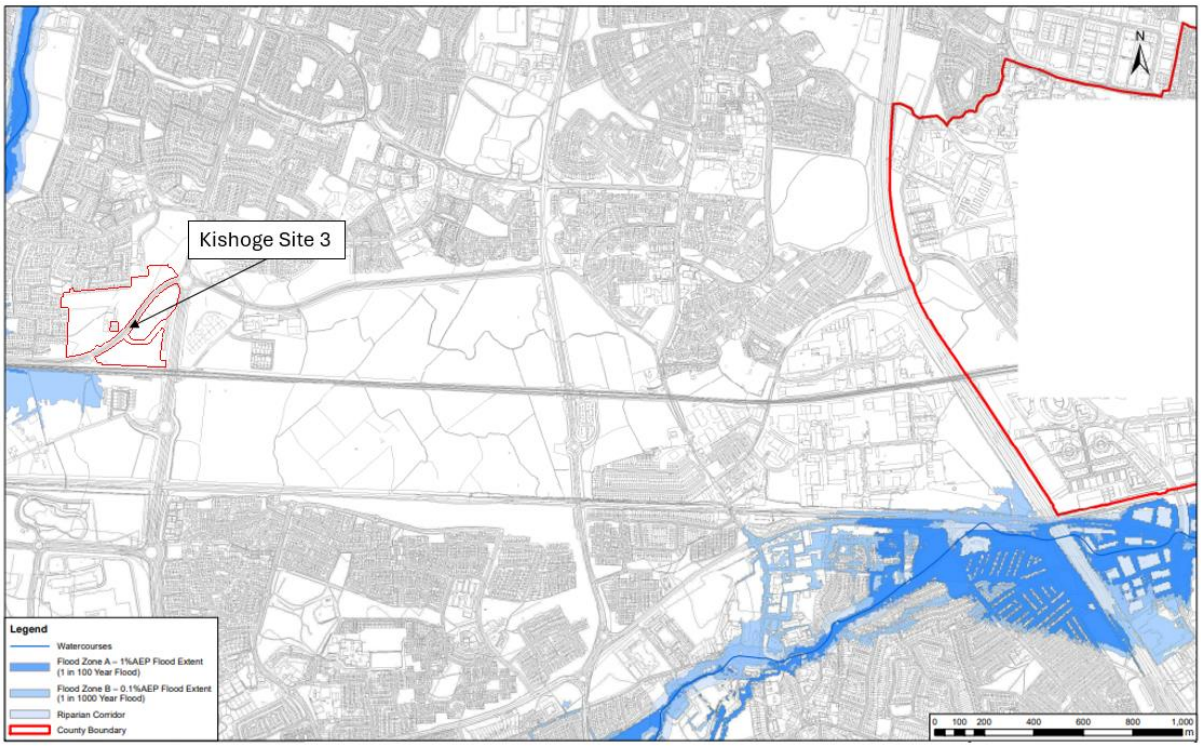

Figure 4.5 SDCC 2022-2028 SFRA flood extents (1)

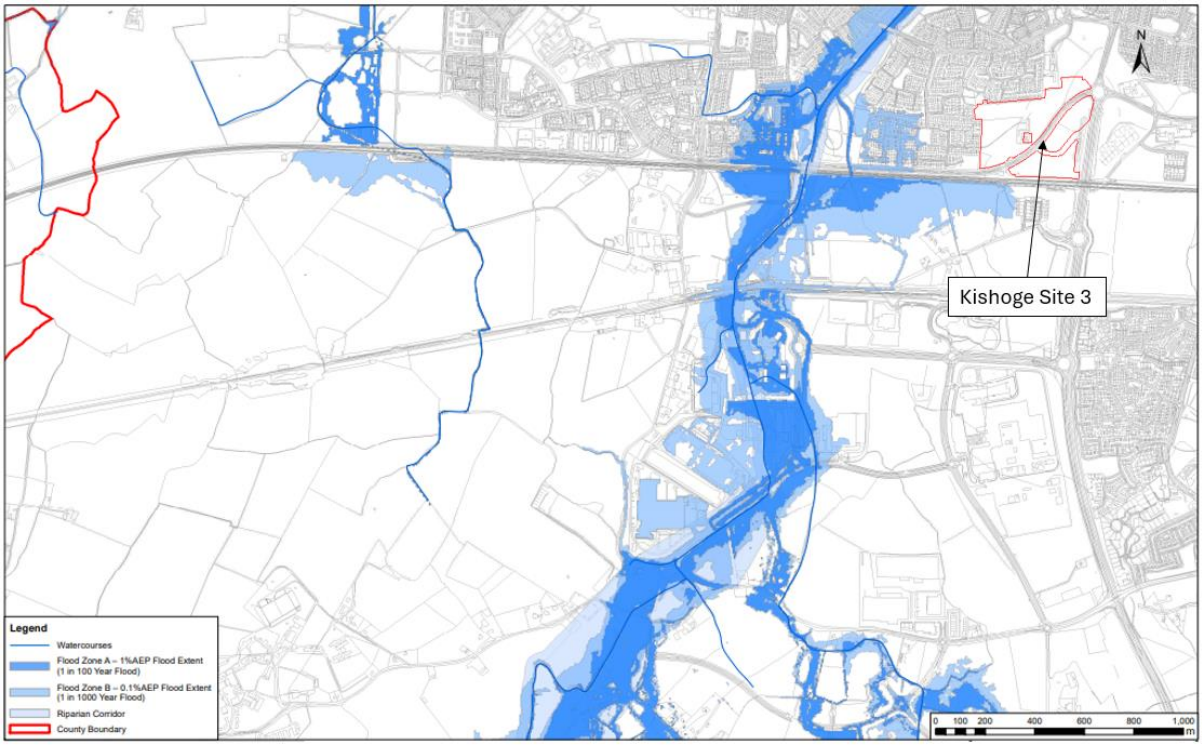

Figure 4.6 SDCC 2022-2028 SFRA flood extents (2)

5 FRA STAGE II – INITIAL FLOOD RISK ASSESSMENT

5.1 Potential Flood Sources

The potential flooding mechanisms in consideration of the proposed development site are summarised in Table 5.1 below.

The purpose of this screening assessment was to identify whether a potential risk of flooding exists and to what extent for the proposed development site. The assessment was based on the collation and assessment of existing current information, historical information and data which may indicate the level or extent of any flood risk.

A source-pathway-receptor model has been produced to summarise the possible sources of floodwater, the pathways by which flood water could reach receptors and the receptors that could be affected by potential flooding. Table 5.1 below outlines effects of various potential sources, the performance and response of pathways and the consequences to the receptors in the context of the proposed development.

Additionally, Table 5.2 showing the risk matrix, explains the impact and likelihood of a flood event on the proposed development.

These sources, pathways and receptors will be assessed further by the initial flood risk assessment stage.

Table 5.1 Source-Pathway-Receptor analysis

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Fluvial	Griffeen River	People / Vehicular route / dwellings / ESB substation	Rare	High	Moderate
Surface Water (Pluvial)	Blockage or surcharging of the proposed surface water drainage network	People / Vehicular route / dwellings / ESB substation	Unlikely	High	Moderate
Ground-water	Rising groundwater levels within the site	People / Vehicular route / dwellings / ESB substation	Unlikely	High	Moderate

Table 5.2 Qualitative risk matrix

		Impact				
		Very Low	Low	Medium	High	Very High
		2	3	4	5	6
Likelihood	Highly Probable	Moderate	Significant	Significant	Severe	Severe
	Probable	Moderate	Moderate	Significant	Significant	Severe
	Possible	Minor	Moderate	Moderate	Significant	Significant
	Unlikely	Minor	Minor	Moderate	Moderate	Significant
	Rare	Minor	Minor	Minor	Moderate	Moderate

5.2 Determination of Flood Zones

After reviewing the flood zone determination guidelines in section 1.1, it is determined, due to the proposed dwellings and the existing ESB sub-station within the site, that the proposed development site is classified as a 'Highly Vulnerable Development'. Table 5.3 below describes the land uses and types of development within the vulnerability class.

Table 5.3 Classification of vulnerability of different types of development

Vulnerability Class	Land uses and types of development which include:
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.

In accordance with 'The Planning and Flood Risk Management' (2009) guidelines, there are three flood zone classifications, which relate to the probability of a flood event occurring. See Table 5.4 below for flood zone descriptions.

Table 5.4 Planning implications relating to each flood zone

Flood Zone	Description
Flood Zone A – High Probability	Most types of development would be considered inappropriate in this zone. Development in this zone should be avoided and/or only considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside

	location, amenity open space, outdoor sports and recreation, would be considered appropriate in this zone.
Flood Zone B – Moderate Probability	Highly vulnerable development, such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses and primary strategic transport and utilities infrastructure, would generally be considered inappropriate in this zone, unless the requirements of the Justification Test can be met. Less vulnerable development, such as retail, commercial and industrial uses, sites used for short-let for caravans and camping and secondary strategic transport and utilities infrastructure, and water-compatible development might be considered appropriate in this zone. In general however, less vulnerable development should only be considered in this zone if adequate lands or sites are not available in Zone C and subject to a flood risk assessment to the appropriate level of detail to demonstrate that flood risk to and from the development can or will adequately be managed.
Flood Zone C – Low Probability	Development in this zone is appropriate from a flood risk perspective (subject to assessment of flood hazard from sources other than rivers and the coast) but would need to meet the normal range of other proper planning and sustainable development considerations.

5.2.1 Coastal Flooding

The proposed development site is not at risk of coastal flooding as the nearby waterbodies are not tidally influenced, therefore no further assessment is carried out. From a coastal flooding perspective, the proposed development site is classified as 'Flood Zone C'.

5.2.2 Fluvial Flooding

The CFRAM Flood Maps shows overbank flooding along the Griffeen River. The proposed development site is approximately 450m to the east of the Griffeen River and outside of any flood risk from 1-in-1000-year storm events. As the proposed development site is classified as Flood Zone C from a river flooding perspective, no further assessment is carried out.

5.2.3 Pluvial Flooding (Urban Drainage)

The subject development proposes a new surface water drainage network which will be split into two separate outfall locations. 4.7 hectares of the western portion of the proposed site will drain

to the existing 600mm outfall sewer in Oldbridge estate to the northwest of the proposed site. The rest of the site will drain into the proposed trunk sewer and route towards the regional attenuation pond to be constructed as part of the separate Clonburris Joint Infrastructure Works. See Figure 5.1 and Figure 5.2 illustrating the proposed surface water drainage discharge strategy.

SuDS systems such as bioretention areas, tree pits and permeable paving have also been proposed across the whole site.

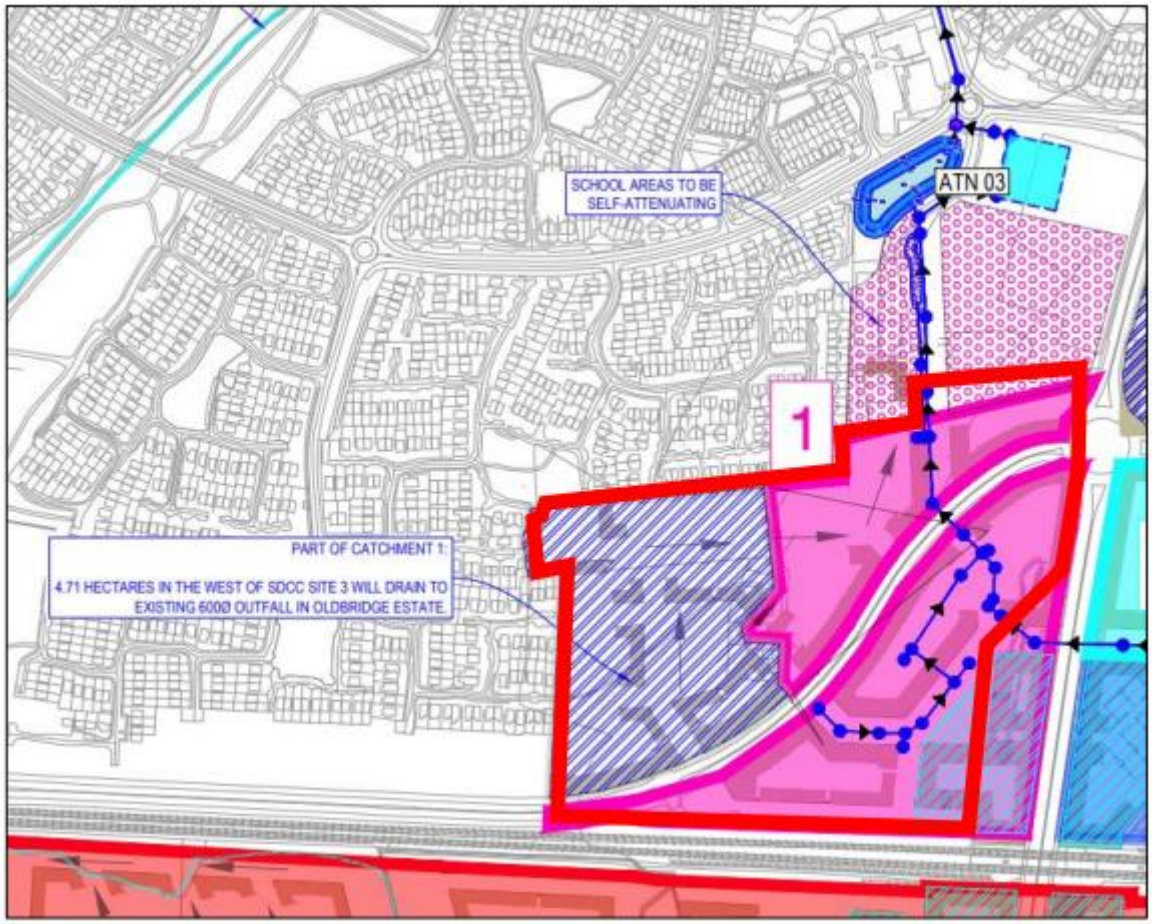

Figure 5.1 Kishoge Site 3 – surface water sub-catchment and outfalls

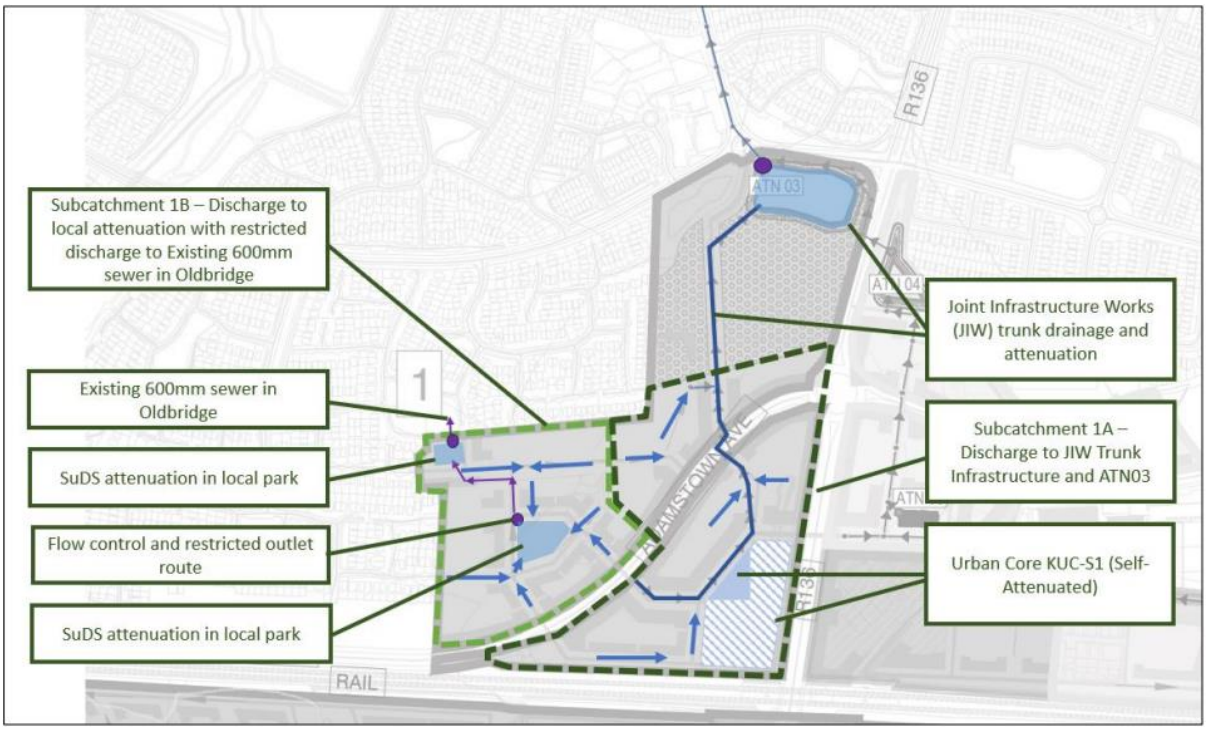

Figure 5.2 Kishoge Site 3 -surface water discharge routes

5.3 Justification Test Requirement

The requirement for a justification test was reviewed for this study to determine whether the proposed works are deemed acceptable in terms of flood risk. The conclusion of 'Stage 1 – Flood Risk Identification' noted that there is no risk of fluvial flooding within the new development from the Griffeen River.

After using the Risk Matrix in Table 5.2, it was deemed that the likelihood of flooding is 'unlikely' due to the stream being in 'Flood Zone C'. The impact of flooding was deemed as 'high', resulting in an overall risk classification of 'moderate'. The requirement for a Justification Test is based on the type of development and flood zone designation is indicated in Table 5.5 below.

Table 5.5 Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test

Type of Development	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

As the location of the proposed development site has been determined as being within 'Flood Zone C' and determined as a 'Highly Vulnerable Development', a justification test is not required to be passed as the development is appropriate.

5.4 Initial Flood Risk Assessment Conclusion

In order to satisfy the justification test there is a requirement to quantify the flood risk at the proposed site and where necessary, mitigate the flood risk.

The initial findings from Stage 2 Assessment are the different potential flood sources in the area. Pluvial flooding has been identified as a 'moderate' risk, while groundwater and fluvial flooding have been identified as 'moderate' risks based on the risk matrix.

After assessing the sources, with flood zone and vulnerability classification, it is determined that the site is 'Highly Vulnerable Development' within 'Flood Zone C'. (see Table 5.5).

Additional findings show that coastal flooding posed no risk to the proposed development site. Fluvial flooding also shows no potential risk to the proposed development site.

The risk of pluvial flooding has been outlined as the main risk due to the existing Balgaddy ESB substation being in close proximity to a proposed Attenuation Pond. In order to ensure the potential flood risks are reduced, mitigating measures must be used where appropriate such as design of Attenuation Pond top water levels and overland flood routing away from the substation.

Although the proposed development site is classified as 'Appropriate' ('Highly Vulnerable' in 'Flood Zone C'), a detailed flood risk assessment is conducted for the existing ESB substation to determine water levels and appropriate flood routing.

6 FRA STAGE III – DETAILED FLOOD RISK ASSESSMENT

Section 5 of this report has concluded that, while a detailed flood risk assessment is not required for the proposed development site, the flood levels and potential impacts need to be determined at the existing ESB substation within the proposed development site. The proposed 'Attenuation Pond A' within the proposed development is located circa 25m to the west of the existing ESB substation. (See Figure 6.1 below).

The proposed surface water drainage network, including the proposed attenuation ponds within the site, were modelled using MicroDrainage.

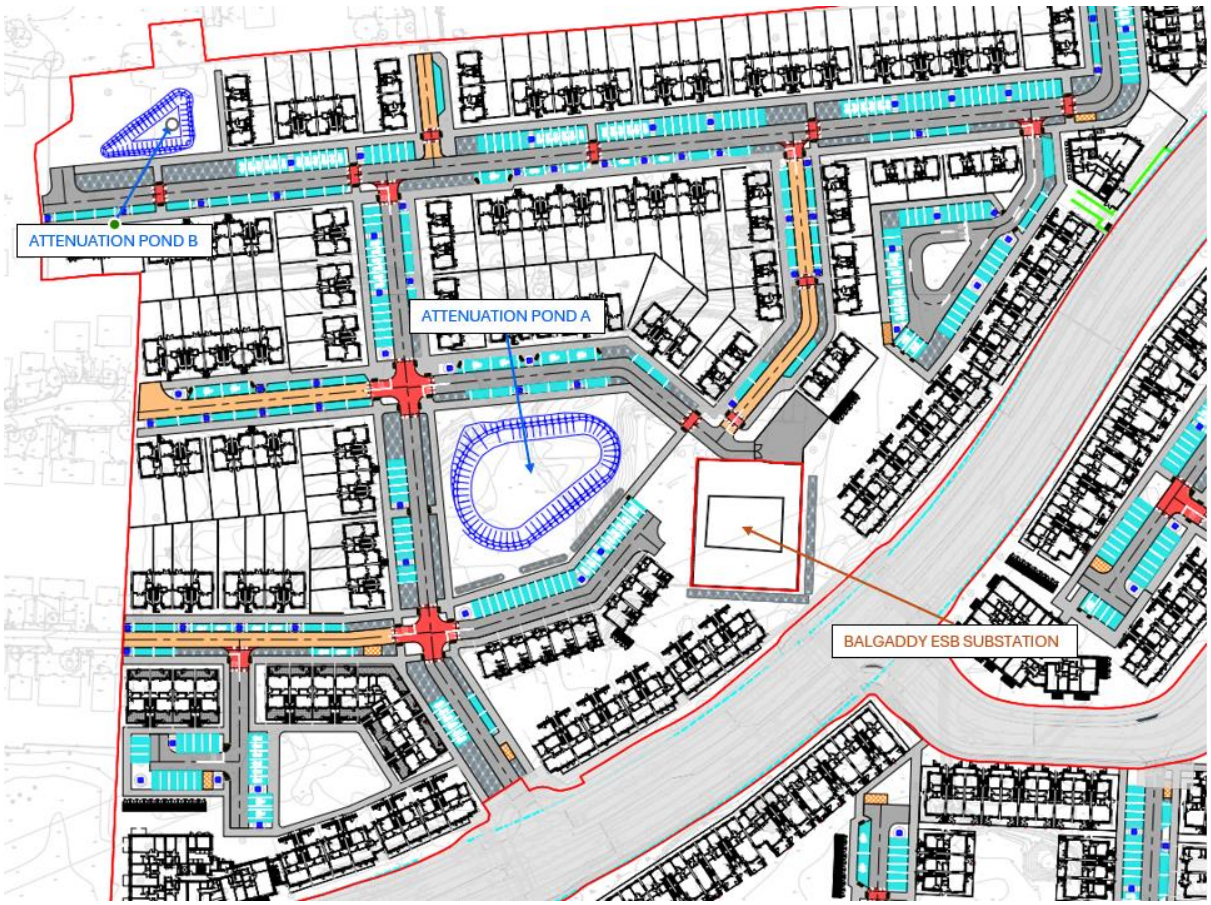

Figure 6.1 Location of ESB substation & 'Attenuation Pond A'

6.1 Attenuation Model & Overland Flood Routes

From the topographical survey carried out, it is determined that the existing ground levels at the ESB substation is **56.90m** AOD.

As shown in Figure 6.2 below, proposed levels fall from southeast to northwest along the proposed roads network towards the proposed 'Attenuation Pond B'. This design ensures that excess storm water is routed away from the existing Balgaddy ESB substation in the case of a network blockage.

Locally around the ESB substation, surface water will be routed around the perimeter of the substation, towards the proposed 'Attenuation Pond A' through bioretention strips and shaping the site levels to suit.

Figure 6.2 Proposed Overland Flood Routing

The 'Attenuation Pond A' has been designed and modelled to hold capacity for a 1% AEP storm (+20% for climate change). The 'Attenuation Pond A' under a 1% AEP storm would have a top water level of **56.401m** AOD.

The top of bank levels of the proposed 'Attenuation Pond A' are **56.80m** AOD.

There is a freeboard level difference of **0.499m** between the ESB substation ground level and the attenuation top water level.

If the 'Attenuation Pond A' were to exceed its capacity and overtop its banks, surface water would flow away from the substation. It would initially route to the northwest of the pond where the

surrounding road level is lowest at **56.75m** AOD. The excess surface water would continue route further north and west towards 'Attenuation Pond B'.

See Figure 6.3 below showing the levels around the existing ESB substation and the proposed attenuation pond.

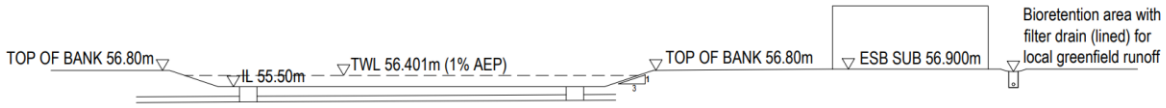

Figure 6.3 'Attenuation Pond A': Section A-A

The detailed calculations obtained from the MicroDrainage analysis tool for the attenuation pond and surface water sub-network around the ESB substation can be found in Appendix B.

6.2 Detailed Flood Risk Assessment Conclusion

The detailed flood risk assessment assesses the potential flood risk at the ESB substation and adjacent 'Attenuation Pond A'.

The levels around the existing ESB substation were observed from the topographical survey as **56.90m** AOD.

The proposed surface water drainage network and attenuation ponds were modelled for a 1% AEP (+20% for climate change) using the MicroDrainage analysis tool.

The results show that the 'Attenuation Pond A' will have a top water level of **56.401m** AOD during a 1% AEP storm.

The proposed top of bank levels of 'Attenuation Pond A' are **56.80m** AOD.

The surrounding landscape levels and proposed road levels create an overland flood route where excess surface water will route away from the ESB substation towards the northwest of the site.

7 PROPOSED SURFACE WATER DRAINAGE SYSTEMS

As previously mentioned in section 5.2.3, the subject development proposes a new surface water drainage network. 4.7 hectares of the western portion of the site will drain to the existing 600mm outfall sewer in OldBridge estate to the northwest of the proposed site. The rest of the site will drain into the proposed trunk sewer and route towards the regional attenuation pond to be constructed as part of the separate Clonburris Joint Infrastructure Works.

An additional +20% rainfall depth is included in the modelling and design of the proposed sites surface water drainage systems to allow for future climate change effects on rainfall volume.

The full proposed drainage layout for the subject development site can be seen in drawing KSG3-DBFL-94-XX-DR-C-1311.

7.1 Flood Impacts

With the application of best practice engineering, it is not anticipated that the proposed development site will be at a risk of flooding. In addition to the proposed main surface water network, a suite of SuDS systems will capture and attenuate the runoff. Proposed attenuation ponds will limit outflows to greenfield runoff rates. Therefore, it is not anticipated that there will be any increased risks of flooding to the adjacent developments and lands.

8 CONCLUSION

The (Stage 1) Flood Risk Identification determined that the site is not likely to be impacted by future flood events. Although a number of past flood events occurred within a 2.5km radius, there were no historical flood events recorded within the proposed development site. CFRAM maps show that the proposed development site is not likely to be impacted by fluvial or coastal flooding.

The (Stage 2) Initial Flood Risk Assessment determined that there are no significant potential flood sources that may affect the proposed development site. Therefore, the proposed development site is categorised as 'Flood Zone C'. Due to the existing ESB substation, the proposed development is classified as a 'Highly Vulnerable Development'. Although there was no need for further justification, a detailed assessment was carried out.

The (Stage 3) Detailed Flood Risk Assessment analysed the potential risk of flooding regarding the existing ESB substation and the proposed adjacent attenuation pond. The detailed assessment concluded that the existing ESB substation is not at risk from flooding. The proposed adjacent attenuation pond is designed to have a top water level of **56.401m** AOD (For a 1% AEP storm) and a top of bank level of **56.80m**. This top of water level of the attenuation pond is over 0.5m lower than the ESB substation level of **56.90m**. An overland flood route will direct any excess surface water away from the ESB substation towards the northwest of the site.

Appendix A : MicroDrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.700	Add Flow / Climate Change (%)	0
Ratio R	0.275	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for SW1

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.134	4-8	1.872	8-12	0.028

Total Area Contributing (ha) = 3.034

Total Pipe Volume (m³) = 154.059

Network Design Table for SW1

« - 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
1.000	27.541	0.138	199.6	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	18.446	0.092	200.5	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	12.450	0.062	200.8	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	19.551	0.098	199.5	0.074	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)
1.000	50.00	4.41	54.818	0.074	0.0	0.0	0.0	1.11	78.4	10.0
1.001	50.00	4.69	54.692	0.148	0.0	0.0	0.0	1.11	78.2	20.0
1.002	50.00	4.88	54.600	0.222	0.0	0.0	0.0	1.11	78.2	30.1
2.000	50.00	4.35	54.603	0.074	0.0	0.0	0.0	0.92	36.7	10.0

Network Design Table for SW1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	38.537	0.128	301.1	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
3.000	19.707	0.099	199.1	0.074	4.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	33.904	0.113	300.0	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	20.943	0.070	299.2	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.006	3.948	0.013	303.7	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.007	68.264	0.228	299.4	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
4.000	28.049	0.140	200.4	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
4.001	55.582	0.278	199.9	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.002	28.871	0.289	99.9	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.003	9.170	0.092	99.7	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.004	6.447	0.032	201.5	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.005	8.171	0.082	99.6	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.006	7.584	0.076	99.8	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.000	27.864	0.139	200.5	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	27.504	0.138	199.3	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.007	46.526	0.381	122.1	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	5.43	54.538	0.370	0.0	0.0	0.0	1.17	185.5	50.1
3.000	50.00	4.23	54.509	0.074	0.0	0.0	0.0	1.44	228.6	10.0
1.004	50.00	5.91	54.410	0.518	0.0	0.0	0.0	1.17	185.8	70.1
1.005	50.00	6.16	54.297	0.592	0.0	0.0	0.0	1.40	396.6	80.2
1.006	50.00	6.21	54.227	0.666	0.0	0.0	0.0	1.39	393.6	90.2
1.007	50.00	7.02	54.214	0.740	0.0	0.0	0.0	1.40	396.4	100.2
4.000	50.00	4.42	55.694	0.074	0.0	0.0	0.0	1.11	78.3	10.0
4.001	50.00	5.26	55.554	0.148	0.0	0.0	0.0	1.11	78.3	20.0
4.002	50.00	5.49	55.289	0.222	0.0	0.0	0.0	2.03	323.5	30.1
4.003	50.00	5.57	55.000	0.296	0.0	0.0	0.0	2.04	323.9	40.1
4.004	50.00	5.64	54.908	0.370	0.0	0.0	0.0	1.43	227.2	50.1
4.005	50.00	5.71	54.844	0.444	0.0	0.0	0.0	2.04	323.9	60.1
4.006	50.00	5.77	54.762	0.518	0.0	0.0	0.0	2.04	323.7	70.1
5.000	50.00	4.42	54.963	0.074	0.0	0.0	0.0	1.11	78.2	10.0
5.001	50.00	4.83	54.824	0.148	0.0	0.0	0.0	1.11	78.5	20.0
4.007	50.00	6.20	54.686	0.740	0.0	0.0	0.0	1.84	292.4	100.2

Network Design Table for SW1

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
6.000	25.107	0.126	199.3	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	12.387	0.039	317.6	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
7.001	4.924	0.039	126.3	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.002	21.167	0.118	179.4	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	20.743	0.104	199.5	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.002	21.048	0.073	288.3	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.008	12.972	0.143	90.7	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.009	11.152	0.111	100.5	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
4.010	13.053	0.065	200.8	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
8.000	65.603	0.328	200.0	0.074	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	66.495	0.332	200.3	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
9.000	51.526	0.258	199.7	0.074	4.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	36.034	0.180	200.2	0.074	0.00	0.0	0.600	o	225	Pipe/Conduit	
10.000	31.085	0.155	200.5	0.074	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)
6.000	50.00	4.38	54.497	0.074	0.0	0.0	0.0	1.11	78.5	10.0
7.000	50.00	4.24	54.566	0.074	0.0	0.0	0.0	0.88	62.0	10.0
7.001	50.00	4.29	54.528	0.148	0.0	0.0	0.0	1.40	98.8	20.0
7.002	50.00	4.60	54.489	0.222	0.0	0.0	0.0	1.17	82.8	30.1
6.001	50.00	4.84	54.371	0.370	0.0	0.0	0.0	1.44	228.4	50.1
6.002	50.00	5.13	54.267	0.444	0.0	0.0	0.0	1.19	189.6	60.1
4.008	50.00	6.30	54.305	1.258	0.0	0.0	0.0	2.14	339.6	170.3
4.009	50.00	6.39	54.162	1.332	0.0	0.0	0.0	2.03	322.6	180.4
4.010	50.00	6.54	54.051	1.406	0.0	0.0	0.0	1.43	227.6	190.4
8.000	50.00	4.99	54.314	0.074	0.0	0.0	0.0	1.11	78.3	10.0
1.008	50.00	7.67	53.986	2.294	0.0	0.0	0.0	1.72	485.5	310.6
9.000	50.00	4.93	54.175	0.074	0.0	0.0	0.0	0.92	36.6	10.0
9.001	50.00	5.58	53.917	0.148	0.0	0.0	0.0	0.92	36.6	20.0
10.000	50.00	4.56	53.892	0.074	0.0	0.0	0.0	0.92	36.6	10.0

Network Design Table for SW1

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
9.002	16.666	0.083	200.8	0.074	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	61.773	0.309	199.9	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
11.000	29.580	0.370	79.9	0.074	4.00	0.0	0.600	o	450	Pipe/Conduit	
1.010	10.296	0.051	201.9	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.011	15.925	0.080	199.1	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.012	12.234	0.061	200.6	0.074	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.013	8.610	0.043	200.2	0.074	0.00	0.0	0.600	o	600	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)
9.002	50.00	5.89	53.737	0.296	0.0	0.0	0.0	0.92	36.5«	40.1
1.009	50.00	8.27	53.654	2.664	0.0	0.0	0.0	1.72	486.0	360.7
11.000	50.00	4.22	53.715	0.074	0.0	0.0	0.0	2.28	361.9	10.0
1.010	50.00	8.37	53.345	2.812	0.0	0.0	0.0	1.71	483.6	380.8
1.011	50.00	8.52	53.294	2.886	0.0	0.0	0.0	1.72	487.0	390.8
1.012	50.00	8.64	53.214	2.960	0.0	0.0	0.0	1.72	485.2	400.8
1.013	50.00	8.72	53.153	3.034	0.0	0.0	0.0	1.72	485.6	410.8

PIPELINE SCHEDULES for SW1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	SA14	57.400	54.818	2.282	Open Manhole	1200
1.001	o	300	SA13	57.100	54.692	2.108	Open Manhole	1200
1.002	o	300	SA12	56.800	54.600	1.900	Open Manhole	1200
2.000	o	225	SA11-1	56.965	54.603	2.137	Open Manhole	1200
1.003	o	450	SA11	56.610	54.538	1.622	Open Manhole	1200
3.000	o	450	SA10-1	56.308	54.509	1.349	Open Manhole	1200
1.004	o	450	SA10	56.346	54.410	1.486	Open Manhole	1200
1.005	o	600	SA9	56.737	54.297	1.840	Open Manhole	1500
1.006	o	600	SA8	56.968	54.227	2.141	Open Manhole	1500
1.007	o	600	SA7	57.033	54.214	2.219	Open Manhole	1500
4.000	o	300	SA6-11	57.300	55.694	1.306	Open Manhole	1200
4.001	o	300	SA6-10	57.300	55.554	1.446	Open Manhole	1200
4.002	o	450	SA6-9	57.705	55.289	1.966	Open Manhole	1200
4.003	o	450	SA6-8	57.149	55.000	1.699	Open Manhole	1200
4.004	o	450	SA6-7	56.990	54.908	1.632	Open Manhole	1200
4.005	o	450	SA6-6	57.023	54.844	1.729	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	27.541	199.6	SA13	57.100	54.680	2.120	Open Manhole	1200
1.001	18.446	200.5	SA12	56.800	54.600	1.900	Open Manhole	1200
1.002	12.450	200.8	SA11	56.610	54.538	1.772	Open Manhole	1200
2.000	19.551	199.5	SA11	56.610	54.505	1.880	Open Manhole	1200
1.003	38.537	301.1	SA10	56.346	54.410	1.486	Open Manhole	1200
3.000	19.707	199.1	SA10	56.346	54.410	1.486	Open Manhole	1200
1.004	33.904	300.0	SA9	56.737	54.297	1.990	Open Manhole	1500
1.005	20.943	299.2	SA8	56.968	54.227	2.141	Open Manhole	1500
1.006	3.948	303.7	SA7	57.033	54.214	2.219	Open Manhole	1500
1.007	68.264	299.4	SA6	56.677	53.986	2.091	Open Manhole	1500
4.000	28.049	200.4	SA6-10	57.300	55.554	1.446	Open Manhole	1200
4.001	55.582	199.9	SA6-9	57.705	55.276	2.129	Open Manhole	1200
4.002	28.871	99.9	SA6-8	57.149	55.000	1.699	Open Manhole	1200
4.003	9.170	99.7	SA6-7	56.990	54.908	1.632	Open Manhole	1200
4.004	6.447	201.5	SA6-6	57.023	54.876	1.697	Open Manhole	1200
4.005	8.171	99.6	SA6-5	57.100	54.762	1.888	Open Manhole	1200

PIPELINE SCHEDULES for SW1

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)
4.006	o	450	SA6-5	57.100	54.762	1.888	Open Manhole	1200
5.000	o	300	SA6-4-2	57.135	54.963	1.872	Open Manhole	1200
5.001	o	300	SA6-4-1	57.074	54.824	1.950	Open Manhole	1200
4.007	o	450	SA6-4	57.137	54.686	2.001	Open Manhole	1200
6.000	o	300	SA6-2-2-1	56.794	54.497	1.997	Open Manhole	1200
7.000	o	300	SA6-2-5	57.131	54.566	2.265	Open Manhole	1200
7.001	o	300	SA6-2-4	57.043	54.528	2.215	Open Manhole	1200
7.002	o	300	SA6-2-3	56.996	54.489	2.207	Open Manhole	1200
6.001	o	450	SA6-2-2	56.977	54.371	2.156	Open Manhole	1200
6.002	o	450	SA6-2-1	57.000	54.267	2.283	Open Manhole	1200
4.008	o	450	SA6-3	57.000	54.305	2.245	Open Manhole	1200
4.009	o	450	SA6-2	57.000	54.162	2.388	Open Manhole	1200
4.010	o	450	SA6-1	56.760	54.051	2.259	Open Manhole	1200
8.000	o	300	SA6-12	57.167	54.314	2.553	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)
4.006	7.584	99.8	SA6-4	57.137	54.686	2.001	Open Manhole	1200
5.000	27.864	200.5	SA6-4-1	57.074	54.824	1.950	Open Manhole	1200
5.001	27.504	199.3	SA6-4	57.137	54.686	2.151	Open Manhole	1200
4.007	46.526	122.1	SA6-3	57.000	54.305	2.245	Open Manhole	1200
6.000	25.107	199.3	SA6-2-2	56.977	54.371	2.306	Open Manhole	1200
7.000	12.387	317.6	SA6-2-4	57.043	54.527	2.216	Open Manhole	1200
7.001	4.924	126.3	SA6-2-3	56.996	54.489	2.207	Open Manhole	1200
7.002	21.167	179.4	SA6-2-2	56.977	54.371	2.306	Open Manhole	1200
6.001	20.743	199.5	SA6-2-1	57.000	54.267	2.283	Open Manhole	1200
6.002	21.048	288.3	SA6-3	57.000	54.194	2.356	Open Manhole	1200
4.008	12.972	90.7	SA6-2	57.000	54.162	2.388	Open Manhole	1200
4.009	11.152	100.5	SA6-1	56.760	54.051	2.259	Open Manhole	1200
4.010	13.053	200.8	SA6	56.677	53.986	2.241	Open Manhole	1500
8.000	65.603	200.0	SA6	56.677	53.986	2.391	Open Manhole	1500

PIPELINE SCHEDULES for SW1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.008	o	600	SA6	56.677	53.986	2.091	Open Manhole	1500
9.000	o	225	SA5-3	57.103	54.175	2.703	Open Manhole	1200
9.001	o	225	SA5-2	56.754	53.917	2.612	Open Manhole	1200
10.000	o	225	SA5-1-1	56.700	53.892	2.583	Open Manhole	1200
9.002	o	225	SA5-1	56.549	53.737	2.587	Open Manhole	1200
1.009	o	600	SA5	56.396	53.654	2.142	Open Manhole	1500
11.000	o	450	SA4-1	55.978	53.715	1.813	Open Manhole	1200
1.010	o	600	SA4	56.099	53.345	2.154	Open Manhole	1500
1.011	o	600	SA3	56.300	53.294	2.406	Open Manhole	1500
1.012	o	600	SA2	56.300	53.214	2.486	Open Manhole	1500
1.013	o	600	SA1	56.300	53.153	2.547	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.008	66.495	200.3	SA5	56.396	53.654	2.142	Open Manhole	1500
9.000	51.526	199.7	SA5-2	56.754	53.917	2.612	Open Manhole	1200
9.001	36.034	200.2	SA5-1	56.549	53.737	2.587	Open Manhole	1200
10.000	31.085	200.5	SA5-1	56.549	53.737	2.587	Open Manhole	1200
9.002	16.666	200.8	SA5	56.396	53.654	2.517	Open Manhole	1500
1.009	61.773	199.9	SA4	56.099	53.345	2.154	Open Manhole	1500
11.000	29.580	79.9	SA4	56.099	53.345	2.304	Open Manhole	1500
1.010	10.296	201.9	SA3	56.300	53.294	2.406	Open Manhole	1500
1.011	15.925	199.1	SA2	56.300	53.214	2.486	Open Manhole	1500
1.012	12.234	200.6	SA1	56.300	53.153	2.547	Open Manhole	1500
1.013	8.610	200.2	SA0	56.000	53.110	2.290	Open Manhole	0

Area Summary for SW1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.074	0.074	0.074
1.001	-	-	100	0.074	0.074	0.074
1.002	-	-	100	0.074	0.074	0.074
2.000	-	-	100	0.074	0.074	0.074
1.003	-	-	100	0.074	0.074	0.074
3.000	-	-	100	0.074	0.074	0.074
1.004	-	-	100	0.074	0.074	0.074
1.005	-	-	100	0.074	0.074	0.074
1.006	-	-	100	0.074	0.074	0.074
1.007	-	-	100	0.074	0.074	0.074
4.000	-	-	100	0.074	0.074	0.074
4.001	-	-	100	0.074	0.074	0.074
4.002	-	-	100	0.074	0.074	0.074
4.003	-	-	100	0.074	0.074	0.074
4.004	-	-	100	0.074	0.074	0.074
4.005	-	-	100	0.074	0.074	0.074
4.006	-	-	100	0.074	0.074	0.074
5.000	-	-	100	0.074	0.074	0.074
5.001	-	-	100	0.074	0.074	0.074
4.007	-	-	100	0.074	0.074	0.074
6.000	-	-	100	0.074	0.074	0.074
7.000	-	-	100	0.074	0.074	0.074
7.001	-	-	100	0.074	0.074	0.074
7.002	-	-	100	0.074	0.074	0.074
6.001	-	-	100	0.074	0.074	0.074
6.002	-	-	100	0.074	0.074	0.074
4.008	-	-	100	0.074	0.074	0.074
4.009	-	-	100	0.074	0.074	0.074
4.010	-	-	100	0.074	0.074	0.074
8.000	-	-	100	0.074	0.074	0.074
1.008	-	-	100	0.074	0.074	0.074
9.000	-	-	100	0.074	0.074	0.074
9.001	-	-	100	0.074	0.074	0.074
10.000	-	-	100	0.074	0.074	0.074
9.002	-	-	100	0.074	0.074	0.074
1.009	-	-	100	0.074	0.074	0.074
11.000	-	-	100	0.074	0.074	0.074
1.010	-	-	100	0.074	0.074	0.074
1.011	-	-	100	0.074	0.074	0.074
1.012	-	-	100	0.074	0.074	0.074
1.013	-	-	100	0.074	0.074	0.074
				Total	Total	Total
				3.034	3.034	3.034

Free Flowing Outfall Details for SW1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	SA0	56.000	53.110	0.000	0	0

Simulation Criteria for SW1

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.700	Storm Duration (mins)	30
Ratio R	0.275		

Online Controls for SW1

Hydro-Brake® Optimum Manhole: SA6-2, DS/PN: 4.009, Volume (m³): 5.1

Unit Reference	MD-SHE-0112-8000-2413-8000
Design Head (m)	2.413
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	54.162
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.413	8.0
Flush-Flo™	0.492	6.6
Kick-Flo®	0.999	5.3
Mean Flow over Head Range	-	6.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	5.8	3.000	8.9	7.000	13.3
0.200	5.8	1.400	6.2	3.500	9.5	7.500	13.7
0.300	6.4	1.600	6.6	4.000	10.2	8.000	14.1
0.400	6.6	1.800	7.0	4.500	10.7	8.500	14.5
0.500	6.6	2.000	7.3	5.000	11.3	9.000	14.9
0.600	6.6	2.200	7.7	5.500	11.8	9.500	15.3
0.800	6.3	2.400	8.0	6.000	12.3		
1.000	5.3	2.600	8.3	6.500	12.8		

Hydro-Brake® Optimum Manhole: SA2, DS/PN: 1.012, Volume (m³): 9.5

Unit Reference	MD-SHE-0150-1450-2507-1450
Design Head (m)	2.507
Design Flow (l/s)	14.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	150
Invert Level (m)	53.214
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Hydro-Brake® Optimum Manhole: SA2, DS/PN: 1.012, Volume (m³): 9.5

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.507	14.5
Flush-Flo™	0.656	13.7
Kick-Flo®	1.342	10.8
Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.4	1.200	12.1	3.000	15.8	7.000	23.7
0.200	11.0	1.400	11.0	3.500	17.0	7.500	24.5
0.300	12.4	1.600	11.7	4.000	18.1	8.000	25.3
0.400	13.1	1.800	12.4	4.500	19.2	8.500	26.0
0.500	13.5	2.000	13.0	5.000	20.2	9.000	26.7
0.600	13.7	2.200	13.6	5.500	21.1	9.500	27.4
0.800	13.6	2.400	14.2	6.000	22.0		
1.000	13.1	2.600	14.8	6.500	22.9		

Storage Structures for SW1

Tank or Pond Manhole: SA6-2, DS/PN: 4.009

Invert Level (m) 55.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1268.0	1.200	2088.0

Tank or Pond Manhole: SA2, DS/PN: 1.012

Invert Level (m) 54.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	500.0	1.200	500.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.275
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.700	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SA14	120 Winter	1	+20%	30/15 Summer			
1.001	SA13	120 Winter	1	+20%	30/15 Summer			
1.002	SA12	120 Winter	1	+20%	1/120 Winter			
2.000	SA11-1	120 Winter	1	+20%	1/60 Winter			
1.003	SA11	120 Winter	1	+20%	30/15 Summer			
3.000	SA10-1	120 Winter	1	+20%	30/15 Summer			
1.004	SA10	120 Winter	1	+20%	1/120 Winter			
1.005	SA9	120 Winter	1	+20%	30/15 Summer			
1.006	SA8	480 Winter	1	+20%	1/120 Winter			
1.007	SA7	480 Winter	1	+20%	1/120 Winter			
4.000	SA6-11	60 Winter	1	+20%	1/30 Winter			
4.001	SA6-10	60 Winter	1	+20%	1/30 Summer			
4.002	SA6-9	60 Winter	1	+20%	1/15 Summer	100/5760 Winter		
4.003	SA6-8	60 Winter	1	+20%	1/15 Summer	100/5760 Winter		
4.004	SA6-7	60 Winter	1	+20%	1/15 Summer			
4.005	SA6-6	60 Winter	1	+20%	1/15 Summer			
4.006	SA6-5	60 Winter	1	+20%	1/15 Summer			
5.000	SA6-4-2	60 Winter	1	+20%	1/15 Summer			
5.001	SA6-4-1	60 Winter	1	+20%	1/15 Summer			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	SA14	54.908	-0.210	0.000	0.06			3.9	OK
1.001	SA13	54.905	-0.087	0.000	0.12			7.8	OK
1.002	SA12	54.902	0.002	0.000	0.18			11.5	SURCHARGED
2.000	SA11-1	54.901	0.073	0.000	0.12			3.8	SURCHARGED
1.003	SA11	54.897	-0.091	0.000	0.11			18.4	OK
3.000	SA10-1	54.885	-0.074	0.000	0.02			3.8	OK
1.004	SA10	54.884	0.024	0.000	0.15			24.6	SURCHARGED
1.005	SA9	54.879	-0.018	0.000	0.08			25.1	OK
1.006	SA8	54.845	0.018	0.000	0.05			11.9	SURCHARGED
1.007	SA7	54.844	0.030	0.000	0.04			13.0	SURCHARGED
4.000	SA6-11	56.107	0.113	0.000	0.08			5.9	SURCHARGED
4.001	SA6-10	56.103	0.249	0.000	0.15			10.9	SURCHARGED
4.002	SA6-9	56.091	0.352	0.000	0.05			12.8	SURCHARGED
4.003	SA6-8	56.087	0.637	0.000	0.09			14.6	SURCHARGED
4.004	SA6-7	56.083	0.725	0.000	0.13			18.4	SURCHARGED
4.005	SA6-6	56.080	0.786	0.000	0.13			22.3	SURCHARGED
4.006	SA6-5	56.075	0.863	0.000	0.15			26.1	SURCHARGED
5.000	SA6-4-2	56.078	0.815	0.000	0.06			4.1	SURCHARGED
5.001	SA6-4-1	56.074	0.950	0.000	0.10			7.4	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	SA14	
1.001	SA13	
1.002	SA12	
2.000	SA11-1	
1.003	SA11	
3.000	SA10-1	
1.004	SA10	
1.005	SA9	
1.006	SA8	
1.007	SA7	
4.000	SA6-11	
4.001	SA6-10	
4.002	SA6-9	
4.003	SA6-8	
4.004	SA6-7	
4.005	SA6-6	
4.006	SA6-5	
5.000	SA6-4-2	
5.001	SA6-4-1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
4.007	SA6-4	60 Winter	1	+20%	1/15 Summer			
6.000	SA6-2-2-1	60 Winter	1	+20%	1/15 Summer			
7.000	SA6-2-5	60 Winter	1	+20%	1/15 Summer			
7.001	SA6-2-4	60 Winter	1	+20%	1/15 Summer			
7.002	SA6-2-3	60 Winter	1	+20%	1/15 Summer			
6.001	SA6-2-2	60 Winter	1	+20%	1/15 Summer			
6.002	SA6-2-1	60 Winter	1	+20%	1/15 Summer			
4.008	SA6-3	180 Winter	1	+20%	1/15 Summer			
4.009	SA6-2	720 Winter	1	+20%	1/15 Summer			
4.010	SA6-1	720 Winter	1	+20%	1/30 Summer			
8.000	SA6-12	1440 Winter	1	+20%	1/30 Summer			
1.008	SA6	480 Winter	1	+20%	1/30 Summer			
9.000	SA5-3	120 Winter	1	+20%	1/15 Winter			
9.001	SA5-2	120 Winter	1	+20%	1/15 Summer			
10.000	SA5-1-1	1440 Winter	1	+20%	1/15 Summer			
9.002	SA5-1	120 Winter	1	+20%	1/15 Summer			
1.009	SA5	720 Winter	1	+20%	1/15 Summer			
11.000	SA4-1	720 Winter	1	+20%	1/15 Summer			
1.010	SA4	720 Winter	1	+20%	1/15 Summer			
1.011	SA3	720 Winter	1	+20%	1/15 Summer			
1.012	SA2	720 Winter	1	+20%	1/15 Summer			
1.013	SA1	15 Winter	1	+20%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
4.007	SA6-4	56.065	0.929	0.000	0.14			37.1	SURCHARGED
6.000	SA6-2-2-1	56.011	1.214	0.000	0.06			4.1	SURCHARGED
7.000	SA6-2-5	56.027	1.161	0.000	0.08			4.1	SURCHARGED
7.001	SA6-2-4	56.023	1.195	0.000	0.14			8.7	SURCHARGED
7.002	SA6-2-3	56.020	1.231	0.000	0.18			13.3	SURCHARGED
6.001	SA6-2-2	56.006	1.185	0.000	0.12			22.1	SURCHARGED
6.002	SA6-2-1	55.997	1.280	0.000	0.17			26.7	SURCHARGED
4.008	SA6-3	55.972	1.217	0.000	0.23			49.7	SURCHARGED
4.009	SA6-2	55.889	1.277	0.000	0.04			6.6	SURCHARGED
4.010	SA6-1	54.846	0.345	0.000	0.04			7.4	SURCHARGED
8.000	SA6-12	54.845	0.231	0.000	0.01			0.8	SURCHARGED
1.008	SA6	54.845	0.259	0.000	0.05			21.8	SURCHARGED
9.000	SA5-3	54.862	0.462	0.000	0.09			3.0	SURCHARGED
9.001	SA5-2	54.856	0.714	0.000	0.18			6.1	SURCHARGED
10.000	SA5-1-1	54.853	0.736	0.000	0.02			0.8	SURCHARGED
9.002	SA5-1	54.845	0.883	0.000	0.37			12.2	SURCHARGED
1.009	SA5	54.841	0.587	0.000	0.06			24.8	SURCHARGED
11.000	SA4-1	54.838	0.673	0.000	0.00			1.2	SURCHARGED
1.010	SA4	54.838	0.893	0.000	0.09			27.3	SURCHARGED
1.011	SA3	54.836	0.942	0.000	0.08			28.5	SURCHARGED

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	SA2	54.834	1.020	0.000	0.04			13.6	SURCHARGED
1.013	SA1	53.261	-0.492	0.000	0.08			21.9	OK

PN	US/MH Name	Level Exceeded
4.007	SA6-4	
6.000	SA6-2-2-1	
7.000	SA6-2-5	
7.001	SA6-2-4	
7.002	SA6-2-3	
6.001	SA6-2-2	
6.002	SA6-2-1	
4.008	SA6-3	
4.009	SA6-2	
4.010	SA6-1	
8.000	SA6-12	
1.008	SA6	
9.000	SA5-3	
9.001	SA5-2	
10.000	SA5-1-1	
9.002	SA5-1	
1.009	SA5	
11.000	SA4-1	
1.010	SA4	
1.011	SA3	
1.012	SA2	
1.013	SA1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.275
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.700	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SA14	60 Summer	30	+20%	30/15 Summer			
1.001	SA13	60 Summer	30	+20%	30/15 Summer			
1.002	SA12	240 Winter	30	+20%	1/120 Winter			
2.000	SA11-1	240 Winter	30	+20%	1/60 Winter			
1.003	SA11	240 Winter	30	+20%	30/15 Summer			
3.000	SA10-1	240 Winter	30	+20%	30/15 Summer			
1.004	SA10	240 Winter	30	+20%	1/120 Winter			
1.005	SA9	720 Winter	30	+20%	30/15 Summer			
1.006	SA8	720 Winter	30	+20%	1/120 Winter			
1.007	SA7	720 Winter	30	+20%	1/120 Winter			
4.000	SA6-11	30 Summer	30	+20%	1/30 Winter			
4.001	SA6-10	30 Summer	30	+20%	1/30 Summer			
4.002	SA6-9	30 Summer	30	+20%	1/15 Summer	100/5760 Winter		
4.003	SA6-8	30 Summer	30	+20%	1/15 Summer	100/5760 Winter		
4.004	SA6-7	15 Winter	30	+20%	1/15 Summer			
4.005	SA6-6	15 Winter	30	+20%	1/15 Summer			
4.006	SA6-5	180 Winter	30	+20%	1/15 Summer			
5.000	SA6-4-2	30 Summer	30	+20%	1/15 Summer			
5.001	SA6-4-1	30 Summer	30	+20%	1/15 Summer			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	SA14	55.696	0.578	0.000	0.19			13.2	SURCHARGED
1.001	SA13	55.678	0.686	0.000	0.36			24.2	SURCHARGED
1.002	SA12	55.627	0.727	0.000	0.25			15.6	SURCHARGED
2.000	SA11-1	55.625	0.797	0.000	0.16			5.2	SURCHARGED
1.003	SA11	55.618	0.630	0.000	0.16			25.9	SURCHARGED
3.000	SA10-1	55.610	0.651	0.000	0.03			5.3	SURCHARGED
1.004	SA10	55.608	0.748	0.000	0.22			36.5	SURCHARGED
1.005	SA9	55.587	0.690	0.000	0.06			18.4	SURCHARGED
1.006	SA8	55.586	0.759	0.000	0.09			20.7	SURCHARGED
1.007	SA7	55.586	0.772	0.000	0.06			22.9	SURCHARGED
4.000	SA6-11	56.874	0.880	0.000	0.22			15.5	SURCHARGED
4.001	SA6-10	56.854	1.000	0.000	0.39			29.1	SURCHARGED
4.002	SA6-9	56.751	1.012	0.000	0.16			43.8	SURCHARGED
4.003	SA6-8	56.635	1.185	0.000	0.34			58.7	SURCHARGED
4.004	SA6-7	56.531	1.173	0.000	0.51			70.9	SURCHARGED
4.005	SA6-6	56.467	1.173	0.000	0.51			86.7	SURCHARGED
4.006	SA6-5	56.366	1.154	0.000	0.26			43.5	SURCHARGED
5.000	SA6-4-2	56.360	1.097	0.000	0.28			19.8	SURCHARGED
5.001	SA6-4-1	56.340	1.216	0.000	0.54			37.9	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	SA14	
1.001	SA13	
1.002	SA12	
2.000	SA11-1	
1.003	SA11	
3.000	SA10-1	
1.004	SA10	
1.005	SA9	
1.006	SA8	
1.007	SA7	
4.000	SA6-11	
4.001	SA6-10	
4.002	SA6-9	
4.003	SA6-8	
4.004	SA6-7	
4.005	SA6-6	
4.006	SA6-5	
5.000	SA6-4-2	
5.001	SA6-4-1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
4.007	SA6-4	180 Winter	30	+20%	1/15 Summer			
6.000	SA6-2-2-1	30 Summer	30	+20%	1/15 Summer			
7.000	SA6-2-5	30 Summer	30	+20%	1/15 Summer			
7.001	SA6-2-4	30 Summer	30	+20%	1/15 Summer			
7.002	SA6-2-3	30 Summer	30	+20%	1/15 Summer			
6.001	SA6-2-2	30 Summer	30	+20%	1/15 Summer			
6.002	SA6-2-1	180 Winter	30	+20%	1/15 Summer			
4.008	SA6-3	360 Winter	30	+20%	1/15 Summer			
4.009	SA6-2	600 Winter	30	+20%	1/15 Summer			
4.010	SA6-1	720 Winter	30	+20%	1/30 Summer			
8.000	SA6-12	720 Winter	30	+20%	1/30 Summer			
1.008	SA6	720 Winter	30	+20%	1/30 Summer			
9.000	SA5-3	720 Winter	30	+20%	1/15 Winter			
9.001	SA5-2	720 Winter	30	+20%	1/15 Summer			
10.000	SA5-1-1	720 Winter	30	+20%	1/15 Summer			
9.002	SA5-1	720 Winter	30	+20%	1/15 Summer			
1.009	SA5	720 Winter	30	+20%	1/15 Summer			
11.000	SA4-1	720 Winter	30	+20%	1/15 Summer			
1.010	SA4	720 Winter	30	+20%	1/15 Summer			
1.011	SA3	720 Winter	30	+20%	1/15 Summer			
1.012	SA2	720 Winter	30	+20%	1/15 Summer			
1.013	SA1	15 Summer	30	+20%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
4.007	SA6-4	56.264	1.128	0.000	0.24			62.2	SURCHARGED
6.000	SA6-2-2-1	56.306	1.509	0.000	0.29			20.0	SURCHARGED
7.000	SA6-2-5	56.482	1.616	0.000	0.42			20.4	SURCHARGED
7.001	SA6-2-4	56.469	1.641	0.000	0.66			40.7	SURCHARGED
7.002	SA6-2-3	56.386	1.597	0.000	0.83			60.0	SURCHARGED
6.001	SA6-2-2	56.287	1.466	0.000	0.53			97.2	SURCHARGED
6.002	SA6-2-1	56.192	1.475	0.000	0.24			37.3	SURCHARGED
4.008	SA6-3	56.169	1.414	0.000	0.31			65.4	SURCHARGED
4.009	SA6-2	56.109	1.497	0.000	0.04			6.6	SURCHARGED
4.010	SA6-1	55.588	1.087	0.000	0.05			8.9	SURCHARGED
8.000	SA6-12	55.586	0.972	0.000	0.03			2.3	SURCHARGED
1.008	SA6	55.586	1.000	0.000	0.08			36.4	SURCHARGED
9.000	SA5-3	55.589	1.189	0.000	0.07			2.3	SURCHARGED
9.001	SA5-2	55.587	1.445	0.000	0.13			4.6	SURCHARGED
10.000	SA5-1-1	55.586	1.469	0.000	0.07			2.3	SURCHARGED
9.002	SA5-1	55.585	1.623	0.000	0.29			9.3	SURCHARGED
1.009	SA5	55.583	1.329	0.000	0.11			48.0	SURCHARGED
11.000	SA4-1	55.579	1.414	0.000	0.01			2.3	SURCHARGED
1.010	SA4	55.579	1.634	0.000	0.17			52.5	SURCHARGED
1.011	SA3	55.577	1.683	0.000	0.16			54.8	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	SA2	55.574	1.760	0.000	0.04			14.0	SURCHARGED
1.013	SA1	53.296	-0.457	0.000	0.13			37.7	OK

PN	US/MH Name	Level Exceeded
4.007	SA6-4	
6.000	SA6-2-2-1	
7.000	SA6-2-5	
7.001	SA6-2-4	
7.002	SA6-2-3	
6.001	SA6-2-2	
6.002	SA6-2-1	
4.008	SA6-3	
4.009	SA6-2	
4.010	SA6-1	
8.000	SA6-12	
1.008	SA6	
9.000	SA5-3	
9.001	SA5-2	
10.000	SA5-1-1	
9.002	SA5-1	
1.009	SA5	
11.000	SA4-1	
1.010	SA4	
1.011	SA3	
1.012	SA2	
1.013	SA1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.275
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.700	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	SA14	720 Winter	100	+20%	30/15 Summer			
1.001	SA13	720 Winter	100	+20%	30/15 Summer			
1.002	SA12	720 Winter	100	+20%	1/120 Winter			
2.000	SA11-1	720 Winter	100	+20%	1/60 Winter			
1.003	SA11	720 Winter	100	+20%	30/15 Summer			
3.000	SA10-1	720 Winter	100	+20%	30/15 Summer			
1.004	SA10	720 Winter	100	+20%	1/120 Winter			
1.005	SA9	720 Winter	100	+20%	30/15 Summer			
1.006	SA8	960 Winter	100	+20%	1/120 Winter			
1.007	SA7	960 Winter	100	+20%	1/120 Winter			
4.000	SA6-11	30 Summer	100	+20%	1/30 Winter			
4.001	SA6-10	30 Summer	100	+20%	1/30 Summer			
4.002	SA6-9	30 Summer	100	+20%	1/15 Summer	100/5760 Winter		
4.003	SA6-8	30 Summer	100	+20%	1/15 Summer	100/5760 Winter		
4.004	SA6-7	30 Summer	100	+20%	1/15 Summer			
4.005	SA6-6	30 Summer	100	+20%	1/15 Summer			
4.006	SA6-5	30 Summer	100	+20%	1/15 Summer			
5.000	SA6-4-2	15 Winter	100	+20%	1/15 Summer			
5.001	SA6-4-1	30 Summer	100	+20%	1/15 Summer			

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	SA14	55.973	0.855	0.000	0.04			2.9	SURCHARGED
1.001	SA13	55.973	0.981	0.000	0.09			5.8	SURCHARGED
1.002	SA12	55.972	1.072	0.000	0.14			8.7	SURCHARGED
2.000	SA11-1	55.972	1.144	0.000	0.09			2.9	SURCHARGED
1.003	SA11	55.971	0.983	0.000	0.09			14.4	SURCHARGED
3.000	SA10-1	55.970	1.011	0.000	0.02			2.9	SURCHARGED
1.004	SA10	55.970	1.110	0.000	0.12			20.1	SURCHARGED
1.005	SA9	55.968	1.071	0.000	0.08			23.0	SURCHARGED
1.006	SA8	55.968	1.141	0.000	0.09			20.8	SURCHARGED
1.007	SA7	55.968	1.154	0.000	0.06			23.1	SURCHARGED
4.000	SA6-11	57.226	1.232	0.000	0.30			21.5	FLOOD RISK
4.001	SA6-10	57.160	1.306	0.000	0.55			40.8	FLOOD RISK
4.002	SA6-9	57.060	1.321	0.000	0.22			61.5	SURCHARGED
4.003	SA6-8	56.892	1.442	0.000	0.49			83.2	FLOOD RISK
4.004	SA6-7	56.787	1.429	0.000	0.75			104.9	FLOOD RISK
4.005	SA6-6	56.767	1.473	0.000	0.75			126.8	FLOOD RISK
4.006	SA6-5	56.664	1.452	0.000	0.88			148.6	SURCHARGED
5.000	SA6-4-2	56.725	1.462	0.000	0.36			25.2	SURCHARGED
5.001	SA6-4-1	56.657	1.533	0.000	0.63			44.8	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	SA14	
1.001	SA13	
1.002	SA12	
2.000	SA11-1	
1.003	SA11	
3.000	SA10-1	
1.004	SA10	
1.005	SA9	
1.006	SA8	
1.007	SA7	
4.000	SA6-11	
4.001	SA6-10	
4.002	SA6-9	
4.003	SA6-8	
4.004	SA6-7	
4.005	SA6-6	
4.006	SA6-5	
5.000	SA6-4-2	
5.001	SA6-4-1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
4.007	SA6-4	30 Summer	100	+20%	1/15 Summer			
6.000	SA6-2-2-1	15 Winter	100	+20%	1/15 Summer			
7.000	SA6-2-5	30 Summer	100	+20%	1/15 Summer			
7.001	SA6-2-4	30 Summer	100	+20%	1/15 Summer			
7.002	SA6-2-3	30 Summer	100	+20%	1/15 Summer			
6.001	SA6-2-2	30 Summer	100	+20%	1/15 Summer			
6.002	SA6-2-1	30 Summer	100	+20%	1/15 Summer			
4.008	SA6-3	30 Summer	100	+20%	1/15 Summer			
4.009	SA6-2	720 Winter	100	+20%	1/15 Summer			
4.010	SA6-1	960 Winter	100	+20%	1/30 Summer			
8.000	SA6-12	960 Winter	100	+20%	1/30 Summer			
1.008	SA6	960 Winter	100	+20%	1/30 Summer			
9.000	SA5-3	960 Winter	100	+20%	1/15 Winter			
9.001	SA5-2	960 Winter	100	+20%	1/15 Summer			
10.000	SA5-1-1	960 Winter	100	+20%	1/15 Summer			
9.002	SA5-1	960 Winter	100	+20%	1/15 Summer			
1.009	SA5	960 Winter	100	+20%	1/15 Summer			
11.000	SA4-1	960 Winter	100	+20%	1/15 Summer			
1.010	SA4	960 Winter	100	+20%	1/15 Summer			
1.011	SA3	960 Winter	100	+20%	1/15 Summer			
1.012	SA2	960 Winter	100	+20%	1/15 Summer			
1.013	SA1	15 Summer	100	+20%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
4.007	SA6-4	56.561	1.425	0.000	0.81			213.0	SURCHARGED
6.000	SA6-2-2-1	56.585	1.788	0.000	0.38			26.7	FLOOD RISK
7.000	SA6-2-5	56.725	1.859	0.000	0.50			24.3	SURCHARGED
7.001	SA6-2-4	56.705	1.877	0.000	0.79			48.6	SURCHARGED
7.002	SA6-2-3	56.626	1.837	0.000	1.00			72.7	SURCHARGED
6.001	SA6-2-2	56.510	1.689	0.000	0.66			120.7	SURCHARGED
6.002	SA6-2-1	56.401	1.684	0.000	0.93			143.5	SURCHARGED
4.008	SA6-3	56.307	1.552	0.000	1.77			377.8	SURCHARGED
4.009	SA6-2	56.236	1.624	0.000	0.04			6.6	SURCHARGED
4.010	SA6-1	55.970	1.469	0.000	0.05			9.0	SURCHARGED
8.000	SA6-12	55.968	1.354	0.000	0.03			2.3	SURCHARGED
1.008	SA6	55.968	1.382	0.000	0.08			36.7	SURCHARGED
9.000	SA5-3	55.971	1.571	0.000	0.07			2.4	SURCHARGED
9.001	SA5-2	55.970	1.828	0.000	0.14			4.7	SURCHARGED
10.000	SA5-1-1	55.969	1.852	0.000	0.07			2.4	SURCHARGED
9.002	SA5-1	55.967	2.005	0.000	0.29			9.5	SURCHARGED
1.009	SA5	55.965	1.711	0.000	0.11			48.5	SURCHARGED
11.000	SA4-1	55.960	1.795	0.000	0.01			2.4	FLOOD RISK
1.010	SA4	55.961	2.016	0.000	0.17			53.1	FLOOD RISK
1.011	SA3	55.959	2.065	0.000	0.16			55.5	SURCHARGED

Attenuation Pond A - Top Water Level

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW1

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	SA2	55.957	2.143	0.000	0.05			15.0	SURCHARGED
1.013	SA1	53.309	-0.444	0.000	0.15			44.2	OK

PN	US/MH Name	Level Exceeded
4.007	SA6-4	
6.000	SA6-2-2-1	
7.000	SA6-2-5	
7.001	SA6-2-4	
7.002	SA6-2-3	
6.001	SA6-2-2	
6.002	SA6-2-1	
4.008	SA6-3	
4.009	SA6-2	
4.010	SA6-1	
8.000	SA6-12	
1.008	SA6	
9.000	SA5-3	
9.001	SA5-2	
10.000	SA5-1-1	
9.002	SA5-1	
1.009	SA5	
11.000	SA4-1	
1.010	SA4	
1.011	SA3	
1.012	SA2	
1.013	SA1	

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