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DOCUMENT LEAD SHEET

PROJECT: **ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT AT THE FORMER ST. KEVIN'S HOSPITAL AND GROUNDS, SHANAKIEL, CORK**

PROJECT NO. **19.305**

DOCUMENT TITLE: **CIVIL ENGINEERING INFRASTRUCTURE REPORT FOR PLANNING**

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CIVIL ENGINEERING
INFRASTRUCTURE REPORT
FOR PLANNING

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1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Land Development Agency (LDA) intend to apply to An Bord Pleanála for permission for a Strategic Housing Development with a total application site area of ca. 5.7ha, on lands located at the Former St. Kevin's Hospital and Grounds, Shanakiel, Cork (A Protected Structure, 'Our Lady's Hospital' RPS Ref. PS620).

Figure 1.1: Site Location shown outlined in red

The development, with a total gross floor area of c 24,344 sq m, will provide 266 no. residential units, a crèche and office enterprise centre.

The development will consist of 46 no. town houses (32 no. 3 bedroom units and 14 no. 4 bedroom units) arranged in 11 no. two storey blocks; 54 no. ground floor 2 bedroom duplex apartments and 36 no. 3 bedroom and 18 no. 4 bedroom duplex townhouses above arranged in 7 no. three storey blocks; 52 no. walk-up apartments (11 no. 1 bedroom apartments and 41 no. 2 bedroom apartments) arranged in 3 no. four storey blocks. The development will also include the conversion and renovation of the former St. Kevin's Hospital building to provide 60 no. apartments (26 no. 1 bedroom and 34 no. 2 bedroom apartments) and a 440 sq m crèche at ground floor level, with ancillary outdoor play area; The conversion of the 630 sq m former chapel building to provide a new Office Enterprise Centre.

The proposed development will include 241 no. surface car parking spaces and 563 no. bicycle parking spaces.

1.2 SCOPE OF THIS REPORT

This report describes the proposed civil engineering infrastructure for the development and how it connects to the public infrastructure serving the area. In particular, foul and surface water drainage, flood risk and water supply are considered. Traffic engineering matters are dealt with under separate cover by ILTP Consultants.

This report should be read in conjunction with the following engineering drawings submitted with the planning application:

Drawing Reference:	**Drawing Title:**
19305-BMD-ZZ-XX-DR-C-1000	Proposed Drainage Plan Layout
19305-BMD-ZZ-XX-DR-C-1001	Foul Drainage Schedule
19305-BMD-ZZ-XX-DR-C-1002	Surface Water Drainage Schedule
19305-BMD-ZZ-XX-DR-C-1003	Proposed SuDS Strategy Layout
19305-BMD-ZZ-XX-DR-C-1010	Proposed Watermain Plan Layout
19305-BMD-ZZ-XX-DR-C-1020	Proposed Roads Plan Layout
19305-BMD-ZZ-XX-DR-C-1021	Proposed Signage & Road Markings
19305-BMD-ZZ-XX-DR-C-1022	Proposed Entrance Junction Plan Layout
19305-BMD-ZZ-XX-DR-C-1023	Vehicle Tracking Assessment - Fire Tender
19305-BMD-ZZ-XX-DR-C-1024	Vehicle Tracking Assessment - Refuse Vehicle
19305-BMD-ZZ-XX-DR-C-1025	Sightlines Assessment at Entrance Junction
19305-BMD-ZZ-XX-DR-C-1050	Phasing Strategy
19305-BMD-ZZ-XX-DR-C-1051	Pedestrian and Cyclist Accessibility and Connectivity Plan Layout
19305-BMD-ZZ-XX-DR-C-1100	Surface Water Drainage Long Sections
19305-BMD-ZZ-XX-DR-C-1101	Foul Drainage Long Sections
19305-BMD-ZZ-XX-DR-C-1120	Roads Long Sections
19305-BMD-ZZ-XX-DR-C-1200	Typical Drainage Details
19305-BMD-ZZ-XX-DR-C-1201	Typical SuDS Details
19305-BMD-ZZ-XX-DR-C-1220	Typical Roads Details (Sheet 1 of 2)
19305-BMD-ZZ-XX-DR-C-1221	Typical Roads Details (Sheet 2 of 2)

1.3 PRE-PLANNING DISCUSSIONS

The following meetings were held during Design Development of the Planning Application package:

- 14th February 2020: S247 Meeting with Cork City Council
- 4th March 2020: Meeting with Cork City Council (Simon Lyons, Sean Lynch & Rory Lucey) re Drainage & Water Supply
- 7th September 2020: Tri-Partite meeting with An Bord Pleanála & Cork City Council.
- 7th October 2020: Meeting with Irish Water Project Team for the Shanakiel Rising and Distribution Mains Project (organised by Diane Carroll of Irish Water)
- 12th October 2020: meeting with Cork City Council Roads Department (Valerie Fenton and James Culhane)
- 20th October 2020: meeting with Irish Water Technical Team for the Cork Area (organised by Paddy O'Flaherty of Irish Water) along with Cork City Council (Sean Lynch)
- 5th November 2020: follow-up meeting with Cork City Council Roads Department (Valerie Fenton and James Culhane)
- 13th November 2020: with Simon Lyons of Cork City Council to agree SuDS approach & discharge point.

2.0 SURFACE WATER DRAINAGE SYSTEM

2.1 EXISTING SURFACE WATER INFRASTRUCTURE

There is an existing surface water pipeline outside the western boundary of the site, to the south of the derelict building adjacent to Atkins Hall Apartments (see Figure 2.1). This pipeline runs southwards and connects to a surface water pipeline that runs eastwards under Lee Road and ultimately discharges into the River Lee at a location due south of the site.

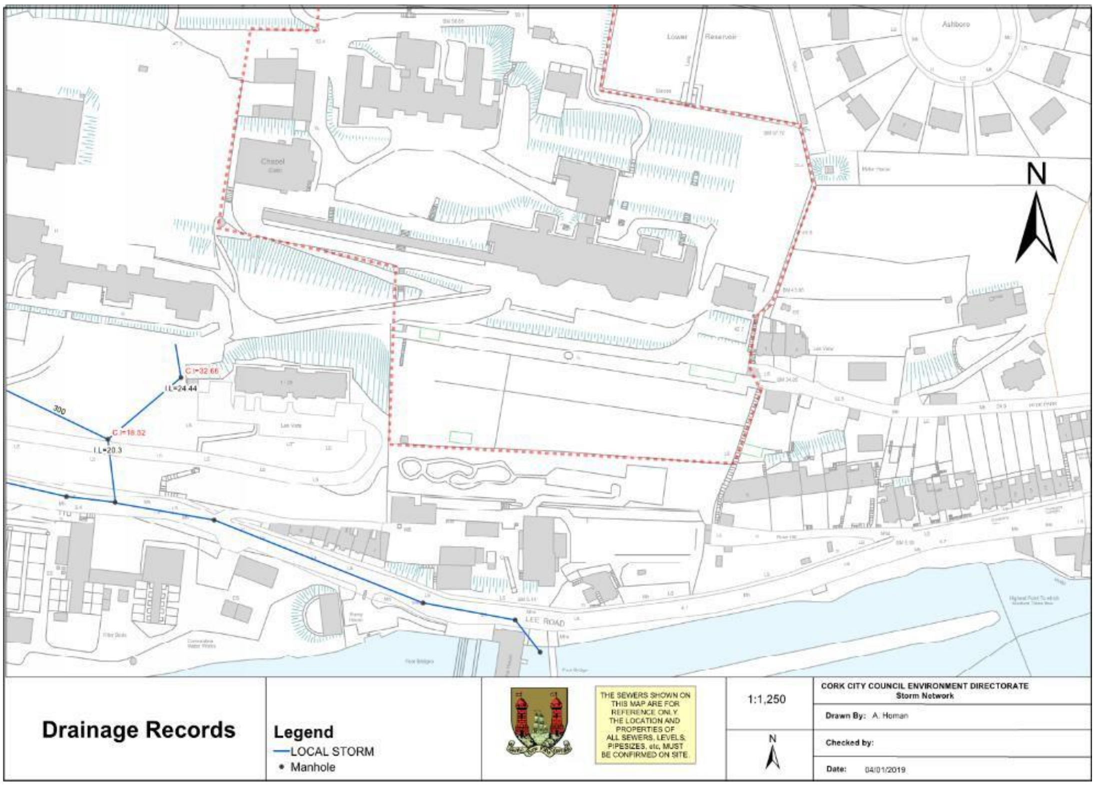


Figure 2.1: Cork City Council local storm drainage records in vicinity of development site

2.2 PROPOSED SURFACE WATER DRAINAGE SYSTEM

A network of surface water pipes of varying diameter will serve the proposed development, falling with the natural site gradient and connecting, after attenuation, to the existing surface water pipeline west of the site, as referenced in Section 2.1. Refer to Appendix VI for letter from the LDA's solicitors, Arthur Cox, regarding the easements available to the LDA to enter upon the adjoining lands for the purposes of construction of and use of drainage services along the route hatched orange to the manhole coloured green on drawing No: 19305-BMD-ZZ-XX-DR-C-1000: Proposed Drainage Plan Layout.

Sustainable Drainage System (SuDS) measures will be incorporated into the development to provide interception storage, attenuation storage, and flow control to limit the rate of discharge to greenfield runoff rates. While the total application site area is ca. 5.7ha, approximately 4.588ha of this will be developed which equates to a QBAR greenfield run-off rate of 14.9 litres per second – see Section 2.3.2.

A below ground concrete attenuation tank will be constructed at the downstream end of the area to be developed, to the south of the old St Kevin's Hospital building. Discharge from the tank will be limited using a Hydrobrake, with an outfall pipe leading to the existing surface water outfall to the west as described previously.

2.2.1 Proposed Development Characteristics

Total Site Area (within Redline Boundary)	=	5.7ha
Total Developed Area (excluding zone to south)	=	4.588ha
Total Drained Area (area contributing to pipe network)	=	2.894ha
M5-60 (5-year 60 minute Rainfall Depth)	=	16.2mm
Rainfall Ratio “r”	=	0.222
Climate Change Allowance	=	20%

2.3 COMPLIANCE WITH THE PRINCIPLES OF SUSTAINABLE URBAN DRAINAGE SYSTEMS

The development of this site will result in increased paved and impermeable areas that could create pressure on the environment and existing services due to the generation of increased run-off and pollution.

In order to avoid this the development will be designed in accordance with the principles of Sustainable Drainage Systems (SuDS) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS). The GDSDS addresses the issue of sustainability by requiring designs to comply with a set of drainage criteria which aim to minimize the impact of urbanization by replicating the run-off characteristics of the greenfield site.

The criteria provide a consistent approach to addressing the increase in both rate and volume of run-off as well as ensuring the environment is protected from pollution that is washed off roads and buildings. These drainage design criteria are as follows:

- Criterion 1 – River Water Quality Protection
- Criterion 2 – River Regime Protection
- Criterion 3 – Flood Risk Assessment
- Criterion 4 – River Flood Protection

The SuDS Strategy for the site will include a management train of SuDS devices to ensure compliance with the above drainage design criteria. Refer to drawing number 19305-BMD-ZZ-XX-DR-C1003 Proposed SuDS Strategy Layout.

It should be noted that infiltration tests have been carried out at a number of locations on the site and percolation rates of 0.071m/hr to 0.690m/hr were found to be achievable. Refer to Appendix F of Ground Investigation Report 20-0105 (July 2020) prepared by Causeway Geotech, included with the Application under separate cover.

In summary the SuDs strategy is as follows:

- Permeable paving in all car parking bays to provide interception storage in the gravel bed below with overflow pipework into the main drainage system at a raised invert from the general gravel bed level – satisfies Criterion 1.
- Shared (impermeable road) surfaces adjacent to permeable paving will drain towards the permeable paving, based on the principle that the gravel bed can accommodate an additional contributing area up to 5 x the permeable area (as per CIRIA SuDS Manual for ground with permeability in excess of 0.036m/hr). – satisfies Criterion 1. It is noted that the impermeable contributing area in this case is approximately two times the permeable paved area. The main spine

road network running down through the site will discharge directly into the main piped surface water system via standard road gully pots with sump traps.

- 3no. online soakaways have been included, to accept roofwater run-off from some buildings where green space is available nearby. These soakaways will be designed for the 10-year return period (BRE365) and will provide interception storage and attenuation storage. Each soakaway will have an overflow pipe discharging to the main drainage system for events in excess of the 10-year return period – satisfies Criterion 1.
- A buried attenuation tank and hydrobrake will be provided, to control the rate of outflow from the site to the public surface water network, and ultimately to the nearby River Lee. The maximum discharge rate will be QBAR (without growth factors) as no long-term storage is proposed – satisfies Criteria 2 & 4.
- A bypass petrol interceptor will be installed downstream of the hydrobrake prior to discharging to the public surface water network – satisfies Criterion 1.
- The main pipe network will be designed to ensure no surcharging during the 1 year return period, no flooding during both the 30 year and 100 year return periods (but with surcharging permitted) -– satisfies Criterion 3.

2.3.1 Criterion 1 GDSDS – River Water Quality Protection

Urban run-off, when drained by pipe systems, results in run-off from virtually every rainfall event, with potential for high levels of pollution, particularly in the first phase of run-off, and with little of the rainfall percolating to the ground. To prevent this happening, Criterion 1 requires that interception storage is provided so that at a minimum the first 5mm of rainfall from the developed site is intercepted and retained on site thereby replicating the run-off characteristics of the pre-development greenfield site.

As per Section 2.2.1, the proposed development will result in a positively drained area of 2.894ha. The minimum required interception storage over this area is 5mm per square metre.

Thus, Interception Storage Required = [2.894ha x 0.005m]

= **144.7m^3**

This minimum requirement will be met by providing interception storage through a combination of soakaways and permeable paving.

2.3.1.1 Permeable Paving / Play Areas

The total area of permeable paving parking spaces = 3,072m^2 and the adjacent shared surface areas that drains into this (roads and paths) sums to approximately 6,385m^2. Intercepting a minimum of 10mm of rainfall on this total area equates to approximately 94.6m^3 of interception storage.

Interception will be achieved by allowing water to percolate through the subbase and into the ground below the permeable paving.

A raised overflow fin drain and outlet will also be provided in each bay of parking spaces, in the event that the expected percolation is not achieved. In addition, baffle walls will be provided for car parking bays intermittently to ensure the requisite storage is achieved.

The invert of this overflow fin drain will need to be set at a level which will provide the above 94.6m^3 of storage within the permeable paved parking bays.

94.6m^3/ 3072m^2 = 0.031m = 31mm of water intercepted on average in each bay

Thus, the invert of the overflow pipes, assuming 30% subbase voids, would need to be located 103.3mm above the formation level of the subbase in order to always intercept the first 10mm of rainfall. For ease of construction, therefore the inverts of these overflow fin drains will be set to 110mm above the formation level of the subbase, and this achieves an interception volume of:

$3072m^2 \times 0.110m \times 30\% = \mathbf{101.38m^3}$

In addition, it is proposed to construct all MUGA/play areas in permeable finishes, similar to permeable paving car parking spaces. In total the area of the play areas sums to 930m^2. Allowing for min. 10mm interception storage under these permeable areas, and assuming a subbase porosity of 30%, the raised overflow fin drain pipework would need to be located approximately 35mm above the formation level of the subbase. In summary, the MUGA/play areas will achieve a total interception volume of:

$930m^2 \times 0.035m \times 30\% = \mathbf{9.77m^3}$

2.3.1.2 Soakaways

The balance of the required interception storage will be provided by the 3no. soakaways, intercepting 10mm minimum of the rainfall on the roofs that drain into them. It should be noted that these soakaways will be designed for the 10 year return period in accordance with BRE Digest 365 guidance, and so will have the capacity to intercept far more than 10mm of rainfall and effectively provide additional attenuation storage at source.

See Appendix II for MicroDrainage output for each soakaway calculation. It has been conservatively assumed for design purposes that zero infiltration is available through the base of these soakaways, and only infiltration through the sides (using a percolation value of 0.071m/hr) is assumed. In order to maximise storage, soakaways have been designed with a void ratio of 0.95, which equates to standard void ratios available with proprietary cellular storage systems (e.g. Wavin Aquacell). In line with BRE Digest 365 guidance, the half drain time for the 10 year return period is less than 24hrs.

An overflow pipe will be provided in each soakaway above water level for the 10 year return period volume, so that overflow to the main drainage system can occur for storm events in excess of the 10 year return period. A summary of the soakaway design calculations is given in Table 1 below.

Table 2.1: Summary of Soakaway Design Calculations

	Soakaway 1	Soakaway 2	Soakaway 3
Contributing Roof Area:	0.116ha	0.109ha	0.185ha
Return Period (years):	10	10	10
Infiltration through base	Nil	Nil	Nil
Infiltration through side	0.0710 m/hr	0.0710 m/hr	0.0710 m/hr
Porosity	0.95	0.95	0.95
Dimensions (L x W x D):	25m x 3m x 1.6m	20m x 2m x 1.6m	25m x 3m x 1.6m
Interception storage provided: (10mm over contributing roof area)	11.6m^3	10.9m^3	18.5m^3
Total Interception + Attenuation storage provided:	114m^3	60.8m^3	114m^3

In summary the total amount of interception storage provided is:

[101.38 + 9.77 + 11.6 + 10.9 + 18.5] = **152.15m³** provided > 144.7m³ required

A class 1 bypass petrol interceptor with peak flow capacity in excess of 14.9l/s will be provided on the downstream side of the hydrobrake to ensure no hydrocarbon contamination of the receiving watercourse – the River Lee.

2.3.2 Criterion 2 GDSDS – River Regime Protection

Whatever the rainfall event unchecked run-off from the developed site through traditional pipe networks will discharge into receiving waters at rates that are an order of magnitude greater than that prior to development. This can cause flash flow in the outfall river / stream that can cause scour and erosion. Attenuation storage is provided to prevent this occurring by limiting the rate of run-off to that which took place from the pre-development greenfield site. In practice the rate of run-off needs to be appropriately low for the majority of rainfall events and attenuation storage volumes should be provided for the 1 and 100 year storm events, with an allowance for 20% climate change, and the rate of outflow from such storage should be controlled so that it does not exceed the greenfield flow – QBAR – factored by the appropriate growth factors.

For sites < 50 hectares linear interpolation is used to get the following formula:

$$QBAR = 0.583 x SAAR^{1.17} x SOIL^{2.17} x (\frac{AREA}{50}) l/s$$

where

SAAR	=	Standard Average Annual Rainfall in mm for the site = 1147mm as per HR Wallingford site
SOIL	=	An index based on the Winter Rain Acceptance Potential of the soil
		A value of 0.3 (Soil Type 2) will be used as per HR Wallingford site
AREA	=	Area in hectares = Developed Site Area – Area of Preservation Zone to the south
	=	4.588ha

QBAR is the flood flow from the greenfield catchment in litres/second and represents a storm with a return period of approximately 2.3 years. Greenfield flow for storm events of different return periods should be calculated by multiplying QBAR by the following growth factors:

1 Year	=	0.85
10 Years	=	1.7
30 Years	=	2.1
100 Years	=	2.6
200 Years	=	2.9

These factors cannot be applied in this case, however, as long- term storage is not being provided on the site.

On the subject site, therefore, QBAR for storm events, irrespective of return period, has been calculated as follows:

QBAR = 0.583x (1147^ 1.17) x (0.3^2.17) x (4.588/50) = **14.9 l/s**

Appendix II gives MicroDrainage Source Control output showing the storage volume estimation for the 100year return period plus a 20% allowance for climate change. The volume estimation is based on the measured total drained area of the site (2.894ha) with discharge limited to QBAR for the developed portion of the site.

The source control output shows a volume estimation of approximately 2040m^3. The output in Appendix II assumes a tank 680m^2 in area and a tank depth of 3.0m. This, however, does not take into account the interception and attenuation storage provided at source described in Section 2.3.1.

When these are taken into account the required tank size can be calculated as follows:

Tank storage volume estimate = 2040 - (101.38 + 9.77 + 114 + 60.8 + 114)

= 2040 - 399.95

= 1640.05m^3

Furthermore, the storage volume maybe reduced to account for time of entry and upstream pipe storage. To account for this, further reductions in the proposed tank size have been made and a buried attenuation tank, 45m long x 10.5m wide x 3m deep has been selected and modelled in a detailed simulation of the proposed development drainage system, using a hydrobrake limiting discharge to 14.9l/s at a design head of 3m (equals to depth of tank).

Refer to Appendix III which includes Microdrainage simulation of the entire system where the above tank has been modelled, connected to the whole pipe network system conservatively including the permeable paving and network storage volume only. This simulation is a much more accurate model of the system performance compared to the source control output in Appendix II.

When all of these beneficial effects are taken into account the maximum depth of water in the tank during the 100 year return period + 20% climate change for the worst case scenario storm is +36.855m (refer to S1.019) which equates to a depth of water of 1.455m in the tank – this is less than half the tank capacity.

2.3.3 Criterion 3 GDSDS – Check proposed drainage system does not cause an unacceptable risk of site flooding

The GDSDS requires that no flooding should occur on site for storms up to and including the 30-year event unless temporary flood storage is provided in a designated area on site for these high intensity storms. The pipe network and the attenuation storage volumes should, therefore, be checked for such storms to ensure that no site flooding occurs.

No flooding of internal areas should occur during the 100-year event. The pipe network can therefore surcharge and cause site flooding during this event but the top water level due to any such flooding must be at least 500mm below any internal floor levels and the flood waters should be contained within the site. In addition, the top water level in the attenuation tank during the 100-year storm must be at least 500mm below any internal floor levels.

Appendix III gives Microdrainage Simulation output for both the pipe system and attenuation storage volumes during the worst case scenario 1, 30 and 100 year return periods. No flooding occurs during the 100 year event and the water depth of 1.455m = +36.855m, is greater than 0.5m below the lowest internal floor level = +41.26m at St. Kevin's Apartments basement level. For the 30 year return period, 3no. manholes upstream of the tank are shown to be surcharging but do not flood. For the 100year return period, 12no. manholes upstream of the tank are shown to be surcharging but do not flood. Note, manhole

S1.19 is excluded from the above, as this is the hydrobrake manhole and will generally be surcharged for most return periods.

2.3.4 Criterion 4 GDSDS – Check proposed drainage system does not flood receiving watercourse

Criterion 4 is intended to prevent flooding of the receiving system / watercourse by either limiting the volume of run-off to the pre-development greenfield volume using “long term storage” (Option 1) or by limiting the rate of run-off for the 100 year storm to QBAR without applying growth factors using “extended attenuation storage” (Option 2).

In the context of the subject site Criterion 4 has been satisfied using Option 2 by providing extended attenuation storage. As can be seen in the Microdrainage Simulation output given in Appendix III the rate of outflow from the attenuation tank does not exceed QBAR (14.9l/s) during the 100-year storm event.

3.0 SITE FLOOD RISK ASSESSMENT

3.1 INTRODUCTION

The flood risk assessment is carried out in accordance with the OPW publication "The Planning System and Flood Risk Assessment Guidelines for Planning Authorities".

The stages involved in the assessment of flood risk are listed in this publication as follows:

Stage 1: Flood Risk Identification

Stage 2: Initial Flood Risk Assessment

Stage 3: Detailed Flood Risk Assessment

The OPW publication also outlines a Sequential Approach for determining whether a particular development is appropriate for a specified location in terms of flood risk. The categorization of the subject site in terms of the OPW's sequential approach is further outlined in Section 3.2 below.

3.2 FLOOD RISK IDENTIFICATION

Stage 1 identifies whether there are any flooding or surface water management issues related to the site, i.e. it identifies whether a flood risk assessment is required.

The www.Floodinfo.ie website for fluvial and coastal flood events have maps for the area as shown below. The site lies to the north of the River Lee catchment as outlined in red in Figure 3.1 and 3.2.

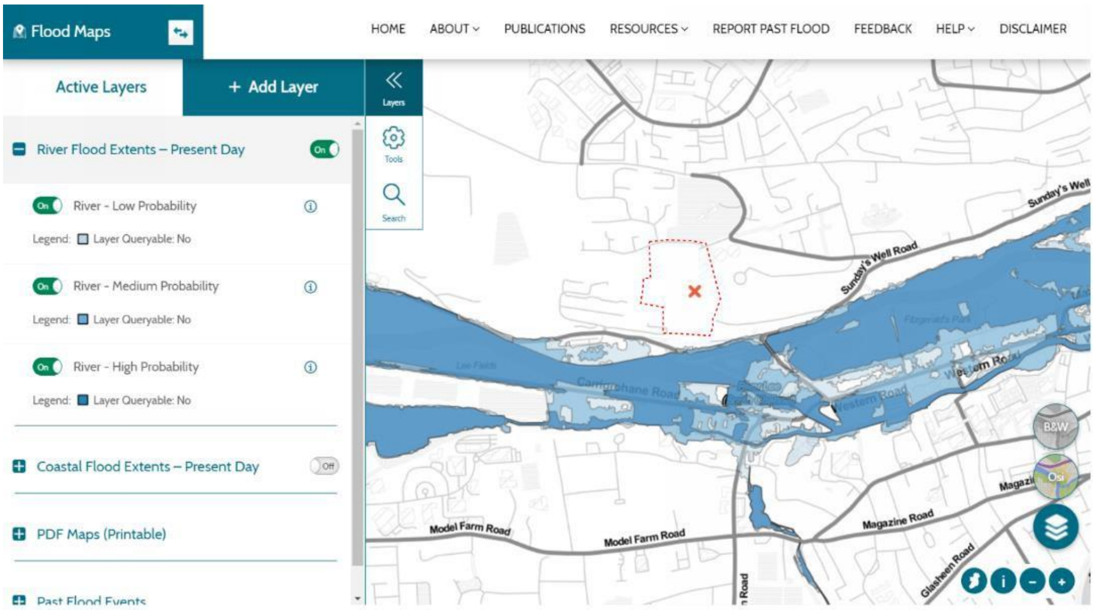


Figure 3.1: Fluvial Flood Risk Mapping in vicinity of development site

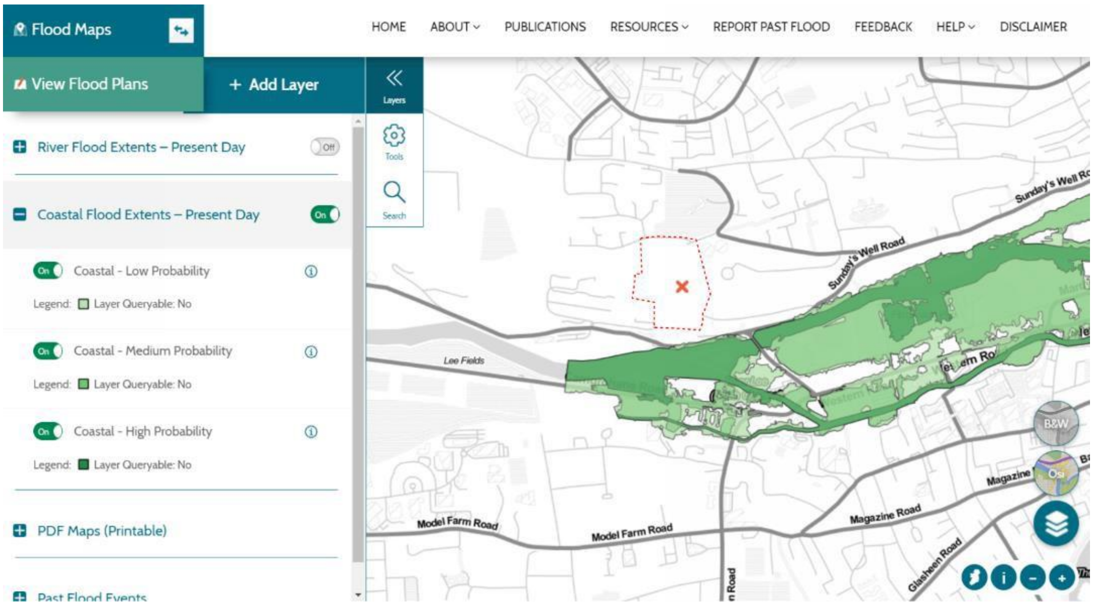


Figure 3.2: Tidal Flood Risk Mapping in vicinity of development site

These maps show the extents of flood risks for 1 in 10, 1 in 100 and 1 in 1000-year events for fluvial flooding (Figure 3.1) and 1 in 10, 1 in 200 and 1 in 1000-year events for tidal flooding (Figure 3.2). As can be seen from the maps there is no evident flood risk from a review of the available information.

It is worth noting that the first phase of the Lower Lee Flood Relief Scheme is scheduled to begin construction in 2020. This scheme will involve work to flood defences along the River Lee, downstream of the Inniscarra Dam and through Cork City as well as changes to the operating procedures for the Carrigadrohid and Iniscarra reservoirs for the purposes of flood risk management. A flood forecasting system to help guide the decision making on dam discharges and, if necessary, the erection of temporary systems is also to be put in place

3.2.1 Flood Zones

The sequential approach defines the flood zones as detailed below:

- 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 site is, therefore, located in Flood Zone C.

3.2.2 Vulnerability Class

The sequential approach describes the vulnerability classes as follows:

- Highly vulnerable development – hospitals, schools, houses, student halls of residence etc.;
- Less vulnerable development – retail, commercial, industrial, agriculture etc.; and

- Water compatible development – docks, marinas, amenity open space etc.

The development is a residential development which is classed as 'highly vulnerable'.

3.2.3 Development Classification

The matrix of vulnerability as per "The Planning System and Flood Risk Management – Guidelines for Planning Authorities" is reproduced in Table 3.1.

Table 3.1: Matrix of Vulnerability

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development	Justification Test	Justification Test	**Appropriate**
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water compatible development	Appropriate	Appropriate	Appropriate

This development is therefore deemed appropriate and the justification test is not required.

3.3 Stage 2: Initial Flood Risk Assessment

The initial flood risk assessment should ensure that all relevant flood risk issues are assessed in relation to the decisions to be made and potential conflicts between flood risk and development are addressed. It should assess the adequacy of existing information and any flood defences.

3.3.1 Examination of potential flooding sources that can affect the site

The possible sources of flood water are assessed in the Table 3.2 below using the "Source – Pathway – Receptor Model".

Table 3.2: The possible sources of flood water

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Tidal	Overtop Breach	People Property	Extremely Unlikely	High	**Extremely Low**
Fluvial	Overtop Breach	People Property	Extremely Unlikely	High	**Extremely Low**
Pluvial/ Surface water	Overflow/ Blockage	People Property	Possible	High	**Medium**
Groundwater	Rising groundwater levels	People Property	Very Unlikely	Medium	**Very Low**

3.3.2 Appraisal of the availability and adequacy of existing information and flood zone maps

Comprehensive data is available on possible flooding of the site and surrounding area on the www.Floodinfo.ie website for fluvial and coastal flood events as discussed in Section 3.2.

3.3.3 Determination of what technical studies are appropriate

Given the comprehensive nature of the existing information available regarding flooding, it is not considered necessary to carry out any further analysis of fluvial or tidal flooding of the area.

3.3.4 Description of what residual risks will be assessed and how they might be mitigated and potential impacts of development on flooding elsewhere

As stated in Section 3.3.1 the residual risk to the site is from site flooding due to pluvial sources. This risk has been assessed in Section 2.3.3 and in the Simulation output in Appendix III, which shows that the network does not flood for the 1 in 30, and 1 in 100 year events, and that the top water level in the tank is >0.5m below the lowest FFL of the development.

3.4 STAGE 3: DETAILED FLOOD RISK ASSESSMENT

As shown in Section 3.3 the only residual risk is due to pluvial flooding and Section 2.3.3 shows that there is no risk of flooding for extreme events such as the 1 in 100 year storm.

One final check is carried out in Appendix III where the proposed drainage network response to a 50% blockage of the discharge manhole is simulated, with outflow restricted to 7.5l/s maximum. This shows that, notwithstanding that many of the upstream manholes are surcharged, no site flooding occurs and the maximum depth of water in the tank is +37.420m (i.e. 2.020m depth of water in a 3m deep tank), and as such, is still well below the lowest internal floor level = +41.26m at St. Kevin’s Apartments basement level.

3.5 CONCLUSION

The flood risk assessment has been carried out in accordance with the OPW publication “The Planning System and Flood Risk Assessment Guidelines for Planning Authorities” and it has been shown that there is no significant risk of flooding and, indeed, given the SuDS measures incorporated in the proposed development, there will be decreased risk of flooding to public infrastructure post development.

4.0 FOUL DRAINAGE SYSTEM

4.1 EXISTING FOUL SEWER INFRASTRUCTURE

There is a foul sewer running west to east through the southern portion of the site. The diameter of the sewer is 375mm as indicated on Irish Water records included with their confirmation of Feasibility letter- see Appendix IV.

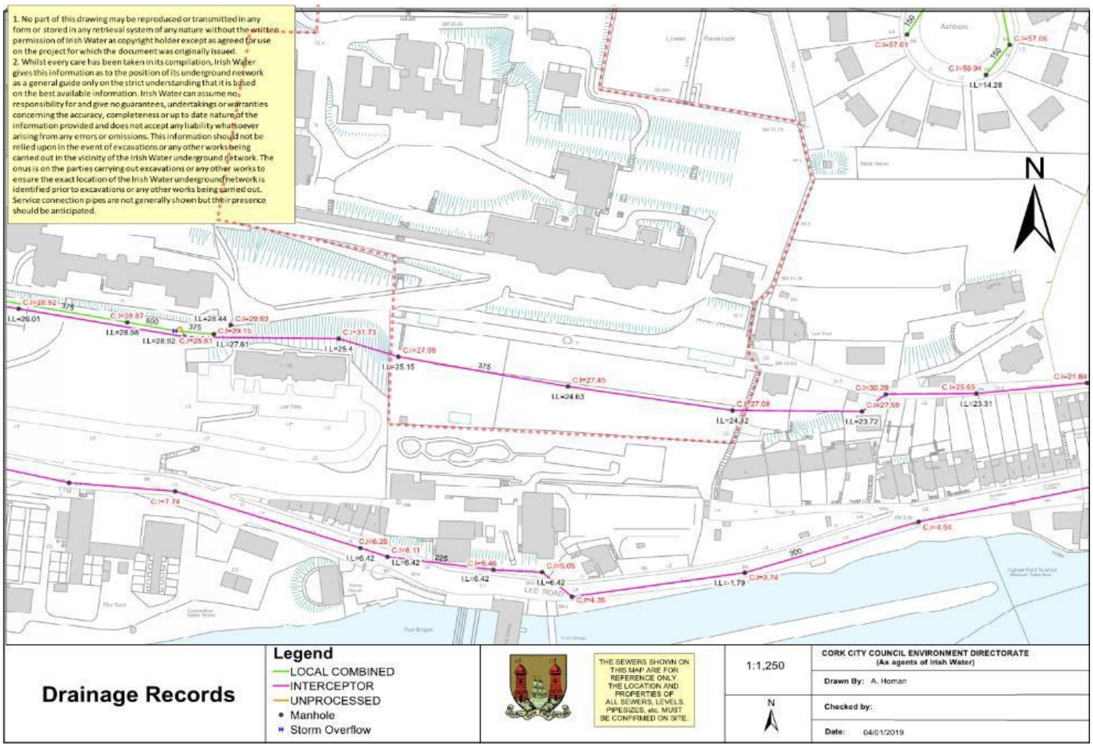


Figure 4.1: Cork City Council local records of wastewater drainage in vicinity of development site

There are 3no. manholes located along this foul pipe falling within the boundary of the site. Given the steep natural gradient of the site from north to south there will be no difficulty in terms of invert levels, when connecting into this sewer.

In this regard it is also noted that the current Cork City Development Plan states that the Carrigrennan Wastewater Treatment Plant has adequate capacity through 2020 based on population forecasts.

4.2 PROPOSED FOUL SEWER SYSTEM

A network of 225mm diameter pipes will serve the proposed development falling with the natural site gradient and connecting to one of the existing foul manholes to the south of the site as described in Section 4.1.

The Irish Water Pre-connection Enquiry Form (Appendix IV) estimated the foul flow at 8.353 l/s for 270no. units. Irish Water have reviewed the proposal and confirmed feasibility – see Irish Water letter in Appendix IV.

It should be noted that the number of proposed units has now reduced to 266no. following amendments to the planning design drawings. This revised number of units equates to a peak foul flow of 8.23 l/s.

The minimum pipe size on the main foul network will be 225mm diameter with a minimum gradient of 1:150 which provides a minimum hydraulic capacity of 23 l/s.

An application for Design Acceptance was subsequently made to Irish Water and Confirmation of Design Acceptance was received on 4th December 2020. A copy of this Confirmation of Design Acceptance letter is given in Appendix IV.

5.0 WATER SUPPLY

5.1 EXISTING WATER SUPPLY INFRASTRUCTURE

The Lee Road Water Treatment Plant is located close by, to the south west of the site. This supplies approximately 70% of Cork City's potable water and feeds the Shanakiel Reservoir which is situated adjacent to the north east corner of the site.

There are several large diameter watermains running across the site from the water treatment plant to the reservoir and from the reservoir to the main city supply mains as shown on the Irish Water Web Map extract in Figure 5.1.

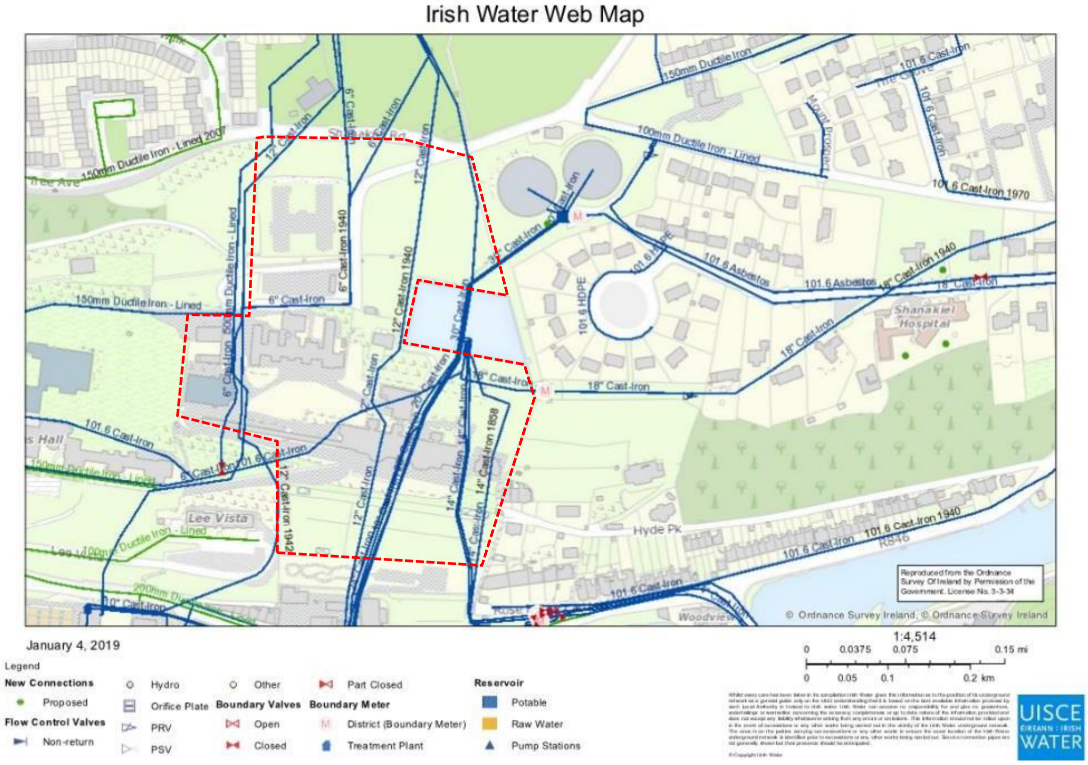


Figure 5.1: Irish Water local records of water supply services in vicinity of development site

A 30" cast iron watermain runs from the Shanakiel Reservoir southwards across the existing historical reservoir where it meets the former St Kevin's Hospital site boundary. At this point it separates into several smaller watermains. Both 14" and 20" lines run south from this point under the St Kevin's building, before exiting the site at its southern boundary.

Two further 14" cast iron watermains run south again from the same point. One of these runs beneath the eastern gable of the St Kevin's building, while the other runs under the St Brigid's Hostel building.

Several other smaller, though nonetheless significant, watermains, ranging in diameter from 6" to 12", also cross the site as can be seen on the Irish Water Web Map extract in Figure 5.1. These smaller watermains generally follow the alignment of the internal road network, and so logically, persevering with the existing alignment for the new proposed road minimises the extent of watermain diversions required.

It is understood that Irish Water plan to rationalise the layout of the watermains across the site and their Confirmation of Feasibility letter (see Appendix IV) shows that most of the existing watermains will be decommissioned as per previously granted planning permission, Cork City Council Reg Ref: 18/37965.

Given the proximity of the site to the main reservoir servicing Cork City, it is not envisaged that the supply of potable water to this site will be a constraint to development. It should be noted that the Strategic Environmental Assessment Statement and Appropriate Assessment Screening of the CCDP states that:

'Increased development and construction of residential and commercial units will lead to increased demand for potable water', Water supply capacity will impose no constraints on development in Cork City. The two supply schemes have adequate capacity to supply metropolitan Cork through 2071 with regard to population forecasts, treatment capacity and abstraction limits.'

5.2 PROPOSED WATER SUPPLY SYSTEM

It is proposed to lay a new 150mm diameter watermain to serve the proposed development and connect to the existing system at the northern & southern end of the site.

The site network will be split into two separate systems with the southern (lower) end being fed from existing watermains to the south and the northern (higher) end being fed from the existing watermains serving lands to the north. The exact connection details will be agreed with Irish Water upon application for a connection.

The split system approach will control the pressure in the network and avoid excessive pressures in the southern (lower) end. The two networks will be connected, with two sluice valves and a centrally located hydrant. The sluice valves will normally be closed, and the hydrant will facilitate checking that these valves are working properly.

The Irish Water Pre-connection Enquiry Form (Appendix IV) estimated the water demand at 7.910 l/s for 270no. units. Irish Water have reviewed the proposals and confirmed feasibility – see Irish Water Letter in Appendix IV.

It should be noted that the number of proposed units has now reduced to 266no. following amendments to the planning design drawings. This revised number of units equates to a peak water demand of 7.79l/s.

Since receiving confirmation of feasibility from Irish Water 2no. meetings have been held with them:
one with the Project Team for the Shanakiel Rising and Distribution Mains Project and one with Irish Water's Technical Team for the Cork Area along with Cork City Council Senior Engineer, Sean Lynch. These meetings discussed inter alia:

- The design of the Shanakiel scheme
- Timescale for the Shanakiel scheme
- Irish Water & the LDA potentially working simultaneously on both projects
- The proposed diversions of watermains remaining after the Shanakiel Scheme is completed.

These meetings were very useful in clarifying the issues involved and minor revisions to the design were made in response to Irish Water & Cork City Council comments. An application for Design Acceptance and for permission to Divert Watermains was subsequently made to Irish Water and Confirmation of Design Acceptance was received on 4th December 2020. A copy of this Confirmation of Design Acceptance letter and the Diversion Application form submitted with the design drawings is given in Appendix IV of this report.

6.0 ROADS AND TRAFFIC

6.1 EXISTING ROAD NETWORK

The site is currently accessed from a single entrance to the north on Beechtree Avenue which in turn links to Shanakiel Road.

The existing road network within the site which served the layout of the old hospital campus, is narrow and has gradients in excess of 10% in places. Notwithstanding these steep sections the existing road layout provides good access to the existing plateaus on which the original buildings stood.

6.2 PROPOSED ROAD NETWORK

Meetings were held with Cork City Council Roads Department on 12th October 2020 and on 5th November 2020. At these meetings Cork City Council emphasised the importance of pedestrian & cyclist priority at the entrance to the site and this informed the re-design of the existing entrance which will be modified to provide a junction which emphasises pedestrian & cyclist priority, and which will connect the site to the existing footpath to the north of Beechtree Avenue - see drawing no. 19305-BMD-ZZ-XX-DR-C-1022. Traffic calming measures on the steep uphill gradient (eastern approach) on Beechtree Avenue are also proposed. The proposed road network, within the site, will follow the existing network as the residential clusters will be located on the plateaus where the original buildings stood. The vertical alignment of the main spine road will be designed to keep steep gradients to a minimum, and only reach 10% (1:10) gradient on two short sections, each 20m in length. All other roads with houses fronting onto them do not exceed 6.7% (1:15) except for a section of the entrance road adjacent to Block F which is at 7.7% (1:13).

The landscape architecture will provide an integrated approach where the principles of DMURS are adopted for the road network with a hierarchy of streetscape networks within the site that will promote pedestrian priority such as shared spaces, raised tables, and homezone streets.

Provision will be made for connectivity with adjoining lands to the north west, south west (Atkins Hall), to the south east (Rose Hill Upper) and to the north east (old reservoir). The vertical and horizontal alignment of the site infrastructure will be designed to match the adjoining topography at these locations.

A total of 241no. car-parking spaces and 563no. cycle spaces will be provided in the development.

A Stage 1 Road Safety Audit for the proposed development was carried out and this is given in Appendix V along with the signed Feedback Form signed by Designer, Employer and Auditor. A Stage 2 Road Safety Audit in accordance with standard practice will be carried out at detailed design stage.

6.3 TRAFFIC ENGINEERING

Traffic engineering matters including DMURS compliance and Traffic Impact are discussed in detail under separate cover in the ILTP report covering those aspects of the proposed development.

APPENDIX I: Rainfall Data & SuDS Information

- Met Eireann Site Specific Rainfall Data
- Wallingford Greenfield Run-off Rate Estimation
- Wallingford SuDS Site Assessment

Met Eireann Rainfall Data for
St. Kevin's Hospital and Grounds, Shanakiel, Co. Cork

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 165026, Northing: 71661,

	Interval		Years													
DURATION	6months	1year	2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.7	3.6	4.1	4.8	5.3	5.6	6.7	8.0	8.8	9.9	10.8	11.6	12.7	13.6	14.3	N/A
10 mins	3.8	5.1	5.7	6.7	7.3	7.8	9.4	11.1	12.2	13.8	15.1	16.1	17.7	18.9	19.9	N/A
15 mins	4.4	5.9	6.7	7.9	8.6	9.2	11.0	13.1	14.4	16.2	17.8	19.0	20.8	22.2	23.4	N/A
30 mins	6.1	8.1	9.1	10.5	11.5	12.2	14.5	17.1	18.7	21.0	22.9	24.4	26.6	28.4	29.8	N/A
1 hours	8.4	10.9	12.2	14.1	15.3	16.2	19.1	22.3	24.3	27.1	29.5	31.3	34.1	36.2	37.9	N/A
2 hours	11.5	14.8	16.4	18.8	20.4	21.5	25.2	29.2	31.7	35.1	38.0	40.2	43.6	46.1	48.2	N/A
3 hours	13.8	17.7	19.6	22.3	24.1	25.4	29.6	34.1	36.9	40.8	44.1	46.6	50.3	53.1	55.4	N/A
4 hours	15.8	20.0	22.1	25.2	27.1	28.6	33.2	38.1	41.2	45.4	49.0	51.7	55.7	58.8	61.3	N/A
6 hours	19.0	23.9	26.4	29.8	32.1	33.8	39.0	44.6	48.1	52.8	56.8	59.8	64.3	67.8	70.5	N/A
9 hours	22.9	28.6	31.4	35.4	37.9	39.8	45.8	52.1	56.0	61.3	65.9	69.3	74.3	78.1	81.2	N/A
12 hours	26.1	32.4	35.5	39.9	42.7	44.8	51.4	58.2	62.5	68.3	73.2	76.8	82.3	86.4	89.7	N/A
18 hours	31.4	38.7	42.3	47.3	50.5	52.9	60.3	68.1	72.9	79.4	84.9	88.9	95.0	99.6	103.3	N/A
24 hours	35.8	43.9	47.8	53.4	56.9	59.5	67.6	76.1	81.3	88.3	94.3	98.7	105.3	110.2	114.1	127.3
2 days	45.4	54.9	59.4	65.8	69.9	72.9	82.1	91.7	97.6	105.4	112.0	116.9	124.1	129.5	133.9	148.3
3 days	53.3	63.9	69.1	76.2	80.6	84.0	94.2	104.6	111.1	119.6	126.8	132.1	139.9	145.7	150.4	165.9
4 days	60.4	72.0	77.6	85.3	90.2	93.8	104.8	116.1	123.0	132.2	139.8	145.5	153.9	160.1	165.1	181.6
6 days	73.1	86.5	92.9	101.7	107.2	111.3	123.7	136.4	144.2	154.4	163.0	169.3	178.6	185.5	191.0	209.2
8 days	84.5	99.5	106.5	116.3	122.4	126.9	140.6	154.6	163.1	174.2	183.6	190.4	200.5	208.0	214.0	233.6
10 days	95.2	111.5	119.2	129.9	136.5	141.4	156.3	171.3	180.5	192.5	202.5	209.9	220.7	228.7	235.1	256.1
12 days	105.3	122.9	131.2	142.6	149.8	155.0	170.9	187.0	196.8	209.6	220.3	228.1	239.6	248.1	254.9	277.1
16 days	124.3	144.3	153.7	166.6	174.6	180.5	198.3	216.3	227.2	241.4	253.3	262.0	274.7	284.1	291.5	316.0
20 days	142.2	164.4	174.8	189.0	197.9	204.4	223.9	243.6	255.5	271.0	283.9	293.4	307.2	317.4	325.5	352.0
25 days	163.6	188.3	199.9	215.6	225.4	232.6	254.1	275.7	288.8	305.8	319.9	330.2	345.3	356.4	365.3	394.1

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Based on the above Rainfall Data gleaned from Met Eireann:

M5-60 = 16.2mm
M5-2D = 72.9mm

Ratio "**r**" = 16.2/72.9 = 0.222

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Peter O'Dwyer
Site name:	St. Kevins
Site location:	Shanakiel, Co. Cork

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

Site Details

Latitude:	51.89635° N
Longitude:	8.50873° W
Reference:	2792426070
Date:	Dec 02 2020 16:13

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 4.588

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	1147	1147
Hydrological region:	13	13
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.65	1.65
Growth curve factor 100 years:	1.95	1.95
Growth curve factor 200 years:	2.15	2.15

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	14.9	14.9
1 in 1 year (l/s):	12.67	12.67
1 in 30 years (l/s):	24.59	24.59
1 in 100 year (l/s):	29.06	29.06
1 in 200 years (l/s):	32.04	32.04

Site Drainage Evaluation

Site name: St Kevins Hospital Site
Site location: Shanakiel Co. Cork

Report Reference: 1607086351949
Date: 4/12/2020

1. INTRODUCTION

This is a bespoke report providing initial guidance on potential implementation of SuDS for the development site in line with current best practice.

The use of this tool should be supplemented by more detailed guidance on SuDS best practice provided in a number of sources, principally the CIRIA SUDS Manual (2007), other CIRIA documents; the Use of SUDS in High Density Developments, HR Wallingford, (2005) and other HR Wallingford documents.

The objective is to provide some early guidance on the numbers and types of components that might be suitable for consideration within the site design. This may facilitate pre-application discussions with planners and other relevant authorities.

This guidance has been provided prior to the completion of the SUDS standards and the supporting guidance. However the principles of this tool are unlikely to be very different to the aims of the SUDS standards. HR Wallingford is not liable for the use of any output from the use of this tool and the performance of the drainage system. It is recommended that detailed design using appropriately experienced engineers professionals and tools is undertaken before finalising any drainage scheme arrangement for a site.

THE CONTENT OF THE REPORT

This report is split into 8 sections as follows:

2. Generic SuDS Best Practice Principles
3. Runoff Destination
4. Hydraulic Design Criteria
5. Water Quality Design Criteria
6. Site-Specific Drainage Design Considerations
7. SuDS Construction
8. SuDS Components Performance
9. Guidance on The Use of Individual Components

2. GENERIC SuDS BEST PRACTICE PRINCIPLES

To comply with current best practice, the drainage system should:

(i) manage runoff at or close to its source;
(ii) manage runoff at the surface;
(iii) be integrated with public open space areas and contribute towards meeting the objectives of the urban plan;
(iv) be cost-effective to operate and maintain.

The drainage system should endeavour to ensure that, for any particular site:

(i) natural hydrological processes are protected through maintaining Interception of an initial depth of rainfall and prioritising infiltration, where appropriate;
(ii) flood risk is managed through the control of runoff peak flow rates and volumes discharged from the site;
(iii) stormwater runoff is treated to prevent detrimental impacts to the receiving water body as a result of urban contaminants.

In addition, it is desirable to maximise the amenity and ecological benefits associated with the drainage system where there are appropriate opportunities. SuDS are green infrastructure components and can provide health benefits, and reduce the vulnerability of developments to the impacts of climate change.

3. RUNOFF DESTINATION

Introduction

Infiltration should be prioritised as the method of controlling surface water runoff from the development site, unless it can be demonstrated that the use of infiltration would have a detrimental environmental impact.

Groundwater (via Infiltration)

Infiltration may not be appropriate for managing runoff from this site. Robust studies are reqired to confirm the significance of the following constraints to infiltration:

(1) This is a steeply sloping site and full consideration must be given to the hydrogeological infiltration pathways, to ensure that there is no risk of water re-emerging on the site or on other sites and contributing to downstream flood risk.

(2) The subsurface geology is primarily impermeable and the use of infiltration is unlikely to be suitable. Where infiltration rates are confirmed via testing to be < 1 x 10-7 m/s, infiltration will be very limited. Where infiltration rates are between 1 x 10-7 and 1 x 10-5 m/s, then soils can still provide Interception and partial infiltration. If rates are confirmed to be > 1 x 10-5 m/s, full infiltration can be considered in the design.

The groundwater beneath the site is designated as , and this designation will define the treatment requirement for any infiltrated water (See Water Quality Design Criteria).

Surface water body

It has been determined that surface water runoff from the site (that cannot be discharged to groundwater via infiltration) cannot practicably be discharged to a surface water body. The results of robust studies to confirm the significance of the following constraints should be presented as evidence:

(1) The distance from the point of discharge from the site to the surface water body is significantly greater than to the proposed alternative receiving waterbody, and this constraint outweighs any negative impacts resulting from discharging to the alternative location.

Surface water sewer /local highway drain
All surface water runoff that cannot be discharged to groundwater via infiltration will be managed on site and discharged to a surface water sewer or local highway drain.

The surface sewer reference is: *Atkins Hall Surface Water Pipeline* and the asset owner is: *Owner of Adjoining Lands.*

4. HYDRAULIC DESIGN CRITERIA

Introduction
Best practice criteria for hydraulic control require Interception, runoff and volume control.

Interception
To fulfill the requirements for Interception, there should normally be no runoff from the site for an initial depth of rainfall - usually 5mm. This is achieved through the use of infiltration, evapotranspiration, or rainwater harvesting.

Flow and Volume Control
The site has been previously developed. It is likely that there will be a requirement for the runoff to be constrained to levels as close to the equivalent greenfield rates and volumes as possible. Discharges that exceed equivalent pre-development rates and volumes will not, generally, be acceptable.

Rainwater harvesting, or the use of Long Term Storage provide the means to achieve runoff volume control. Where volume control is not practicable, flows discharged from the site will need to be constrained to 2 l/s/ha.

5. WATER QUALITY DESIGN CRITERIA

Introduction
Current best practice takes a risk-based approach to managing discharges of surface runoff to the receiving environment. The following text provides guidance on the extent of water quality management likely to be appropriate for the site.

Hazard Classification
Runoff from clean roof surfaces (ie not metal roofs, roofs close to polluted atmospheric discharges, or roofs close to populations of flocking birds) is classified as Low in terms of hazard status.

Runoff from roads, parking and other areas of residential, commercial and industrial sites (that are not contaminated with waste, high levels of hydrocarbons, or other chemicals) is classified as Medium in terms of hazard status.

Treatment requirements for disposal to surface water systems
Roof runoff will not require treatment prior to discharge.

Runoff from other parts of this site such as roads, parking and other areas will require at least 2 treatment stages prior to discharge.

6. SITE-SPECIFIC DRAINAGE DESIGN CONSIDERATIONS

The site is a high density residential site. The HR Wallingford documenet 'SuDS for high density developments' is a useful guidance document for efficient drainage design where space is heavily constrained.

Components likely to be particularly suitable for high density sites include:

• permeable pavement parking areas which can often manage roof runoff as well as rainfall falling on the parking surface;
• green roofs which limit runoff from roof surfaces;
• bioretention areas integrated within impermeable zones;
• individual property soakaways;
• subsurface infiltration and/or detention systems (eg beneath functional, permeable surfaces);
• infiltration/detention/retention ponds/basins/channels integrated within public open space areas.

Where SuDS are being designed for sites with steep slopes, careful consideration of site layout planning and SUDS alignment is needed to minimise gradients of conveyance pathways and construction of large embankments, and to minimise flood risk when drainage systems are exceeded.

The design of SuDS with access to temporary or permanent water should consider public health and safety as well as issues associated with construction and operational management of the structures. Health and safety issues and risk mitigation features are presented in the CIRIA SuDS Manual.

Individual SuDS components should not be treated in isolation, but should be seen together as providing a suite of drainage features which are appropriate in different combinations for varying scales. It is always desirable to have a mix of SuDS components across the site as different components have different capacities for treatment of individual pollutants.

7. SuDS CONSTRUCTION

SuDS are a combination of civil engineering structures and landscaping practice. Due to the limited experience of building SuDS in the water industry, there are a number of key issues which need to be particularly considered as their construction requires a change in approach to some standard construction practices.

• SuDS components should be constructed in line with either the manufacturer's guidelines or best practice methods.
• The construction of SuDS usually only requires the use of fairly standard civil engineering construction and landscaping operations, such as excavation, filling, grading, top-soiling, seeding, planting etc. These operations are specified in various standard construction documents, such as the Civil Engineering Specification for the Water Industry (CESWI).
• Construction of soakaways is regulated by the Buildings Regulations part H (Drainage and waste disposal) which sets out the requirements for drainage of rainwater from the roofs of buildings.
• During construction, any surfaces which are intended to enable infiltration must be protected from compaction. This includes protecting from heavy traffic or storage of materials.
• Water contaminated with silt must not be allowed to enter a watercourse or drain as it can cause pollution. All parts of the drainage system must be protected from construction runoff to prevent silt clogging the system and causing pollution downstream. Measures to prevent this include soil stabilisation, early construction of sediment management basins, channelling run-off away from watercourses and surface water drains, and erosion prevention measures.
• After the end of the construction period and prior to handover to the site owner/operator:
 - Subsoil that has been compacted during construction activities should be broken up prior to the re-application of topsoil to garden areas and other areas of public open space to reinstate the natural infiltration performance of the ground;
 - Any areas of the SuDs that have been compacted during construction but are intended to permit infiltration must be completely refurbished;
 - Checks must be made for blockages or partial blockages of orifices or pipe systems;
 - Any silt deposited during the construction must be completely removed;
 - Soils must be stabilised and protected from erosion whilst planting becomes established.

Detailed guidance on the construction related issues for SuDS is available in the SuDS Manual and the associated Construction Site handbook (CIRIA, 2007).

8. SuDS COMPONENTS PERFORMANCE

	Interception	Peak flow control: Low	Peak flow control: High	Volume reduction	Volume control	Gross sediments	Fine sediments	Hydrocarbons/ PAHs	Metals	Nutrients
Rainwater Harvesting	Y	Y	S	Y	N	N	N	N	N	N
Pervious Pavement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Var
Filter Strips	Y	N	N	N	N	Y	N	Y	Y	Var
Swales	Y	Y	S	Y(*)	N	Y	Y(+)	Y	Y	Y(-)
Trenches	Y	Y	S	Y(*)	N	N	N	Y	Y	Y(-)
Detention Basins	Y	Y	Y	N	Y	Y	Y(+)	Y	Y	Var
Ponds	N	Y	Y	N	Y	N(~)	Y	Limited	Y	Var
Wetlands	N	Y	S	N	Y	N(~)	Y	Limited	Y	Y
Green Roofs	Y	Y	N	N	N	N	N	Y	N	N
Bioretention Systems	Y	Y	S	Y(*)	N	N(~)	Y	Y	Y	Y
Proprietary Treatment Systems	N	N	N	N	N	Y	Y	Y(!)	Y(!)	Y(!)
Subsurface Storage	N	Y	Y	N	Y	N(~)	N	N	N	N
Subsurface Conveyance Pipes	N	N	N	N	Y	N(~)	N	N	N	N

Notes:
S: Not normally with standard designs, but possible where space is available and designs mitigate impact of high flow rates.
Y(*): Where infiltration is facilitated by the design.
N(~): Gross sediment retention is possible, but not recommended due to negative maintenance and performance implications.
Y(+): Where designs minimise the risk of fine sediment mobilisation during larger events.
Y(!): Where designs specifically promote the trapping and breakdown of oils and PAH based constitutents.
Y("): Where subsurface soil structure facilitates the trapping and breakdown of oils and PAH based constituents.
Var: The nutrient removal performance is variable, and can be negative in some situations.
Y(-): Good nutrient removal performance where subsurface biofiltration systems with a permanently saturated zone included within the design.

9. GUIDANCE ON THE USE OF INDIVIDUAL COMPONENTS

Rainwater Harvesting

• *High density*
For large occupancy buildings (offices, supermarkets, etc.), communal rainwater harvesting systems may provide significant stormwater management benefits.

• *Roofs*
Rainwater harvesting systems can be used to effectively drain roofs and provide both water supply and stormwater management benefits.

Pervious Pavement

• *High density*
Pervious pavement systems provide an effective way to drain, store and treat the surface runoff, all within the footprint of the car park area. Larger areas of communal parking will provide the most cost effective systems.

• *Roofs*
Roof water can be drained into pervious pavement areas using diffusers to dissipate the point inflows. Detailed design of the pavement will need to take account of the additional impermeable roof area.

• *Roads*
Some types of pervious pavement can be used for relatively highly trafficked roads and pavement manufacturers should be consulted on the appropriate specification.

• *Car parks/other impermable surfaces*
Pervious pavements provide effective drainage, storage and treatment of car park surfacing,

• *Steep site*
Pervious pavements can be used on sloping sites, with the use of internal dams in order to attenuate and store the water effectively through a cascade system.

Filter Strips

• *High density*
Filter strips can be used as treatment for road or car park runoff where space allows.

• *Roads*
Filter strips can provide treatment for road runoff, upstream of swales or trench components. They can reduce the need for kerbing and runoff collection systems.

• *Car parks/other impermable surfaces*
Filter strips can provide treatment for runoff from impermeable surfaces, upstream of swales or trench components. They can reduce the need for kerbing and runoff collection systems.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
Filter strips can be used on sloping sites, where implemented parallel to the contours. The consequences of exceedance and flood flow paths will need to be considered.

Swales

• *High density*
Swales can be used for road or car park drainage where space allows. Underdrained swales (ie with a subsurface gravel filled conveyance and treatment trench) can provide a more efficient solution for hydraulic control and water quality treatment.

• *Roofs*
Swales can be used to convey roof water to other parts of the site.

• *Roads*
Swales provide treatment and conveyance of road runoff. There are a range of swale types - standard grass channels, underdrained swales, and wetland swales - depending on drainage requirements.

• *Car parks/other impermable surfaces*
Swales provide treatment and conveyance of runoff from impermeable areas. There are a range of swale types - standard grass channels, underdrained swales, and wetland swales - depending on drainage requirements.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
Swales can be used on sloping sites, where implemented parallel to the contours. The consequences of exceedance and flood flow paths will need to be considered.

Trenches

• *High density*
Trenches can provide treatment and runoff control for road or car park drainage.

• *Roofs*
Trenches can be used to convey roof water to other parts of the site.

• *Roads*
Trenches can provide treatment and conveyance of road runoff. They require effective pretreatment to minimise the risk of blockage.

• *Car parks/other impermable surfaces*
Trenches can provide treatment and conveyance of runoff for impermeable areas.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
Trenches can be used on sloping sites, where implemented parallel to the contours. The consequences of exceedance and flood flow paths will need to be considered.

Detention Basins

• *High density*
Detention basins can be used in high density developments when effectively integrated within public open space areas.

• *Roofs*
Detention basins can be used to attenuate and treat runoff.

• *Roads*
Detention basins can be used to attenuate and treat runoff.

• *Car parks/other impermable surfaces*
Detention basins can be used to attenuate and treat runoff.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria. A risk assessment should be used to determine the maximum appropriate depth of stored water in the basin.

• *Steep site*
Large basins may require embankments that may pose a safety risk to site residents.

Ponds

• *High density*
It is unlikely that a pond would be suitable for high density development, unless it is an integral amenity feature within the public open space area.

• *Roofs*
Ponds can be used to attenuate and treat roof runoff.

• *Roads*
Ponds can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in ponds for extended periods, nutrient concentrations can rise - particularly in the summer months, and the pond can become unattractive with poor amenity and biodiversity potential.

• *Car parks/other impermable surfaces*
Ponds can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in ponds for extended periods, nutrient concentrations can rise - particularly in the summer months, and the pond can become unattractive with poor amenity and biodiversity potential.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
Large ponds may require embankments that may pose a safety risk to site residents.

• *Other*
Ponds built in permeable soils will require lining to maintain the water level of the permanent pool. The lining may be finished 100 or 200 mm lower than the outlet invert to encourage some infiltration to take place to contribute to interception.

Wetlands

• *High density*
It is unlikely that a wetland would be suitable for high density development, unless it is an integral amenity feature within the public open space area.

• *Roofs*
Wetlands can be used to attenuate and treat roof runoff.

• *Roads*
Wetlands can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in wetlands for extended periods, nutrient concentrations can rise - particularly in the summer months, and the wetland can become unattractive with poor amenity and biodiversity potential.

• *Car parks/other impermable surfaces*
Wetlands can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in wetlands for extended periods, nutrient concentrations can rise - particularly in the summer months, and the wetland can become unattractive with poor amenity and biodiversity potential.

• *Site size > 50 ha*
The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
It is likely that wetlands would require embankments that may pose safety risks to site residents.

Green Roofs

• *HighDensity*
Green roofs can be implemented most cost-effectively on larger roofs. They provide a range of benefits in addition to stormwater management, including combatting the heat island effect, biodiversity and amenity functions.

• *Roofs*
Green roofs can be designed to provide interception, management and treatment of rainfall up to specified rainfall depths.

Bioretention Systems

• *High density*
Biorention systems (either cells or linear systems) can be used for road or car park drainage where space allows.

• *Roofs*
Bioretention systems can be used to attenuate and treat roof runoff.

• *Roads*
Linear bioretention systems (ie biofiltration swales) can be used to attenuate and treat road runoff.

• *Car parks/other impermable surfaces*
Bioretention systems canbe used for car park drainage.

• *Site size > 50 ha*
Bioretention systems will tend to be suitable for managing small areas only.The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

• *Steep site*
Bioretention systems can be used on sloping sites, when implemented parallel to the contours. The consequences of exceedance and flood flow paths will need to be considered.

Proprietary Treatment Systems

• *High density*
Proprietary treatment systems may be appropriate to use particularly where there is no space for surface, vegetated treatment systems. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.

• *Roads*
Proprietary treatment systems can be used where surface vegetated systems are impracticable. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.

• *Car parks/other impermable surfaces*
Proprietary treatment systems could be used where surface vegetated systems are impracticable. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.

• *Site size > 50 ha*
Proprietary treatment systems will tend to be suitable for managing small areas only. The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

Subsurface Storage

• *High density*
Subsurface storage of runoff is likely to be needed for high density developments. This can be implemented via a range of proprietary high void systems, or within gravels beneath permeable pavements which provide treatment as well. Sub-surface storage allows the land above the storage system to be used for car parking or public open space areas.

• *Roofs*
Subsurface storage can be used to attenuate roof runoff.

• *Roads*
Subsurface storage can be used to attenuate road runoff.

• *Car parks/other impermable surfaces*
Subsurface storage can be used to attenuate car park runoff.

Subsurface Conveyance Pipes

• *High density*
Subsurface conveyance systems may be an important means of connecting drainage components together and routing flows downstream. Space constraints in high density developments are likely to constrain the use of surface conveyance options.

HR Wallingford Ltd, the Environment Agency and any local authority are not liable for the performance of a drainage scheme which is based upon the output of this report.

APPENDIX II: Attenuation Volume Sizing & Soakaway Design

- Micro-Drainage Output: Attenuation Storage Volume Preliminary Estimation
- Micro-Drainage Output: 3no. Soakaways Designed for 10 Year Return Period

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.591	0.591	12.7	401.7	O K
30 min Summer	0.859	0.859	12.7	584.3	O K
60 min Summer	1.191	1.191	12.7	809.8	O K
120 min Summer	1.585	1.585	12.7	1077.9	O K
180 min Summer	1.822	1.822	12.7	1238.9	O K
240 min Summer	1.977	1.977	12.7	1344.5	O K
360 min Summer	2.185	2.185	12.8	1485.5	O K
480 min Summer	2.320	2.320	13.2	1577.8	O K
600 min Summer	2.411	2.411	13.4	1639.4	O K
720 min Summer	2.471	2.471	13.6	1680.5	O K
960 min Summer	2.534	2.534	13.7	1722.9	O K
1440 min Summer	2.576	2.576	13.8	1751.4	O K
2160 min Summer	2.565	2.565	13.8	1744.1	O K
2880 min Summer	2.523	2.523	13.7	1715.7	O K
4320 min Summer	2.422	2.422	13.4	1646.8	O K
5760 min Summer	2.306	2.306	13.1	1568.3	O K
7200 min Summer	2.188	2.188	12.8	1487.8	O K
8640 min Summer	2.072	2.072	12.7	1408.9	O K
10080 min Summer	1.960	1.960	12.7	1332.6	O K
15 min Winter	0.663	0.663	12.7	450.8	O K
30 min Winter	0.966	0.966	12.7	656.6	O K
60 min Winter	1.341	1.341	12.7	912.0	O K
120 min Winter	1.785	1.785	12.7	1213.7	O K
180 min Winter	2.056	2.056	12.7	1397.7	O K
240 min Winter	2.235	2.235	12.9	1519.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	75.923	0.0	401.1	23
30 min Summer	55.559	0.0	588.5	37
60 min Summer	38.927	0.0	839.0	68
120 min Summer	26.404	0.0	1138.1	126
180 min Summer	20.655	0.0	1334.6	186
240 min Summer	17.156	0.0	1476.8	246
360 min Summer	13.138	0.0	1691.6	366
480 min Summer	10.858	0.0	1853.6	484
600 min Summer	9.353	0.0	1967.8	604
720 min Summer	8.271	0.0	2011.1	722
960 min Summer	6.801	0.0	2011.2	936
1440 min Summer	5.142	0.0	1974.5	1172
2160 min Summer	3.872	0.0	3017.7	1560
2880 min Summer	3.161	0.0	3281.4	1984
4320 min Summer	2.381	0.0	3585.3	2816
5760 min Summer	1.950	0.0	4060.4	3640
7200 min Summer	1.672	0.0	4353.0	4472
8640 min Summer	1.478	0.0	4614.4	5280
10080 min Summer	1.333	0.0	4852.6	6144
15 min Winter	75.923	0.0	449.8	23
30 min Winter	55.559	0.0	658.8	37
60 min Winter	38.927	0.0	939.8	66
120 min Winter	26.404	0.0	1274.3	126
180 min Winter	20.655	0.0	1493.5	184
240 min Winter	17.156	0.0	1651.1	242

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
360 min Winter	2.480	2.480	13.6	1686.3	O K
480 min Winter	2.645	2.645	14.0	1798.5	O K
600 min Winter	2.760	2.760	14.3	1876.6	O K
720 min Winter	2.841	2.841	14.5	1931.8	O K
960 min Winter	2.937	2.937	14.7	1997.5	O K
1440 min Winter	2.986	2.986	14.8	2030.3	O K
2160 min Winter	2.966	2.966	14.8	2016.9	O K
2880 min Winter	2.895	2.895	14.6	1968.5	O K
4320 min Winter	2.712	2.712	14.2	1844.4	O K
5760 min Winter	2.511	2.511	13.7	1707.5	O K
7200 min Winter	2.311	2.311	13.1	1571.4	O K
8640 min Winter	2.118	2.118	12.7	1440.0	O K
10080 min Winter	1.932	1.932	12.7	1314.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
360 min Winter	13.138	0.0	1883.5	358
480 min Winter	10.858	0.0	2026.0	474
600 min Winter	9.353	0.0	2059.4	588
720 min Winter	8.271	0.0	2065.2	702
960 min Winter	6.801	0.0	2064.2	922
1440 min Winter	5.142	0.0	2082.3	1326
2160 min Winter	3.872	0.0	3378.5	1664
2880 min Winter	3.161	0.0	3670.4	2136
4320 min Winter	2.381	0.0	3785.4	3032
5760 min Winter	1.950	0.0	4547.8	3928
7200 min Winter	1.672	0.0	4875.4	4824
8640 min Winter	1.478	0.0	5168.0	5704
10080 min Winter	1.333	0.0	5435.8	6552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.200	Shortest Storm (mins)	15
Ratio R	0.222	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 2.894

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.623	4	8	2.241	8	12	0.030

Estimation of volume required for drained area of 2.894ha at discharge rate of 14.9l/s:
680sq.m x 3.0m deep tank = 2040cu.m storage

Model Details

Storage is Online Cover Level (m) 3.100

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	680.0	3.000	680.0	3.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0145-1490-3000-1490
Design Head (m)	3.000
Design Flow (l/s)	14.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	145
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	14.9	Kick-Flo®	1.298	10.0
Flush-Flo™	0.630	12.7	Mean Flow over Head Range	-	11.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.800	12.6	2.000	12.3	4.000	17.1	7.000	22.3
0.200	10.4	1.000	12.1	2.200	12.8	4.500	18.1	7.500	23.1
0.300	11.6	1.200	11.0	2.400	13.4	5.000	19.0	8.000	23.8
0.400	12.3	1.400	10.4	2.600	13.9	5.500	19.9	8.500	24.5
0.500	12.6	1.600	11.0	3.000	14.9	6.000	20.7	9.000	25.2
0.600	12.7	1.800	11.7	3.500	16.0	6.500	21.5	9.500	25.8

Estimation of volume required for Soakaway 1 to north east of development

Summary of Results for 10 year Return Period (+20%)

Half Drain Time : 724 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	61.308	0.158	0.2	0.0	0.2	10.4	O K
30 min Summer	61.367	0.217	0.2	0.0	0.2	14.6	O K
60 min Summer	61.437	0.287	0.3	0.0	0.3	19.6	O K
120 min Summer	61.518	0.368	0.4	0.0	0.4	25.3	O K
180 min Summer	61.569	0.419	0.4	0.0	0.4	29.0	O K
240 min Summer	61.605	0.455	0.5	0.0	0.5	31.6	O K
360 min Summer	61.654	0.504	0.5	0.0	0.5	35.0	O K
480 min Summer	61.683	0.533	0.6	0.0	0.6	37.1	O K
600 min Summer	61.707	0.557	0.6	0.0	0.6	38.8	O K
720 min Summer	61.726	0.576	0.6	0.0	0.6	40.2	O K
960 min Summer	61.756	0.606	0.7	0.0	0.7	42.3	O K
1440 min Summer	61.792	0.642	0.7	0.0	0.7	44.9	O K
2160 min Summer	61.815	0.665	0.7	0.0	0.7	46.5	O K
2880 min Summer	61.819	0.669	0.7	0.0	0.7	46.8	O K
4320 min Summer	61.807	0.657	0.7	0.0	0.7	45.9	O K
5760 min Summer	61.784	0.634	0.7	0.0	0.7	44.3	O K
7200 min Summer	61.760	0.610	0.7	0.0	0.7	42.6	O K
8640 min Summer	61.737	0.587	0.6	0.0	0.6	40.9	O K
10080 min Summer	61.715	0.565	0.6	0.0	0.6	39.4	O K
15 min Winter	61.326	0.176	0.2	0.0	0.2	11.6	O K
30 min Winter	61.392	0.242	0.3	0.0	0.3	16.3	O K
60 min Winter	61.470	0.320	0.3	0.0	0.3	21.9	O K
120 min Winter	61.561	0.411	0.4	0.0	0.4	28.4	O K
180 min Winter	61.619	0.469	0.5	0.0	0.5	32.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	48.166	0.0	0.0	19
30 min Summer	34.051	0.0	0.0	34
60 min Summer	23.155	0.0	0.0	64
120 min Summer	15.411	0.0	0.0	122
180 min Summer	12.075	0.0	0.0	182
240 min Summer	10.139	0.0	0.0	242
360 min Summer	7.913	0.0	0.0	360
480 min Summer	6.631	0.0	0.0	446
600 min Summer	5.779	0.0	0.0	496
720 min Summer	5.164	0.0	0.0	556
960 min Summer	4.323	0.0	0.0	684
1440 min Summer	3.364	0.0	0.0	954
2160 min Summer	2.615	0.0	0.0	1364
2880 min Summer	2.187	0.0	0.0	1764
4320 min Summer	1.699	0.0	0.0	2552
5760 min Summer	1.420	0.0	0.0	3344
7200 min Summer	1.235	0.0	0.0	4104
8640 min Summer	1.103	0.0	0.0	4840
10080 min Summer	1.002	0.0	0.0	5552
15 min Winter	48.166	0.0	0.0	19
30 min Winter	34.051	0.0	0.0	33
60 min Winter	23.155	0.0	0.0	62
120 min Winter	15.411	0.0	0.0	120
180 min Winter	12.075	0.0	0.0	178

Summary of Results for 10 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	61.660	0.510	0.5	0.0	0.5	35.5	O K
360 min Winter	61.716	0.566	0.6	0.0	0.6	39.4	O K
480 min Winter	61.751	0.601	0.7	0.0	0.7	41.9	O K
600 min Winter	61.774	0.624	0.7	0.0	0.7	43.6	O K
720 min Winter	61.794	0.644	0.7	0.0	0.7	45.0	O K
960 min Winter	61.824	0.674	0.7	0.0	0.7	47.2	O K
1440 min Winter	61.854	0.704	0.8	0.0	0.8	49.3	O K
2160 min Winter	61.862	0.712	0.8	0.0	0.8	49.9	O K
2880 min Winter	61.852	0.702	0.8	0.0	0.8	49.1	O K
4320 min Winter	61.815	0.665	0.7	0.0	0.7	46.5	O K
5760 min Winter	61.774	0.624	0.7	0.0	0.7	43.6	O K
7200 min Winter	61.736	0.586	0.6	0.0	0.6	40.9	O K
8640 min Winter	61.702	0.552	0.6	0.0	0.6	38.5	O K
10080 min Winter	61.672	0.522	0.6	0.0	0.6	36.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	10.139	0.0	0.0	236
360 min Winter	7.913	0.0	0.0	348
480 min Winter	6.631	0.0	0.0	456
600 min Winter	5.779	0.0	0.0	548
720 min Winter	5.164	0.0	0.0	570
960 min Winter	4.323	0.0	0.0	722
1440 min Winter	3.364	0.0	0.0	1024
2160 min Winter	2.615	0.0	0.0	1468
2880 min Winter	2.187	0.0	0.0	1900
4320 min Winter	1.699	0.0	0.0	2720
5760 min Winter	1.420	0.0	0.0	3512
7200 min Winter	1.235	0.0	0.0	4256
8640 min Winter	1.103	0.0	0.0	5016
10080 min Winter	1.002	0.0	0.0	5760

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.200	Shortest Storm (mins)	15
Ratio R	0.222	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.116

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.116

Soakaway 1:
25m x 3m x 1.6m
@ 95% Porosity

Model Details

Storage is Online Cover Level (m) 63.979

Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.07100	Trench Length (m)	25.0
Safety Factor	1.0	Slope (1:X)	1000.0
Porosity	0.95	Cap Volume Depth (m)	0.000
Invert Level (m)	61.150	Cap Infiltration Depth (m)	1.600

Pipe Overflow Control

Diameter (m)	0.225	Roughness k (mm)	0.600	Upstream Invert Level (m)	62.750
Slope (1:X)	100.0	Entry Loss Coefficient	0.500		
Length (m)	10.000	Coefficient of Contraction	0.600		

Estimation of volume required for Soakaway 2 to south of Block R.

Summary of Results for 10 year Return Period (+20%)

Half Drain Time : 488 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	38.776	0.266	0.2	0.0	0.2	9.7	O K
30 min Summer	38.878	0.368	0.3	0.0	0.3	13.6	O K
60 min Summer	38.997	0.487	0.4	0.0	0.4	18.1	O K
120 min Summer	39.130	0.620	0.5	0.0	0.5	23.2	O K
180 min Summer	39.209	0.699	0.6	0.0	0.6	26.2	O K
240 min Summer	39.261	0.751	0.6	0.0	0.6	28.2	O K
360 min Summer	39.326	0.816	0.7	0.0	0.7	30.6	O K
480 min Summer	39.373	0.863	0.7	0.0	0.7	32.4	O K
600 min Summer	39.409	0.899	0.8	0.0	0.8	33.8	O K
720 min Summer	39.437	0.927	0.8	0.0	0.8	34.8	O K
960 min Summer	39.475	0.965	0.8	0.0	0.8	36.3	O K
1440 min Summer	39.512	1.002	0.9	0.0	0.9	37.7	O K
2160 min Summer	39.518	1.008	0.9	0.0	0.9	37.9	O K
2880 min Summer	39.502	0.992	0.9	0.0	0.9	37.3	O K
4320 min Summer	39.451	0.941	0.8	0.0	0.8	35.4	O K
5760 min Summer	39.398	0.888	0.8	0.0	0.8	33.4	O K
7200 min Summer	39.350	0.840	0.7	0.0	0.7	31.5	O K
8640 min Summer	39.307	0.797	0.7	0.0	0.7	29.9	O K
10080 min Summer	39.270	0.760	0.7	0.0	0.7	28.5	O K
15 min Winter	38.806	0.296	0.2	0.0	0.2	10.9	O K
30 min Winter	38.921	0.411	0.3	0.0	0.3	15.2	O K
60 min Winter	39.055	0.545	0.5	0.0	0.5	20.3	O K
120 min Winter	39.205	0.695	0.6	0.0	0.6	26.0	O K
180 min Winter	39.295	0.785	0.7	0.0	0.7	29.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	48.166	0.0	0.0	19
30 min Summer	34.051	0.0	0.0	34
60 min Summer	23.155	0.0	0.0	64
120 min Summer	15.411	0.0	0.0	122
180 min Summer	12.075	0.0	0.0	182
240 min Summer	10.139	0.0	0.0	240
360 min Summer	7.913	0.0	0.0	314
480 min Summer	6.631	0.0	0.0	374
600 min Summer	5.779	0.0	0.0	434
720 min Summer	5.164	0.0	0.0	504
960 min Summer	4.323	0.0	0.0	638
1440 min Summer	3.364	0.0	0.0	910
2160 min Summer	2.615	0.0	0.0	1320
2880 min Summer	2.187	0.0	0.0	1704
4320 min Summer	1.699	0.0	0.0	2468
5760 min Summer	1.420	0.0	0.0	3232
7200 min Summer	1.235	0.0	0.0	3968
8640 min Summer	1.103	0.0	0.0	4752
10080 min Summer	1.002	0.0	0.0	5448
15 min Winter	48.166	0.0	0.0	19
30 min Winter	34.051	0.0	0.0	33
60 min Winter	23.155	0.0	0.0	62
120 min Winter	15.411	0.0	0.0	120
180 min Winter	12.075	0.0	0.0	178

Summary of Results for 10 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	39.355	0.845	0.7	0.0	0.7	31.7	O K
360 min Winter	39.430	0.920	0.8	0.0	0.8	34.6	O K
480 min Winter	39.476	0.966	0.8	0.0	0.8	36.3	O K
600 min Winter	39.513	1.003	0.9	0.0	0.9	37.7	O K
720 min Winter	39.539	1.029	0.9	0.0	0.9	38.7	O K
960 min Winter	39.570	1.060	0.9	0.0	0.9	39.9	O K
1440 min Winter	39.585	1.075	0.9	0.0	0.9	40.5	O K
2160 min Winter	39.560	1.050	0.9	0.0	0.9	39.5	O K
2880 min Winter	39.517	1.007	0.9	0.0	0.9	37.9	O K
4320 min Winter	39.427	0.917	0.8	0.0	0.8	34.5	O K
5760 min Winter	39.347	0.837	0.7	0.0	0.7	31.4	O K
7200 min Winter	39.281	0.771	0.7	0.0	0.7	28.9	O K
8640 min Winter	39.225	0.715	0.6	0.0	0.6	26.8	O K
10080 min Winter	39.178	0.668	0.6	0.0	0.6	25.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	10.139	0.0	0.0	232
360 min Winter	7.913	0.0	0.0	338
480 min Winter	6.631	0.0	0.0	382
600 min Winter	5.779	0.0	0.0	458
720 min Winter	5.164	0.0	0.0	534
960 min Winter	4.323	0.0	0.0	684
1440 min Winter	3.364	0.0	0.0	980
2160 min Winter	2.615	0.0	0.0	1404
2880 min Winter	2.187	0.0	0.0	1816
4320 min Winter	1.699	0.0	0.0	2596
5760 min Winter	1.420	0.0	0.0	3352
7200 min Winter	1.235	0.0	0.0	4112
8640 min Winter	1.103	0.0	0.0	4848
10080 min Winter	1.002	0.0	0.0	5640

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.200	Shortest Storm (mins)	15
Ratio R	0.222	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.109

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.109

Soakaway 2:
20m x 2m x 1.6m
@ 95% Porosity

Model Details

Storage is Online Cover Level (m) 42.000

Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	2.0
Infiltration Coefficient Side (m/hr)	0.07100	Trench Length (m)	20.0
Safety Factor	1.0	Slope (1:X)	1000.0
Porosity	0.95	Cap Volume Depth (m)	0.000
Invert Level (m)	38.510	Cap Infiltration Depth (m)	1.600

Pipe Overflow Control

Diameter (m)	0.225	Roughness k (mm)	0.600	Upstream Invert Level (m)	40.110
Slope (1:X)	100.0	Entry Loss Coefficient	0.500		
Length (m)	10.000	Coefficient of Contraction	0.600		

Estimation of volume required for Soakaway 3 to south of St. Kevins Apts.

Summary of Results for 10 year Return Period (+20%)

Half Drain Time : 723 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	37.652	0.245	0.3	0.0	0.3	16.6	O K
30 min Summer	37.746	0.339	0.4	0.0	0.4	23.3	O K
60 min Summer	37.857	0.450	0.5	0.0	0.5	31.2	O K
120 min Summer	37.986	0.579	0.6	0.0	0.6	40.4	O K
180 min Summer	38.068	0.661	0.7	0.0	0.7	46.2	O K
240 min Summer	38.126	0.719	0.8	0.0	0.8	50.3	O K
360 min Summer	38.203	0.796	0.9	0.0	0.9	55.8	O K
480 min Summer	38.250	0.843	0.9	0.0	0.9	59.2	O K
600 min Summer	38.288	0.881	1.0	0.0	1.0	61.9	O K
720 min Summer	38.319	0.912	1.0	0.0	1.0	64.1	O K
960 min Summer	38.366	0.959	1.0	0.0	1.0	67.5	O K
1440 min Summer	38.424	1.017	1.1	0.0	1.1	71.6	O K
2160 min Summer	38.460	1.053	1.1	0.0	1.1	74.2	O K
2880 min Summer	38.467	1.060	1.2	0.0	1.2	74.6	O K
4320 min Summer	38.447	1.040	1.1	0.0	1.1	73.2	O K
5760 min Summer	38.411	1.004	1.1	0.0	1.1	70.6	O K
7200 min Summer	38.373	0.966	1.1	0.0	1.1	67.9	O K
8640 min Summer	38.336	0.929	1.0	0.0	1.0	65.3	O K
10080 min Summer	38.301	0.894	1.0	0.0	1.0	62.8	O K
15 min Winter	37.680	0.273	0.3	0.0	0.3	18.5	O K
30 min Winter	37.785	0.378	0.4	0.0	0.4	26.1	O K
60 min Winter	37.910	0.503	0.5	0.0	0.5	35.0	O K
120 min Winter	38.055	0.648	0.7	0.0	0.7	45.3	O K
180 min Winter	38.147	0.740	0.8	0.0	0.8	51.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	48.166	0.0	0.0	19
30 min Summer	34.051	0.0	0.0	34
60 min Summer	23.155	0.0	0.0	64
120 min Summer	15.411	0.0	0.0	122
180 min Summer	12.075	0.0	0.0	182
240 min Summer	10.139	0.0	0.0	242
360 min Summer	7.913	0.0	0.0	360
480 min Summer	6.631	0.0	0.0	446
600 min Summer	5.779	0.0	0.0	496
720 min Summer	5.164	0.0	0.0	556
960 min Summer	4.323	0.0	0.0	684
1440 min Summer	3.364	0.0	0.0	954
2160 min Summer	2.615	0.0	0.0	1364
2880 min Summer	2.187	0.0	0.0	1764
4320 min Summer	1.699	0.0	0.0	2552
5760 min Summer	1.420	0.0	0.0	3344
7200 min Summer	1.235	0.0	0.0	4104
8640 min Summer	1.103	0.0	0.0	4840
10080 min Summer	1.002	0.0	0.0	5552
15 min Winter	48.166	0.0	0.0	19
30 min Winter	34.051	0.0	0.0	33
60 min Winter	23.155	0.0	0.0	62
120 min Winter	15.411	0.0	0.0	120
180 min Winter	12.075	0.0	0.0	178

Summary of Results for 10 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	38.213	0.806	0.9	0.0	0.9	56.6	O K
360 min Winter	38.302	0.895	1.0	0.0	1.0	62.9	O K
480 min Winter	38.358	0.951	1.0	0.0	1.0	66.9	O K
600 min Winter	38.395	0.988	1.1	0.0	1.1	69.5	O K
720 min Winter	38.427	1.020	1.1	0.0	1.1	71.8	O K
960 min Winter	38.475	1.068	1.2	0.0	1.2	75.2	O K
1440 min Winter	38.523	1.116	1.2	0.0	1.2	78.6	O K
2160 min Winter	38.536	1.129	1.2	0.0	1.2	79.5	O K
2880 min Winter	38.520	1.113	1.2	0.0	1.2	78.4	O K
4320 min Winter	38.461	1.054	1.2	0.0	1.2	74.2	O K
5760 min Winter	38.395	0.988	1.1	0.0	1.1	69.5	O K
7200 min Winter	38.335	0.928	1.0	0.0	1.0	65.2	O K
8640 min Winter	38.280	0.873	1.0	0.0	1.0	61.3	O K
10080 min Winter	38.232	0.825	0.9	0.0	0.9	57.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
240 min Winter	10.139	0.0	0.0	236
360 min Winter	7.913	0.0	0.0	348
480 min Winter	6.631	0.0	0.0	456
600 min Winter	5.779	0.0	0.0	548
720 min Winter	5.164	0.0	0.0	570
960 min Winter	4.323	0.0	0.0	722
1440 min Winter	3.364	0.0	0.0	1024
2160 min Winter	2.615	0.0	0.0	1468
2880 min Winter	2.187	0.0	0.0	1900
4320 min Winter	1.699	0.0	0.0	2720
5760 min Winter	1.420	0.0	0.0	3512
7200 min Winter	1.235	0.0	0.0	4256
8640 min Winter	1.103	0.0	0.0	5016
10080 min Winter	1.002	0.0	0.0	5760

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.200	Shortest Storm (mins)	15
Ratio R	0.222	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.185

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.185

Soakaway 3:
25m x 3m x 1.6m
@ 95% Porosity

Model Details

Storage is Online Cover Level (m) 41.335

Trench Soakaway Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.07100	Trench Length (m)	25.0
Safety Factor	1.0	Slope (1:X)	1000.0
Porosity	0.95	Cap Volume Depth (m)	0.000
Invert Level (m)	37.407	Cap Infiltration Depth (m)	1.600

Pipe Overflow Control

Diameter (m)	0.375	Roughness k (mm)	0.600	Upstream Invert Level (m)	39.082
Slope (1:X)	100.0	Entry Loss Coefficient	0.500		
Length (m)	10.000	Coefficient of Contraction	0.600		

APPENDIX III: Surface Water Drainage - Network Simulation & Design

- Simulation Calculations, 1, 30 & 100 Year Critical Return Period Storms
- Simulation Calculations, 1, 30 & 100 Year Critical Return Period Storms assuming 50% Blockage.

Overall Development Network Design and Simulation

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Water

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.200	Add Flow / Climate Change (%)	0
Ratio R	0.222	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	10.000
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 Surface Water

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.623	4-8	2.241	8-12	0.030

Total Area Contributing (ha) = 2.894

Total Pipe Volume (m³) = 106.000

Total Drained Area = 2.894ha

Network Design Table for Surface Water

« - 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	45.280	1.372	33.0	0.136	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	11.520	0.281	41.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	11.560	0.289	40.0	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	14.190	0.364	39.0	0.014	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	43.130	0.260	165.9	0.288	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	9.650	0.228	42.3	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	51.240	0.758	67.6	0.095	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	4.33	67.990	0.136	0.0	0.0	0.0	2.29	90.9	18.4
1.001	50.00	4.42	65.820	0.152	0.0	0.0	0.0	2.05	81.5	20.6
1.002	50.00	4.52	64.760	0.162	0.0	0.0	0.0	2.07	82.5	21.9
1.003	50.00	4.63	63.370	0.176	0.0	0.0	0.0	2.10	83.6	23.8
2.000	50.00	4.59	62.390	0.288	0.0	0.0	0.0	1.22	86.1	39.0
1.004	50.00	4.70	62.050	0.473	0.0	0.0	0.0	2.42	171.3	64.1
3.000	50.00	4.54	62.570	0.095	0.0	0.0	0.0	1.59	63.3	12.9

Network Design Table for Surface Water

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
1.005	36.350	0.895	40.6	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	29.540	0.446	66.2	0.052	4.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	20.094	0.402	50.0	0.029	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	49.400	1.482	33.3	0.205	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.002	24.180	0.242	99.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.003	16.211	0.162	100.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	26.688	0.400	66.7	0.007	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.004	19.846	0.490	40.5	0.008	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.005	9.690	0.174	55.7	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.006	15.900	0.079	201.3	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	6.825	0.183	37.3	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	6.701	0.168	39.9	0.006	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	8.020	0.167	48.0	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.009	63.711	3.222	19.8	0.286	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	19.590	0.930	21.1	0.020	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	30.080	1.446	20.8	0.114	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.012	12.540	0.409	30.7	0.024	0.00	0.0	0.600	o	375	Pipe/Conduit	
7.000	78.780	0.532	148.1	0.142	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)
1.005	50.00	4.94	60.090	0.615	0.0	0.0	0.0	2.47	174.9	83.3
4.000	50.00	4.31	64.678	0.052	0.0	0.0	0.0	1.61	64.0	7.0
5.000	50.00	4.18	65.280	0.029	0.0	0.0	0.0	1.85	73.7	3.9
4.001	50.00	4.61	64.232	0.286	0.0	0.0	0.0	2.73	193.2	38.7
4.002	50.00	4.86	62.750	0.286	0.0	0.0	0.0	1.57	111.2	38.7
4.003	50.00	5.04	62.508	0.286	0.0	0.0	0.0	1.57	111.1	38.7
6.000	50.00	4.28	61.584	0.007	0.0	0.0	0.0	1.60	63.8	0.9
4.004	50.00	5.17	59.880	0.301	0.0	0.0	0.0	2.48	175.1	40.8
4.005	50.00	5.25	59.290	0.321	0.0	0.0	0.0	2.11	149.2	43.5
4.006	50.00	5.49	59.041	0.366	0.0	0.0	0.0	1.10	78.1	49.6
1.006	50.00	5.53	58.000	0.988	0.0	0.0	0.0	2.58	182.6	133.8
1.007	50.00	5.57	57.120	0.994	0.0	0.0	0.0	2.50	176.5	134.6
1.008	50.00	5.63	56.170	1.003	0.0	0.0	0.0	2.27	160.8	135.8
1.009	50.00	5.93	54.800	1.289	0.0	0.0	0.0	3.55	251.1	174.5
1.010	50.00	6.01	50.090	1.309	0.0	0.0	0.0	3.96	437.7	177.3
1.011	50.00	6.14	49.160	1.423	0.0	0.0	0.0	3.99	440.5	192.7
1.012	50.00	6.20	46.820	1.447	0.0	0.0	0.0	3.28	362.6	195.9
7.000	50.00	5.22	54.260	0.142	0.0	0.0	0.0	1.07	42.6	19.2

Network Design Table for Surface Water

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
7.001	17.307	0.259	66.8	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	17.660	0.268	65.9	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	17.460	0.437	40.0	0.083	4.00	0.0	0.600	o	225	Pipe/Conduit	
8.001	12.989	0.325	40.0	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.003	11.365	0.284	40.0	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.004	18.544	0.464	40.0	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.000	6.824	0.048	142.2	0.073	4.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	50.950	0.345	147.7	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.002	25.932	0.183	141.7	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit	
9.003	19.040	0.121	157.4	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.005	23.327	0.156	149.5	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
7.006	49.420	0.988	50.0	0.144	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.013	22.999	0.597	38.5	0.103	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	13.560	0.654	20.7	0.019	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.015	8.940	0.447	20.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
10.000	30.910	0.775	39.9	0.064	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.016	63.287	0.356	177.8	0.045	0.00	0.0	0.600	o	450	Pipe/Conduit	
11.000	59.490	1.982	30.0	0.113	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)
7.001	50.00	5.40	53.728	0.191	0.0	0.0	0.0	1.60	63.7	25.9
7.002	50.00	5.59	52.720	0.207	0.0	0.0	0.0	1.61	64.2	28.0
8.000	50.00	4.14	55.989	0.083	0.0	0.0	0.0	2.08	82.5	11.2
8.001	50.00	4.24	53.600	0.088	0.0	0.0	0.0	2.08	82.5	11.9
7.003	50.00	5.68	51.100	0.299	0.0	0.0	0.0	2.07	82.5	40.5
7.004	50.00	5.83	48.990	0.305	0.0	0.0	0.0	2.08	82.5	41.3
9.000	50.00	4.10	48.423	0.073	0.0	0.0	0.0	1.09	43.5	9.9
9.001	50.00	4.89	48.375	0.202	0.0	0.0	0.0	1.07	42.7	27.4
9.002	50.00	5.29	48.010	0.255	0.0	0.0	0.0	1.10	43.6	34.5
9.003	50.00	5.59	47.827	0.286	0.0	0.0	0.0	1.04	41.3	38.7
7.005	50.00	6.09	47.556	0.656	0.0	0.0	0.0	1.48	163.4	88.8
7.006	49.77	6.41	47.400	0.800	0.0	0.0	0.0	2.57	283.5	107.8
1.013	49.44	6.53	45.140	2.350	0.0	0.0	0.0	3.28	522.2	314.7
1.014	49.30	6.58	43.440	2.369	0.0	0.0	0.0	4.48	712.6	316.3
1.015	49.21	6.61	41.330	2.369	0.0	0.0	0.0	4.56	725.6	316.3
10.000	50.00	4.25	41.653	0.064	0.0	0.0	0.0	2.08	82.6	8.7
1.016	47.36	7.30	39.940	2.478	0.0	0.0	0.0	1.52	242.0«	317.9
11.000	50.00	4.41	44.970	0.113	0.0	0.0	0.0	2.40	95.3	15.3

Network Design Table for Surface Water

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
11.001	11.003	0.367	30.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.002	4.540	0.151	30.1	0.001	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.017	8.770	0.035	250.6	0.006	0.00	0.0	0.600	o	450	Pipe/Conduit	
12.000	37.370	0.207	180.5	0.128	4.00	0.0	0.600	o	300	Pipe/Conduit	
12.001	56.337	0.320	176.1	0.127	0.00	0.0	0.600	o	300	Pipe/Conduit	
13.000	11.521	0.121	95.2	0.041	4.00	0.0	0.600	o	300	Pipe/Conduit	
12.002	18.771	0.091	206.3	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
12.003	41.367	0.200	206.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
12.004	41.466	0.201	206.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.018	18.540	0.086	215.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.019	24.660	0.432	57.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.020	90.000	5.000	18.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.021	19.380	0.969	20.0	0.000	0.00	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)
11.001	50.00	4.49	41.430	0.113	0.0	0.0	0.0	2.40	95.4	15.3
11.002	50.00	4.52	40.110	0.114	0.0	0.0	0.0	2.39	95.2	15.4
1.017	47.08	7.42	39.584	2.598	0.0	0.0	0.0	1.28	203.5«	331.2
12.000	50.00	4.53	39.684	0.128	0.0	0.0	0.0	1.17	82.5	17.3
12.001	50.00	5.33	39.477	0.255	0.0	0.0	0.0	1.18	83.5	34.5
13.000	50.00	4.12	39.278	0.041	0.0	0.0	0.0	1.61	113.9	5.6
12.002	50.00	5.58	39.082	0.296	0.0	0.0	0.0	1.26	138.9	40.1
12.003	50.00	6.13	38.991	0.296	0.0	0.0	0.0	1.26	138.7	40.1
12.004	49.02	6.68	38.791	0.296	0.0	0.0	0.0	1.26	138.7	40.1
1.018	46.53	7.64	38.561	2.894	0.0	0.0	0.0	1.38	219.6«	364.7
1.019	45.97	7.88	35.400	2.894	0.0	0.0	0.0	1.73	69.0«	364.7
1.020	44.87	8.36	31.440	2.894	0.0	0.0	0.0	3.10	123.2«	364.7
1.021	44.63	8.47	25.440	2.894	0.0	0.0	0.0	2.94	116.9«	364.7

Manhole Schedules for Surface Water

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1.0	71.200	3.210	Open Manhole	1200	1.000	67.990	225				
S1.1	68.040	2.220	Open Manhole	1200	1.001	65.820	225	1.000	66.618	225	798
S1.2	67.010	2.250	Open Manhole	1200	1.002	64.760	225	1.001	65.539	225	779
S1.3	65.910	2.540	Open Manhole	1200	1.003	63.370	225	1.002	64.471	225	1101
S2.0	64.000	1.610	Open Manhole	1200	2.000	62.390	300				
S1.4	64.630	2.580	Open Manhole	1200	1.004	62.050	300	1.003	63.006	225	881
								2.000	62.130	300	80
S3.0	65.850	3.280	Open Manhole	1200	3.000	62.570	225				
S1.5	63.660	3.570	Open Manhole	1200	1.005	60.090	300	1.004	61.822	300	1732
								3.000	61.812	225	1647
S4.0	66.200	1.522	Open Manhole	1200	4.000	64.678	225				
S5.0	66.624	1.344	Open Manhole	1200	5.000	65.280	225				
S4.1	66.684	2.452	Open Manhole	1200	4.001	64.232	300	4.000	64.232	225	
								5.000	64.878	225	571
S4.2	63.979	1.229	Open Manhole	1200	4.002	62.750	300	4.001	62.750	300	
S4.3	63.979	1.471	Open Manhole	1200	4.003	62.508	300	4.002	62.508	300	
S6.0	62.850	1.266	Open Manhole	1200	6.000	61.584	225				
S4.4	62.656	2.776	Open Manhole	1200	4.004	59.880	300	4.003	62.346	300	2466
								6.000	61.184	225	1229
S4.5	61.500	2.210	Open Manhole	1200	4.005	59.290	300	4.004	59.390	300	100
S4.6	60.558	1.517	Open Manhole	1200	4.006	59.041	300	4.005	59.116	300	75
S1.6	60.070	2.070	Open Manhole	1200	1.006	58.000	300	1.005	59.195	300	1195
								4.006	58.962	300	962
S1.7	59.340	2.220	Open Manhole	1200	1.007	57.120	300	1.006	57.817	300	697
S1.8	58.560	2.390	Open Manhole	1200	1.008	56.170	300	1.007	56.952	300	782
S1.9	57.560	2.760	Open Manhole	1200	1.009	54.800	300	1.008	56.003	300	1203
S1.10	53.270	3.180	Open Manhole	1350	1.010	50.090	375	1.009	51.578	300	1413
S1.11	51.360	2.200	Open Manhole	1350	1.011	49.160	375	1.010	49.160	375	
S1.12	49.320	2.500	Open Manhole	1350	1.012	46.820	375	1.011	47.714	375	894
S7.0	55.850	1.590	Open Manhole	1200	7.000	54.260	225				
S7.1	56.130	2.402	Open Manhole	1200	7.001	53.728	225	7.000	53.728	225	
S7.2	56.220	3.500	Open Manhole	1200	7.002	52.720	225	7.001	53.469	225	749
S8.0	57.810	1.821	Open Manhole	1200	8.000	55.989	225				
S8.1	56.750	3.150	Open Manhole	1200	8.001	53.600	225	8.000	55.552	225	1952
S7.3	54.592	3.492	Open Manhole	1200	7.003	51.100	225	7.002	52.452	225	1352
								8.001	53.275	225	2175
S7.4	52.144	3.154	Open Manhole	1200	7.004	48.990	225	7.003	50.816	225	1826
S9.0	49.910	1.487	Open Manhole	1200	9.000	48.423	225				
S9.1	49.791	1.416	Open Manhole	1200	9.001	48.375	225	9.000	48.375	225	
S9.2	49.536	1.526	Open Manhole	1200	9.002	48.010	225	9.001	48.030	225	20
S9.3	49.530	1.703	Open Manhole	1200	9.003	47.827	225	9.002	47.827	225	
S7.5	49.650	2.094	Open Manhole	1350	7.005	47.556	375	7.004	48.526	225	820
								9.003	47.706	225	
S7.6	49.750	2.350	Open Manhole	1350	7.006	47.400	375	7.005	47.400	375	

Manhole Schedules for Surface Water

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)
S1.13	48.460	3.320	Open Manhole	1350	1.013	45.140	450	1.012	46.411	375	1196
								7.006	46.412	375	1197
S1.14	47.040	3.600	Open Manhole	1350	1.014	43.440	450	1.013	44.543	450	1103
S1.15	43.637	2.307	Open Manhole	1350	1.015	41.330	450	1.014	42.786	450	1456
S10.0	45.420	3.767	Open Manhole	1200	10.000	41.653	225				
S1.16	43.000	3.060	Open Manhole	1350	1.016	39.940	450	1.015	40.883	450	943
								10.000	40.878	225	713
S11.0	46.250	1.280	Open Manhole	1200	11.000	44.970	225				
S11.1	44.211	2.781	Open Manhole	1200	11.001	41.430	225	11.000	42.988	225	1558
S11.2	42.000	1.890	Open Manhole	1200	11.002	40.110	225	11.001	41.063	225	953
S1.17	41.290	1.706	Open Manhole	1350	1.017	39.584	450	1.016	39.584	450	
								11.002	39.959	225	150
S12.0	41.200	1.516	Open Manhole	1200	12.000	39.684	300				
S12.1	41.234	1.757	Open Manhole	1200	12.001	39.477	300	12.000	39.477	300	
S13.0	42.750	3.472	Open Manhole	1200	13.000	39.278	300				
S12.2	41.335	2.253	Open Manhole	1350	12.002	39.082	375	12.001	39.157	300	
								13.000	39.157	300	
S12.3	41.157	2.166	Open Manhole	1350	12.003	38.991	375	12.002	38.991	375	
S12.4	41.110	2.319	Open Manhole	1350	12.004	38.791	375	12.003	38.791	375	
S1.18	41.220	2.659	Open Manhole	1350	1.018	38.561	450	1.017	39.549	450	988
								12.004	38.590	375	
S1.19	39.340	3.940	Open Manhole	1350	1.019	35.400	225	1.018	38.475	450	3300
S1.20	36.700	5.260	Open Manhole	1200	1.020	31.440	225	1.019	34.968	225	3528
S1.21	30.200	4.760	Open Manhole	1200	1.021	25.440	225	1.020	26.440	225	1000
Ex. S	27.200	2.729	Open Manhole	225		OUTFALL		1.021	24.471	225	

PIPELINE SCHEDULES for Surface Water

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	225	S1.0	71.200	67.990	2.985	Open Manhole	1200
1.001	o	225	S1.1	68.040	65.820	1.995	Open Manhole	1200
1.002	o	225	S1.2	67.010	64.760	2.025	Open Manhole	1200
1.003	o	225	S1.3	65.910	63.370	2.315	Open Manhole	1200
2.000	o	300	S2.0	64.000	62.390	1.310	Open Manhole	1200
1.004	o	300	S1.4	64.630	62.050	2.280	Open Manhole	1200
3.000	o	225	S3.0	65.850	62.570	3.055	Open Manhole	1200
1.005	o	300	S1.5	63.660	60.090	3.270	Open Manhole	1200
4.000	o	225	S4.0	66.200	64.678	1.297	Open Manhole	1200
5.000	o	225	S5.0	66.624	65.280	1.119	Open Manhole	1200
4.001	o	300	S4.1	66.684	64.232	2.152	Open Manhole	1200
4.002	o	300	S4.2	63.979	62.750	0.929	Open Manhole	1200
4.003	o	300	S4.3	63.979	62.508	1.171	Open Manhole	1200
6.000	o	225	S6.0	62.850	61.584	1.041	Open Manhole	1200
4.004	o	300	S4.4	62.656	59.880	2.476	Open Manhole	1200
4.005	o	300	S4.5	61.500	59.290	1.910	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	45.280	33.0	S1.1	68.040	66.618	1.197	Open Manhole	1200
1.001	11.520	41.0	S1.2	67.010	65.539	1.246	Open Manhole	1200
1.002	11.560	40.0	S1.3	65.910	64.471	1.214	Open Manhole	1200
1.003	14.190	39.0	S1.4	64.630	63.006	1.399	Open Manhole	1200
2.000	43.130	165.9	S1.4	64.630	62.130	2.200	Open Manhole	1200
1.004	9.650	42.3	S1.5	63.660	61.822	1.538	Open Manhole	1200
3.000	51.240	67.6	S1.5	63.660	61.812	1.623	Open Manhole	1200
1.005	36.350	40.6	S1.6	60.070	59.195	0.575	Open Manhole	1200
4.000	29.540	66.2	S4.1	66.684	64.232	2.227	Open Manhole	1200
5.000	20.094	50.0	S4.1	66.684	64.878	1.581	Open Manhole	1200
4.001	49.400	33.3	S4.2	63.979	62.750	0.929	Open Manhole	1200
4.002	24.180	99.9	S4.3	63.979	62.508	1.171	Open Manhole	1200
4.003	16.211	100.1	S4.4	62.656	62.346	0.010	Open Manhole	1200
6.000	26.688	66.7	S4.4	62.656	61.184	1.247	Open Manhole	1200
4.004	19.846	40.5	S4.5	61.500	59.390	1.810	Open Manhole	1200
4.005	9.690	55.7	S4.6	60.558	59.116	1.142	Open Manhole	1200

PIPELINE SCHEDULES for Surface Water

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	300	S4.6	60.558	59.041	1.217	Open Manhole	1200
1.006	o	300	S1.6	60.070	58.000	1.770	Open Manhole	1200
1.007	o	300	S1.7	59.340	57.120	1.920	Open Manhole	1200
1.008	o	300	S1.8	58.560	56.170	2.090	Open Manhole	1200
1.009	o	300	S1.9	57.560	54.800	2.460	Open Manhole	1200
1.010	o	375	S1.10	53.270	50.090	2.805	Open Manhole	1350
1.011	o	375	S1.11	51.360	49.160	1.825	Open Manhole	1350
1.012	o	375	S1.12	49.320	46.820	2.125	Open Manhole	1350
7.000	o	225	S7.0	55.850	54.260	1.365	Open Manhole	1200
7.001	o	225	S7.1	56.130	53.728	2.177	Open Manhole	1200
7.002	o	225	S7.2	56.220	52.720	3.275	Open Manhole	1200
8.000	o	225	S8.0	57.810	55.989	1.596	Open Manhole	1200
8.001	o	225	S8.1	56.750	53.600	2.925	Open Manhole	1200
7.003	o	225	S7.3	54.592	51.100	3.267	Open Manhole	1200
7.004	o	225	S7.4	52.144	48.990	2.929	Open Manhole	1200
9.000	o	225	S9.0	49.910	48.423	1.262	Open Manhole	1200
9.001	o	225	S9.1	49.791	48.375	1.191	Open Manhole	1200
9.002	o	225	S9.2	49.536	48.010	1.301	Open Manhole	1200
9.003	o	225	S9.3	49.530	47.827	1.478	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	15.900	201.3	S1.6	60.070	58.962	0.808	Open Manhole	1200
1.006	6.825	37.3	S1.7	59.340	57.817	1.223	Open Manhole	1200
1.007	6.701	39.9	S1.8	58.560	56.952	1.308	Open Manhole	1200
1.008	8.020	48.0	S1.9	57.560	56.003	1.257	Open Manhole	1200
1.009	63.711	19.8	S1.10	53.270	51.578	1.392	Open Manhole	1350
1.010	19.590	21.1	S1.11	51.360	49.160	1.825	Open Manhole	1350
1.011	30.080	20.8	S1.12	49.320	47.714	1.231	Open Manhole	1350
1.012	12.540	30.7	S1.13	48.460	46.411	1.674	Open Manhole	1350
7.000	78.780	148.1	S7.1	56.130	53.728	2.177	Open Manhole	1200
7.001	17.307	66.8	S7.2	56.220	53.469	2.526	Open Manhole	1200
7.002	17.660	65.9	S7.3	54.592	52.452	1.915	Open Manhole	1200
8.000	17.460	40.0	S8.1	56.750	55.552	0.973	Open Manhole	1200
8.001	12.989	40.0	S7.3	54.592	53.275	1.092	Open Manhole	1200
7.003	11.365	40.0	S7.4	52.144	50.816	1.103	Open Manhole	1200
7.004	18.544	40.0	S7.5	49.650	48.526	0.899	Open Manhole	1350
9.000	6.824	142.2	S9.1	49.791	48.375	1.191	Open Manhole	1200
9.001	50.950	147.7	S9.2	49.536	48.030	1.281	Open Manhole	1200
9.002	25.932	141.7	S9.3	49.530	47.827	1.478	Open Manhole	1200
9.003	19.040	157.4	S7.5	49.650	47.706	1.719	Open Manhole	1350

PIPELINE SCHEDULES for Surface Water

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)
7.005	o	375	S7.5	49.650	47.556	1.719	Open Manhole	1350
7.006	o	375	S7.6	49.750	47.400	1.975	Open Manhole	1350
1.013	o	450	S1.13	48.460	45.140	2.870	Open Manhole	1350
1.014	o	450	S1.14	47.040	43.440	3.150	Open Manhole	1350
1.015	o	450	S1.15	43.637	41.330	1.857	Open Manhole	1350
10.000	o	225	S10.0	45.420	41.653	3.542	Open Manhole	1200
1.016	o	450	S1.16	43.000	39.940	2.610	Open Manhole	1350
11.000	o	225	S11.0	46.250	44.970	1.055	Open Manhole	1200
11.001	o	225	S11.1	44.211	41.430	2.556	Open Manhole	1200
11.002	o	225	S11.2	42.000	40.110	1.665	Open Manhole	1200
1.017	o	450	S1.17	41.290	39.584	1.256	Open Manhole	1350
12.000	o	300	S12.0	41.200	39.684	1.216	Open Manhole	1200
12.001	o	300	S12.1	41.234	39.477	1.457	Open Manhole	1200
13.000	o	300	S13.0	42.750	39.278	3.172	Open Manhole	1200
12.002	o	375	S12.2	41.335	39.082	1.878	Open Manhole	1350
12.003	o	375	S12.3	41.157	38.991	1.791	Open Manhole	1350
12.004	o	375	S12.4	41.110	38.791	1.944	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
7.005	23.327	149.5	S7.6	49.750	47.400	1.975	Open Manhole	1350
7.006	49.420	50.0	S1.13	48.460	46.412	1.673	Open Manhole	1350
1.013	22.999	38.5	S1.14	47.040	44.543	2.047	Open Manhole	1350
1.014	13.560	20.7	S1.15	43.637	42.786	0.401	Open Manhole	1350
1.015	8.940	20.0	S1.16	43.000	40.883	1.667	Open Manhole	1350
10.000	30.910	39.9	S1.16	43.000	40.878	1.897	Open Manhole	1350
1.016	63.287	177.8	S1.17	41.290	39.584	1.256	Open Manhole	1350
11.000	59.490	30.0	S11.1	44.211	42.988	0.998	Open Manhole	1200
11.001	11.003	30.0	S11.2	42.000	41.063	0.712	Open Manhole	1200
11.002	4.540	30.1	S1.17	41.290	39.959	1.106	Open Manhole	1350
1.017	8.770	250.6	S1.18	41.220	39.549	1.221	Open Manhole	1350
12.000	37.370	180.5	S12.1	41.234	39.477	1.457	Open Manhole	1200
12.001	56.337	176.1	S12.2	41.335	39.157	1.878	Open Manhole	1350
13.000	11.521	95.2	S12.2	41.335	39.157	1.878	Open Manhole	1350
12.002	18.771	206.3	S12.3	41.157	38.991	1.791	Open Manhole	1350
12.003	41.367	206.8	S12.4	41.110	38.791	1.944	Open Manhole	1350
12.004	41.466	206.8	S1.18	41.220	38.590	2.255	Open Manhole	1350

PIPELINE SCHEDULES for Surface Water

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)
1.018	o	450	S1.18	41.220	38.561	2.209	Open Manhole	1350
1.019	o	225	S1.19	39.340	35.400	3.715	Open Manhole	1350
1.020	o	225	S1.20	36.700	31.440	5.035	Open Manhole	1200
1.021	o	225	S1.21	30.200	25.440	4.535	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)
1.018	18.540	215.6	S1.19	39.340	38.475	0.415	Open Manhole	1350
1.019	24.660	57.1	S1.20	36.700	34.968	1.507	Open Manhole	1200
1.020	90.000	18.0	S1.21	30.200	26.440	3.535	Open Manhole	1200
1.021	19.380	20.0	Ex. S	27.200	24.471	2.504	Open Manhole	225

Area Summary for Surface Water

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.136	0.136	0.136
1.001	-	-	100	0.016	0.016	0.016
1.002	-	-	100	0.010	0.010	0.010
1.003	-	-	100	0.014	0.014	0.014
2.000	-	-	100	0.288	0.288	0.288
1.004	-	-	100	0.009	0.009	0.009
3.000	-	-	100	0.095	0.095	0.095
1.005	-	-	100	0.047	0.047	0.047
4.000	-	-	100	0.052	0.052	0.052
5.000	-	-	100	0.029	0.029	0.029
4.001	-	-	100	0.205	0.205	0.205
4.002	-	-	100	0.000	0.000	0.000
4.003	-	-	100	0.000	0.000	0.000
6.000	-	-	100	0.007	0.007	0.007
4.004	-	-	100	0.008	0.008	0.008
4.005	-	-	100	0.020	0.020	0.020
4.006	-	-	100	0.045	0.045	0.045
1.006	-	-	100	0.007	0.007	0.007
1.007	-	-	100	0.006	0.006	0.006
1.008	-	-	100	0.009	0.009	0.009
1.009	-	-	100	0.286	0.286	0.286
1.010	-	-	100	0.020	0.020	0.020
1.011	-	-	100	0.114	0.114	0.114
1.012	-	-	100	0.024	0.024	0.024
7.000	-	-	100	0.142	0.142	0.142
7.001	-	-	100	0.049	0.049	0.049
7.002	-	-	100	0.016	0.016	0.016
8.000	-	-	100	0.083	0.083	0.083
8.001	-	-	100	0.005	0.005	0.005
7.003	-	-	100	0.004	0.004	0.004
7.004	-	-	100	0.006	0.006	0.006
9.000	-	-	100	0.073	0.073	0.073
9.001	-	-	100	0.129	0.129	0.129
9.002	-	-	100	0.053	0.053	0.053
9.003	-	-	100	0.031	0.031	0.031
7.005	-	-	100	0.065	0.065	0.065
7.006	-	-	100	0.144	0.144	0.144
1.013	-	-	100	0.103	0.103	0.103
1.014	-	-	100	0.019	0.019	0.019
1.015	-	-	100	0.000	0.000	0.000
10.000	-	-	100	0.064	0.064	0.064
1.016	-	-	100	0.045	0.045	0.045
11.000	-	-	100	0.113	0.113	0.113
11.001	-	-	100	0.000	0.000	0.000
11.002	-	-	100	0.001	0.001	0.001
1.017	-	-	100	0.006	0.006	0.006
12.000	-	-	100	0.128	0.128	0.128
12.001	-	-	100	0.127	0.127	0.127
13.000	-	-	100	0.041	0.041	0.041
12.002	-	-	100	0.000	0.000	0.000
12.003	-	-	100	0.000	0.000	0.000
12.004	-	-	100	0.000	0.000	0.000
1.018	-	-	100	0.000	0.000	0.000
1.019	-	-	100	0.000	0.000	0.000
1.020	-	-	100	0.000	0.000	0.000
1.021	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				2.894	2.894	2.894

Total Drained Area = 2.894ha

Free Flowing Outfall Details for Surface Water

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.021	Ex. S	27.200	24.471	0.000	225	0

Hydrobrake set to QBAR of 14.9l/s at 3m Design Head

Online Controls for Surface Water

Hydro-Brake® Optimum Manhole: S1.19, DS/PN: 1.019, Volume (m³): 8.4

Unit Reference	MD-SHE-0145-1490-3000-1490
Design Head (m)	3.000
Design Flow (l/s)	14.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	145
Invert Level (m)	35.400
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	14.9	Kick-Flo®	1.298	10.0
Flush-Flo™	0.630	12.7	Mean Flow over Head Range	-	11.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.800	12.6	2.000	12.3	4.000	17.1	7.000	22.3
0.200	10.4	1.000	12.1	2.200	12.8	4.500	18.1	7.500	23.1
0.300	11.6	1.200	11.0	2.400	13.4	5.000	19.0	8.000	23.8
0.400	12.3	1.400	10.4	2.600	13.9	5.500	19.9	8.500	24.5
0.500	12.6	1.600	11.0	3.000	14.9	6.000	20.7	9.000	25.2
0.600	12.7	1.800	11.7	3.500	16.0	6.500	21.5	9.500	25.8

Storage Structures for Surface Water

Note: Permeable Paved Car Parking Bays Modeled as Green Roof Structures to replicate delayed time of entry

Tank or Pond Manhole: S1.19, DS/PN: 1.019

Invert Level (m) 35.400

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	472.0	3.000	472.0	3.001	0.0

Tank Size:
45m x 10.5m x 3m

Time Area Diagram for Green Roof at Pipe Number 1.000 (Surface Water)

Area (m^3) 132 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.002399	32	36	0.000484	64	68	0.000098	96	100	0.000020
4	8	0.001964	36	40	0.000397	68	72	0.000080	100	104	0.000016
8	12	0.001608	40	44	0.000325	72	76	0.000066	104	108	0.000013
12	16	0.001316	44	48	0.000266	76	80	0.000054	108	112	0.000011
16	20	0.001078	48	52	0.000218	80	84	0.000044	112	116	0.000009
20	24	0.000882	52	56	0.000178	84	88	0.000036	116	120	0.000007
24	28	0.000722	56	60	0.000146	88	92	0.000029			
28	32	0.000592	60	64	0.000119	92	96	0.000024			

Time Area Diagram for Green Roof at Pipe Number 1.001 (Surface Water)

Area (m^3) 12 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.000218	32	36	0.000044	64	68	0.000009	96	100	0.000002
4	8	0.000179	36	40	0.000036	68	72	0.000007	100	104	0.000001
8	12	0.000146	40	44	0.000030	72	76	0.000006	104	108	0.000001
12	16	0.000120	44	48	0.000024	76	80	0.000005	108	112	0.000001
16	20	0.000098	48	52	0.000020	80	84	0.000004	112	116	0.000001
20	24	0.000080	52	56	0.000016	84	88	0.000003	116	120	0.000001
24	28	0.000066	56	60	0.000013	88	92	0.000003			
28	32	0.000054	60	64	0.000011	92	96	0.000002			

Time Area Diagram for Green Roof at Pipe Number 2.000 (Surface Water)

Area (m^3) 312 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.005670	32	36	0.001145	64	68	0.000231	96	100	0.000047
4	8	0.004642	36	40	0.000937	68	72	0.000189	100	104	0.000038
8	12	0.003800	40	44	0.000767	72	76	0.000155	104	108	0.000031
12	16	0.003112	44	48	0.000628	76	80	0.000127	108	112	0.000026
16	20	0.002548	48	52	0.000514	80	84	0.000104	112	116	0.000021
20	24	0.002086	52	56	0.000421	84	88	0.000085	116	120	0.000017
24	28	0.001708	56	60	0.000345	88	92	0.000070			
28	32	0.001398	60	64	0.000282	92	96	0.000057			

Time Area Diagram for Green Roof at Pipe Number 3.000 (Surface Water)

Area (m³) 412 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.007487	32	36	0.001512	64	68	0.000305	96	100	0.000062
4	8	0.006130	36	40	0.001238	68	72	0.000250	100	104	0.000050
8	12	0.005019	40	44	0.001013	72	76	0.000205	104	108	0.000041
12	16	0.004109	44	48	0.000830	76	80	0.000167	108	112	0.000034
16	20	0.003364	48	52	0.000679	80	84	0.000137	112	116	0.000028
20	24	0.002754	52	56	0.000556	84	88	0.000112	116	120	0.000023
24	28	0.002255	56	60	0.000455	88	92	0.000092			
28	32	0.001846	60	64	0.000373	92	96	0.000075			

Time Area Diagram for Green Roof at Pipe Number 1.005 (Surface Water)

Area (m³) 84 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.001526	32	36	0.000308	64	68	0.000062	96	100	0.000013
4	8	0.001250	36	40	0.000252	68	72	0.000051	100	104	0.000010
8	12	0.001023	40	44	0.000207	72	76	0.000042	104	108	0.000008
12	16	0.000838	44	48	0.000169	76	80	0.000034	108	112	0.000007
16	20	0.000686	48	52	0.000138	80	84	0.000028	112	116	0.000006
20	24	0.000562	52	56	0.000113	84	88	0.000023	116	120	0.000005
24	28	0.000460	56	60	0.000093	88	92	0.000019			
28	32	0.000376	60	64	0.000076	92	96	0.000015			

Time Area Diagram for Green Roof at Pipe Number 4.006 (Surface Water)

Area (m³) 100 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.001817	32	36	0.000367	64	68	0.000074	96	100	0.000015
4	8	0.001488	36	40	0.000300	68	72	0.000061	100	104	0.000012
8	12	0.001218	40	44	0.000246	72	76	0.000050	104	108	0.000010
12	16	0.000997	44	48	0.000201	76	80	0.000041	108	112	0.000008
16	20	0.000817	48	52	0.000165	80	84	0.000033	112	116	0.000007
20	24	0.000669	52	56	0.000135	84	88	0.000027	116	120	0.000006
24	28	0.000547	56	60	0.000111	88	92	0.000022			
28	32	0.000448	60	64	0.000090	92	96	0.000018			

Time Area Diagram for Green Roof at Pipe Number 1.006 (Surface Water)

Area (m³) 12 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000218	12	16	0.000120	24	28	0.000066	36	40	0.000036
4	8	0.000179	16	20	0.000098	28	32	0.000054	40	44	0.000030
8	12	0.000146	20	24	0.000080	32	36	0.000044	44	48	0.000024

Time Area Diagram for Green Roof at Pipe Number 1.006 (Surface Water)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
48	52	0.000020	68	72	0.000007	88	92	0.000003	108	112	0.000001
52	56	0.000016	72	76	0.000006	92	96	0.000002	112	116	0.000001
56	60	0.000013	76	80	0.000005	96	100	0.000002	116	120	0.000001
60	64	0.000011	80	84	0.000004	100	104	0.000001			
64	68	0.000009	84	88	0.000003	104	108	0.000001			

Time Area Diagram for Green Roof at Pipe Number 1.009 (Surface Water)

Area (m³) 319 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005797	32	36	0.001170	64	68	0.000236	96	100	0.000048
4	8	0.004746	36	40	0.000958	68	72	0.000193	100	104	0.000039
8	12	0.003886	40	44	0.000785	72	76	0.000158	104	108	0.000032
12	16	0.003181	44	48	0.000642	76	80	0.000130	108	112	0.000026
16	20	0.002605	48	52	0.000526	80	84	0.000106	112	116	0.000021
20	24	0.002133	52	56	0.000431	84	88	0.000087	116	120	0.000018
24	28	0.001746	56	60	0.000353	88	92	0.000071			
28	32	0.001429	60	64	0.000289	92	96	0.000058			

Time Area Diagram for Green Roof at Pipe Number 1.011 (Surface Water)

Area (m³) 150 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002726	32	36	0.000550	64	68	0.000111	96	100	0.000022
4	8	0.002232	36	40	0.000451	68	72	0.000091	100	104	0.000018
8	12	0.001827	40	44	0.000369	72	76	0.000074	104	108	0.000015
12	16	0.001496	44	48	0.000302	76	80	0.000061	108	112	0.000012
16	20	0.001225	48	52	0.000247	80	84	0.000050	112	116	0.000010
20	24	0.001003	52	56	0.000202	84	88	0.000041	116	120	0.000008
24	28	0.000821	56	60	0.000166	88	92	0.000033			
28	32	0.000672	60	64	0.000136	92	96	0.000027			

Time Area Diagram for Green Roof at Pipe Number 7.000 (Surface Water)

Area (m³) 293 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005324	32	36	0.001075	64	68	0.000217	96	100	0.000044
4	8	0.004359	36	40	0.000880	68	72	0.000178	100	104	0.000036
8	12	0.003569	40	44	0.000721	72	76	0.000145	104	108	0.000029
12	16	0.002922	44	48	0.000590	76	80	0.000119	108	112	0.000024
16	20	0.002392	48	52	0.000483	80	84	0.000098	112	116	0.000020
20	24	0.001959	52	56	0.000395	84	88	0.000080	116	120	0.000016
24	28	0.001604	56	60	0.000324	88	92	0.000065			
28	32	0.001313	60	64	0.000265	92	96	0.000054			

Time Area Diagram for Green Roof at Pipe Number 7.001 (Surface Water)

Area (m³) 169 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.003071	32	36	0.000620	64	68	0.000125	96	100	0.000025
4	8	0.002514	36	40	0.000508	68	72	0.000102	100	104	0.000021
8	12	0.002059	40	44	0.000416	72	76	0.000084	104	108	0.000017
12	16	0.001685	44	48	0.000340	76	80	0.000069	108	112	0.000014
16	20	0.001380	48	52	0.000279	80	84	0.000056	112	116	0.000011
20	24	0.001130	52	56	0.000228	84	88	0.000046	116	120	0.000009
24	28	0.000925	56	60	0.000187	88	92	0.000038			
28	32	0.000757	60	64	0.000153	92	96	0.000031			

Time Area Diagram for Green Roof at Pipe Number 9.001 (Surface Water)

Area (m³) 368 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.006687	32	36	0.001350	64	68	0.000273	96	100	0.000055
4	8	0.005475	36	40	0.001105	68	72	0.000223	100	104	0.000045
8	12	0.004483	40	44	0.000905	72	76	0.000183	104	108	0.000037
12	16	0.003670	44	48	0.000741	76	80	0.000150	108	112	0.000030
16	20	0.003005	48	52	0.000607	80	84	0.000122	112	116	0.000025
20	24	0.002460	52	56	0.000497	84	88	0.000100	116	120	0.000020
24	28	0.002014	56	60	0.000407	88	92	0.000082			
28	32	0.001649	60	64	0.000333	92	96	0.000067			

Time Area Diagram for Green Roof at Pipe Number 9.002 (Surface Water)

Area (m³) 125 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002271	32	36	0.000459	64	68	0.000093	96	100	0.000019
4	8	0.001860	36	40	0.000375	68	72	0.000076	100	104	0.000015
8	12	0.001523	40	44	0.000307	72	76	0.000062	104	108	0.000013
12	16	0.001247	44	48	0.000252	76	80	0.000051	108	112	0.000010
16	20	0.001021	48	52	0.000206	80	84	0.000042	112	116	0.000008
20	24	0.000836	52	56	0.000169	84	88	0.000034	116	120	0.000007
24	28	0.000684	56	60	0.000138	88	92	0.000028			
28	32	0.000560	60	64	0.000113	92	96	0.000023			

Time Area Diagram for Green Roof at Pipe Number 9.003 (Surface Water)

Area (m³) 13 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000236	12	16	0.000130	24	28	0.000071	36	40	0.000039
4	8	0.000193	16	20	0.000106	28	32	0.000058	40	44	0.000032
8	12	0.000158	20	24	0.000087	32	36	0.000048	44	48	0.000026

Time Area Diagram for Green Roof at Pipe Number 9.003 (Surface Water)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
48	52	0.000021	68	72	0.000008	88	92	0.000003	108	112	0.000001
52	56	0.000018	72	76	0.000006	92	96	0.000002	112	116	0.000001
56	60	0.000014	76	80	0.000005	96	100	0.000002	116	120	0.000001
60	64	0.000012	80	84	0.000004	100	104	0.000002			
64	68	0.000010	84	88	0.000004	104	108	0.000001			

Time Area Diagram for Green Roof at Pipe Number 7.005 (Surface Water)

Area (m^3) 119 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002162	32	36	0.000437	64	68	0.000088	96	100	0.000018
4	8	0.001770	36	40	0.000357	68	72	0.000072	100	104	0.000015
8	12	0.001450	40	44	0.000293	72	76	0.000059	104	108	0.000012
12	16	0.001187	44	48	0.000240	76	80	0.000048	108	112	0.000010
16	20	0.000972	48	52	0.000196	80	84	0.000040	112	116	0.000008
20	24	0.000796	52	56	0.000161	84	88	0.000032	116	120	0.000007
24	28	0.000651	56	60	0.000131	88	92	0.000027			
28	32	0.000533	60	64	0.000108	92	96	0.000022			

Time Area Diagram for Green Roof at Pipe Number 7.006 (Surface Water)

Area (m^3) 335 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.006088	32	36	0.001229	64	68	0.000248	96	100	0.000050
4	8	0.004984	36	40	0.001006	68	72	0.000203	100	104	0.000041
8	12	0.004081	40	44	0.000824	72	76	0.000166	104	108	0.000034
12	16	0.003341	44	48	0.000675	76	80	0.000136	108	112	0.000027
16	20	0.002735	48	52	0.000552	80	84	0.000111	112	116	0.000023
20	24	0.002240	52	56	0.000452	84	88	0.000091	116	120	0.000018
24	28	0.001834	56	60	0.000370	88	92	0.000075			
28	32	0.001501	60	64	0.000303	92	96	0.000061			

Time Area Diagram for Green Roof at Pipe Number 1.013 (Surface Water)

Area (m^3) 24 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000436	32	36	0.000088	64	68	0.000018	96	100	0.000004
4	8	0.000357	36	40	0.000072	68	72	0.000015	100	104	0.000003
8	12	0.000292	40	44	0.000059	72	76	0.000012	104	108	0.000002
12	16	0.000239	44	48	0.000048	76	80	0.000010	108	112	0.000002
16	20	0.000196	48	52	0.000040	80	84	0.000008	112	116	0.000002
20	24	0.000160	52	56	0.000032	84	88	0.000007	116	120	0.000001
24	28	0.000131	56	60	0.000027	88	92	0.000005			
28	32	0.000108	60	64	0.000022	92	96	0.000004			

Time Area Diagram for Green Roof at Pipe Number 1.014 (Surface Water)

Area (m³) 12 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000218	32	36	0.000044	64	68	0.000009	96	100	0.000002
4	8	0.000179	36	40	0.000036	68	72	0.000007	100	104	0.000001
8	12	0.000146	40	44	0.000030	72	76	0.000006	104	108	0.000001
12	16	0.000120	44	48	0.000024	76	80	0.000005	108	112	0.000001
16	20	0.000098	48	52	0.000020	80	84	0.000004	112	116	0.000001
20	24	0.000080	52	56	0.000016	84	88	0.000003	116	120	0.000001
24	28	0.000066	56	60	0.000013	88	92	0.000003			
28	32	0.000054	60	64	0.000011	92	96	0.000002			

Time Area Diagram for Green Roof at Pipe Number 10.000 (Surface Water)

Area (m³) 81 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.001472	32	36	0.000297	64	68	0.000060	96	100	0.000012
4	8	0.001205	36	40	0.000243	68	72	0.000049	100	104	0.000010
8	12	0.000987	40	44	0.000199	72	76	0.000040	104	108	0.000008
12	16	0.000808	44	48	0.000163	76	80	0.000033	108	112	0.000007
16	20	0.000661	48	52	0.000134	80	84	0.000027	112	116	0.000005
20	24	0.000541	52	56	0.000109	84	88	0.000022	116	120	0.000004
24	28	0.000443	56	60	0.000090	88	92	0.000018			
28	32	0.000363	60	64	0.000073	92	96	0.000015			

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	120 Summer	1	+20%					67.997	-0.218	0.000
1.001	S1.1	60 Winter	1	+20%					65.829	-0.216	0.000
1.002	S1.2	15 Winter	1	+20%					64.776	-0.209	0.000
1.003	S1.3	15 Winter	1	+20%					63.397	-0.198	0.000
2.000	S2.0	120 Summer	1	+20%					62.412	-0.278	0.000
1.004	S1.4	15 Winter	1	+20%					62.084	-0.266	0.000
3.000	S3.0	120 Summer	1	+20%					62.595	-0.200	0.000
1.005	S1.5	120 Winter	1	+20%					60.125	-0.265	0.000
4.000	S4.0	15 Winter	1	+20%					64.729	-0.174	0.000
5.000	S5.0	15 Summer	1	+20%					65.315	-0.190	0.000
4.001	S4.1	15 Winter	1	+20%					64.317	-0.215	0.000
4.002	S4.2	15 Winter	1	+20%	100/15 Summer				62.868	-0.182	0.000
4.003	S4.3	15 Winter	1	+20%	100/15 Summer				62.629	-0.179	0.000
6.000	S6.0	15 Winter	1	+20%					61.601	-0.208	0.000
4.004	S4.4	15 Winter	1	+20%					59.975	-0.205	0.000
4.005	S4.5	15 Winter	1	+20%	100/15 Summer				59.411	-0.179	0.000
4.006	S4.6	15 Winter	1	+20%	30/15 Summer				59.199	-0.142	0.000
1.006	S1.6	15 Winter	1	+20%	100/15 Summer				58.126	-0.174	0.000
1.007	S1.7	15 Winter	1	+20%	100/15 Summer				57.250	-0.170	0.000
1.008	S1.8	15 Winter	1	+20%	100/15 Summer				56.301	-0.169	0.000
1.009	S1.9	15 Winter	1	+20%					54.882	-0.218	0.000
1.010	S1.10	15 Winter	1	+20%					50.175	-0.290	0.000
1.011	S1.11	15 Winter	1	+20%					49.242	-0.293	0.000
1.012	S1.12	15 Winter	1	+20%					46.926	-0.269	0.000
7.000	S7.0	60 Winter	1	+20%					54.285	-0.200	0.000
7.001	S7.1	120 Summer	1	+20%					53.754	-0.199	0.000
7.002	S7.2	120 Winter	1	+20%					52.751	-0.194	0.000
8.000	S8.0	15 Winter	1	+20%					56.047	-0.167	0.000
8.001	S8.1	15 Winter	1	+20%					53.660	-0.165	0.000
7.003	S7.3	15 Winter	1	+20%					51.167	-0.158	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.01		0.5	OK	
1.001	S1.1	0.01		0.6	OK	
1.002	S1.2	0.01		1.0	OK	
1.003	S1.3	0.03		2.5	OK	
2.000	S2.0	0.01		1.2	OK	
1.004	S1.4	0.03		3.4	OK	
3.000	S3.0	0.03		1.6	OK	
1.005	S1.5	0.03		5.2	OK	
4.000	S4.0	0.11		6.9	OK	
5.000	S5.0	0.06		3.8	OK	
4.001	S4.1	0.18		31.8	OK	
4.002	S4.2	0.32		31.9	OK	
4.003	S4.3	0.34		32.2	OK	
6.000	S6.0	0.02		0.9	OK	
4.004	S4.4	0.22		33.8	OK	
4.005	S4.5	0.34		35.8	OK	
4.006	S4.6	0.54		35.4	OK	
1.006	S1.6	0.36		39.0	OK	
1.007	S1.7	0.39		39.8	OK	
1.008	S1.8	0.40		40.7	OK	
1.009	S1.9	0.17		40.6	OK	
1.010	S1.10	0.12		42.2	OK	
1.011	S1.11	0.11		42.0	OK	
1.012	S1.12	0.18		44.3	OK	
7.000	S7.0	0.03		1.1	OK	
7.001	S7.1	0.03		1.7	OK	
7.002	S7.2	0.04		2.5	OK	
8.000	S8.0	0.15		11.0	OK	
8.001	S8.1	0.16		11.5	OK	
7.003	S7.3	0.19		13.6	OK	

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

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)
7.004	S7.4	15 Winter	1	+20%					49.057	-0.158
9.000	S9.0	15 Summer	1	+20%					48.509	-0.139
9.001	S9.1	15 Winter	1	+20%					48.449	-0.151
9.002	S9.2	15 Winter	1	+20%					48.083	-0.152
9.003	S9.3	15 Winter	1	+20%					47.903	-0.149
7.005	S7.5	15 Winter	1	+20%					47.656	-0.275
7.006	S7.6	15 Winter	1	+20%					47.474	-0.301
1.013	S1.13	15 Winter	1	+20%					45.257	-0.333
1.014	S1.14	15 Winter	1	+20%					43.554	-0.336
1.015	S1.15	15 Winter	1	+20%					41.457	-0.323
10.000	S10.0	120 Summer	1	+20%					41.658	-0.220
1.016	S1.16	15 Winter	1	+20%	100/15 Summer				40.113	-0.277
11.000	S11.0	15 Winter	1	+20%					45.030	-0.165
11.001	S11.1	15 Summer	1	+20%					41.496	-0.159
11.002	S11.2	15 Summer	1	+20%					40.191	-0.144
1.017	S1.17	15 Winter	1	+20%	30/15 Summer				39.827	-0.207
12.000	S12.0	15 Winter	1	+20%					39.779	-0.205
12.001	S12.1	15 Winter	1	+20%	100/15 Summer				39.605	-0.172
13.000	S13.0	15 Winter	1	+20%					39.326	-0.252
12.002	S12.2	15 Winter	1	+20%					39.220	-0.237
12.003	S12.3	15 Winter	1	+20%					39.121	-0.245
12.004	S12.4	15 Winter	1	+20%	100/15 Summer				38.920	-0.246
1.018	S1.18	15 Winter	1	+20%	30/15 Summer				38.824	-0.187
1.019	S1.19	600 Winter	1	+20%	1/60 Winter				$\boxed{35.803}$	0.178
1.020	S1.20	600 Winter	1	+20%					31.488	-0.177
1.021	S1.21	600 Winter	1	+20%					25.491	-0.174

Note S1.19 represents Tank and Hydrobrake MH

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.19		14.2	OK	
9.000	S9.0	0.000	0.31		9.7	OK	
9.001	S9.1	0.000	0.23		9.3	OK	
9.002	S9.2	0.000	0.23		9.2	OK	
9.003	S9.3	0.000	0.25		9.2	OK	
7.005	S7.5	0.000	0.16		22.6	OK	
7.006	S7.6	0.000	0.09		22.6	OK	
1.013	S1.13	0.000	0.15		65.7	OK	
1.014	S1.14	0.000	0.14		65.9	OK	
1.015	S1.15	0.000	0.18		66.3	OK	
10.000	S10.0	0.000	0.00		0.3	OK	
1.016	S1.16	0.000	0.30		68.1	OK	
11.000	S11.0	0.000	0.16		14.9	OK	
11.001	S11.1	0.000	0.19		14.9	OK	
11.002	S11.2	0.000	0.27		15.0	OK	
1.017	S1.17	0.000	0.56		76.9	OK	
12.000	S12.0	0.000	0.22		16.6	OK	
12.001	S12.1	0.000	0.36		28.8	OK	
13.000	S13.0	0.000	0.06		5.4	OK	
12.002	S12.2	0.000	0.29		33.1	OK	
12.003	S12.3	0.000	0.26		32.7	OK	
12.004	S12.4	0.000	0.26		32.3	OK	
1.018	S1.18	0.000	0.64		109.0	OK	
1.019	S1.19	0.000	0.19		12.3	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.10		12.3	OK	
1.021	S1.21	0.000	0.12		12.3	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	60 Winter	30	+20%					68.005	-0.210	0.000
1.001	S1.1	60 Winter	30	+20%					65.841	-0.204	0.000
1.002	S1.2	15 Winter	30	+20%					64.789	-0.196	0.000
1.003	S1.3	15 Summer	30	+20%					63.417	-0.178	0.000
2.000	S2.0	60 Winter	30	+20%					62.427	-0.263	0.000
1.004	S1.4	15 Summer	30	+20%					62.107	-0.243	0.000
3.000	S3.0	60 Winter	30	+20%					62.607	-0.188	0.000
1.005	S1.5	60 Winter	30	+20%					60.148	-0.242	0.000
4.000	S4.0	15 Winter	30	+20%					64.755	-0.148	0.000
5.000	S5.0	15 Winter	30	+20%					65.333	-0.172	0.000
4.001	S4.1	15 Winter	30	+20%					64.375	-0.157	0.000
4.002	S4.2	15 Winter	30	+20%	100/15 Summer				62.962	-0.088	0.000
4.003	S4.3	15 Winter	30	+20%	100/15 Summer				62.728	-0.080	0.000
6.000	S6.0	15 Winter	30	+20%					61.611	-0.198	0.000
4.004	S4.4	15 Winter	30	+20%					60.044	-0.136	0.000
4.005	S4.5	15 Winter	30	+20%	100/15 Summer				59.534	-0.056	0.000
4.006	S4.6	15 Winter	30	+20%	30/15 Summer				59.402	0.061	0.000
1.006	S1.6	15 Winter	30	+20%	100/15 Summer				58.229	-0.071	0.000
1.007	S1.7	15 Winter	30	+20%	100/15 Summer				57.367	-0.053	0.000
1.008	S1.8	15 Winter	30	+20%	100/15 Summer				56.470	0.000	0.000
1.009	S1.9	15 Winter	30	+20%					54.937	-0.163	0.000
1.010	S1.10	15 Winter	30	+20%					50.228	-0.237	0.000
1.011	S1.11	15 Winter	30	+20%					49.294	-0.241	0.000
1.012	S1.12	15 Winter	30	+20%					46.996	-0.199	0.000
7.000	S7.0	60 Winter	30	+20%					54.297	-0.188	0.000
7.001	S7.1	60 Winter	30	+20%					53.769	-0.184	0.000
7.002	S7.2	60 Winter	30	+20%					52.770	-0.175	0.000
8.000	S8.0	15 Winter	30	+20%					56.078	-0.136	0.000
8.001	S8.1	15 Winter	30	+20%					53.693	-0.132	0.000
7.003	S7.3	15 Summer	30	+20%					51.207	-0.118	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.01		1.2	OK	
1.001	S1.1	0.02		1.3	OK	
1.002	S1.2	0.04		2.9	OK	
1.003	S1.3	0.10		7.0	OK	
2.000	S2.0	0.04		2.9	OK	
1.004	S1.4	0.08		9.7	OK	
3.000	S3.0	0.06		3.8	OK	
1.005	S1.5	0.08		13.5	OK	
4.000	S4.0	0.25		15.2	OK	
5.000	S5.0	0.13		8.5	OK	
4.001	S4.1	0.46		83.5	OK	
4.002	S4.2	0.84		83.2	OK	
4.003	S4.3	0.88		82.6	OK	
6.000	S6.0	0.03		2.1	OK	
4.004	S4.4	0.57		87.2	OK	
4.005	S4.5	0.88		92.3	OK	
4.006	S4.6	1.39		91.6	SURCHARGED	
1.006	S1.6	0.94		100.3	OK	
1.007	S1.7	0.98		101.1	OK	
1.008	S1.8	1.01		103.4	OK	
1.009	S1.9	0.43		103.3	OK	
1.010	S1.10	0.29		106.9	OK	
1.011	S1.11	0.27		106.7	OK	
1.012	S1.12	0.44		111.0	OK	
7.000	S7.0	0.07		2.7	OK	
7.001	S7.1	0.08		4.3	OK	
7.002	S7.2	0.11		6.2	OK	
8.000	S8.0	0.33		24.3	OK	
8.001	S8.1	0.36		25.8	OK	
7.003	S7.3	0.45		31.7	OK	

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

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)
7.004	S7.4	15 Summer	30	+20%					49.097	-0.118
9.000	S9.0	15 Summer	30	+20%					48.562	-0.086
9.001	S9.1	15 Summer	30	+20%					48.491	-0.109
9.002	S9.2	15 Winter	30	+20%					48.123	-0.112
9.003	S9.3	15 Winter	30	+20%					47.946	-0.106
7.005	S7.5	15 Winter	30	+20%					47.713	-0.218
7.006	S7.6	15 Winter	30	+20%					47.512	-0.263
1.013	S1.13	15 Winter	30	+20%					45.332	-0.258
1.014	S1.14	15 Winter	30	+20%					43.625	-0.265
1.015	S1.15	15 Winter	30	+20%					41.534	-0.246
10.000	S10.0	30 Winter	30	+20%					41.664	-0.214
1.016	S1.16	15 Winter	30	+20%	100/15 Summer				40.279	-0.111
11.000	S11.0	15 Winter	30	+20%					45.063	-0.132
11.001	S11.1	15 Summer	30	+20%					41.531	-0.124
11.002	S11.2	15 Summer	30	+20%					40.240	-0.095
1.017	S1.17	15 Winter	30	+20%	30/15 Summer				40.084	0.050
12.000	S12.0	15 Winter	30	+20%					39.832	-0.152
12.001	S12.1	15 Winter	30	+20%	100/15 Summer				39.705	-0.072
13.000	S13.0	15 Winter	30	+20%					39.352	-0.226
12.002	S12.2	15 Winter	30	+20%					39.313	-0.144
12.003	S12.3	15 Winter	30	+20%					39.208	-0.158
12.004	S12.4	15 Winter	30	+20%	100/15 Summer				39.160	-0.006
1.018	S1.18	15 Winter	30	+20%	30/15 Summer				39.103	0.092
1.019	S1.19	720 Winter	30	+20%	1/60 Winter				$\boxed{36.453}$	0.828
1.020	S1.20	480 Summer	30	+20%					31.488	-0.177
1.021	S1.21	960 Winter	30	+20%					25.492	-0.173

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.45		33.4	OK	
9.000	S9.0	0.000	0.69		21.4	OK	
9.001	S9.1	0.000	0.50		20.5	OK	
9.002	S9.2	0.000	0.50		20.3	OK	
9.003	S9.3	0.000	0.55		20.4	OK	
7.005	S7.5	0.000	0.37		51.3	OK	
7.006	S7.6	0.000	0.19		50.5	OK	
1.013	S1.13	0.000	0.37		161.7	OK	
1.014	S1.14	0.000	0.35		161.5	OK	
1.015	S1.15	0.000	0.43		160.8	OK	
10.000	S10.0	0.000	0.01		0.7	OK	
1.016	S1.16	0.000	0.74		164.8	OK	
11.000	S11.0	0.000	0.36		33.1	OK	
11.001	S11.1	0.000	0.41		33.1	OK	
11.002	S11.2	0.000	0.61		33.4	OK	
1.017	S1.17	0.000	1.32		181.3	SURCHARGED	
12.000	S12.0	0.000	0.48		36.9	OK	
12.001	S12.1	0.000	0.89		70.4	OK	
13.000	S13.0	0.000	0.14		12.0	OK	
12.002	S12.2	0.000	0.69		79.5	OK	
12.003	S12.3	0.000	0.62		78.7	OK	
12.004	S12.4	0.000	0.53		66.8	OK	
1.018	S1.18	0.000	1.48		249.7	SURCHARGED	
1.019	S1.19	0.000	0.20		12.7	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.11		12.7	OK	
1.021	S1.21	0.000	0.12		12.7	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	60 Winter	100	+20%					68.010	-0.205	0.000
1.001	S1.1	60 Winter	100	+20%					65.844	-0.201	0.000
1.002	S1.2	60 Summer	100	+20%					64.796	-0.189	0.000
1.003	S1.3	15 Summer	100	+20%					63.423	-0.172	0.000
2.000	S2.0	60 Winter	100	+20%					62.432	-0.258	0.000
1.004	S1.4	60 Summer	100	+20%					62.117	-0.233	0.000
3.000	S3.0	60 Winter	100	+20%					62.613	-0.182	0.000
1.005	S1.5	60 Summer	100	+20%					60.158	-0.232	0.000
4.000	S4.0	15 Winter	100	+20%					64.767	-0.136	0.000
5.000	S5.0	15 Winter	100	+20%					65.341	-0.164	0.000
4.001	S4.1	15 Winter	100	+20%					64.399	-0.133	0.000
4.002	S4.2	15 Winter	100	+20%	100/15 Summer				63.108	0.058	0.000
4.003	S4.3	15 Winter	100	+20%	100/15 Summer				62.831	0.023	0.000
6.000	S6.0	15 Winter	100	+20%					61.614	-0.195	0.000
4.004	S4.4	15 Winter	100	+20%					60.068	-0.112	0.000
4.005	S4.5	15 Winter	100	+20%	100/15 Summer				59.695	0.105	0.000
4.006	S4.6	15 Winter	100	+20%	30/15 Summer				59.483	0.142	0.000
1.006	S1.6	15 Winter	100	+20%	100/15 Summer				58.345	0.045	0.000
1.007	S1.7	15 Winter	100	+20%	100/15 Summer				57.484	0.064	0.000
1.008	S1.8	15 Winter	100	+20%	100/15 Summer				56.550	0.080	0.000
1.009	S1.9	15 Winter	100	+20%					54.956	-0.144	0.000
1.010	S1.10	15 Winter	100	+20%					50.245	-0.220	0.000
1.011	S1.11	15 Winter	100	+20%					49.310	-0.225	0.000
1.012	S1.12	15 Winter	100	+20%					47.017	-0.178	0.000
7.000	S7.0	60 Winter	100	+20%					54.304	-0.181	0.000
7.001	S7.1	60 Winter	100	+20%					53.775	-0.178	0.000
7.002	S7.2	60 Summer	100	+20%					52.778	-0.167	0.000
8.000	S8.0	15 Winter	100	+20%					56.091	-0.123	0.000
8.001	S8.1	15 Winter	100	+20%					53.708	-0.117	0.000
7.003	S7.3	15 Summer	100	+20%					51.225	-0.100	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.02		1.6	OK	
1.001	S1.1	0.03		1.7	OK	
1.002	S1.2	0.06		4.0	OK	
1.003	S1.3	0.12		9.1	OK	
2.000	S2.0	0.05		3.8	OK	
1.004	S1.4	0.11		13.1	OK	
3.000	S3.0	0.08		5.0	OK	
1.005	S1.5	0.11		18.4	OK	
4.000	S4.0	0.33		19.7	OK	
5.000	S5.0	0.16		11.0	OK	
4.001	S4.1	0.59		108.0	OK	
4.002	S4.2	1.05		104.2	SURCHARGED	
4.003	S4.3	1.11		104.6	SURCHARGED	
6.000	S6.0	0.04		2.7	OK	
4.004	S4.4	0.71		108.9	OK	
4.005	S4.5	1.08		113.0	SURCHARGED	
4.006	S4.6	1.72		113.8	SURCHARGED	
1.006	S1.6	1.15		123.7	SURCHARGED	
1.007	S1.7	1.22		124.8	SURCHARGED	
1.008	S1.8	1.23		126.2	SURCHARGED	
1.009	S1.9	0.53		126.3	OK	
1.010	S1.10	0.36		130.3	OK	
1.011	S1.11	0.34		130.7	OK	
1.012	S1.12	0.54		134.8	OK	
7.000	S7.0	0.09		3.5	OK	
7.001	S7.1	0.10		5.6	OK	
7.002	S7.2	0.14		8.1	OK	
8.000	S8.0	0.43		31.4	OK	
8.001	S8.1	0.47		33.4	OK	
7.003	S7.3	0.59		41.0	OK	

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

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)
7.004	S7.4	15 Summer	100	+20%					49.115	-0.100
9.000	S9.0	15 Summer	100	+20%					48.589	-0.059
9.001	S9.1	15 Winter	100	+20%					48.511	-0.089
9.002	S9.2	15 Winter	100	+20%					48.143	-0.092
9.003	S9.3	15 Winter	100	+20%					47.967	-0.085
7.005	S7.5	15 Winter	100	+20%					47.736	-0.195
7.006	S7.6	15 Winter	100	+20%					47.527	-0.248
1.013	S1.13	15 Winter	100	+20%					45.356	-0.234
1.014	S1.14	15 Winter	100	+20%					43.647	-0.243
1.015	S1.15	15 Winter	100	+20%					41.562	-0.218
10.000	S10.0	30 Winter	100	+20%					41.667	-0.211
1.016	S1.16	15 Winter	100	+20%	100/15 Summer				40.461	0.071
11.000	S11.0	15 Winter	100	+20%					45.078	-0.117
11.001	S11.1	15 Summer	100	+20%					41.547	-0.108
11.002	S11.2	15 Summer	100	+20%					40.265	-0.070
1.017	S1.17	15 Winter	100	+20%	30/15 Summer				40.148	0.114
12.000	S12.0	15 Winter	100	+20%					39.905	-0.079
12.001	S12.1	15 Winter	100	+20%	100/15 Summer				39.830	0.053
13.000	S13.0	15 Winter	100	+20%					39.412	-0.166
12.002	S12.2	15 Winter	100	+20%					39.407	-0.050
12.003	S12.3	15 Winter	100	+20%					39.362	-0.004
12.004	S12.4	15 Winter	100	+20%	100/15 Summer				39.282	0.117
1.018	S1.18	15 Winter	100	+20%	30/15 Summer				39.204	0.193
1.019	S1.19	960 Winter	100	+20%	1/60 Winter				36.855	1.230
1.020	S1.20	960 Winter	100	+20%					31.488	-0.177
1.021	S1.21	960 Winter	100	+20%					25.492	-0.173

Note S1.19 represents Tank and Hydrobrake MH

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.58		43.2	OK	
9.000	S9.0	0.000	0.90		27.7	OK	
9.001	S9.1	0.000	0.65		26.7	OK	
9.002	S9.2	0.000	0.65		26.2	OK	
9.003	S9.3	0.000	0.70		26.2	OK	
7.005	S7.5	0.000	0.47		65.9	OK	
7.006	S7.6	0.000	0.25		64.8	OK	
1.013	S1.13	0.000	0.46		199.3	OK	
1.014	S1.14	0.000	0.44		198.9	OK	
1.015	S1.15	0.000	0.53		197.9	OK	
10.000	S10.0	0.000	0.01		1.0	OK	
1.016	S1.16	0.000	0.91		204.6	SURCHARGED	
11.000	S11.0	0.000	0.47		42.8	OK	
11.001	S11.1	0.000	0.53		42.8	OK	
11.002	S11.2	0.000	0.79		43.2	OK	
1.017	S1.17	0.000	1.70		232.7	SURCHARGED	
12.000	S12.0	0.000	0.61		46.5	OK	
12.001	S12.1	0.000	1.07		84.4	SURCHARGED	
13.000	S13.0	0.000	0.18		15.4	OK	
12.002	S12.2	0.000	0.82		94.7	OK	
12.003	S12.3	0.000	0.69		87.1	OK	
12.004	S12.4	0.000	0.64		80.5	SURCHARGED	
1.018	S1.18	0.000	1.81		306.7	SURCHARGED	
1.019	S1.19	0.000	0.20		12.7	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.11		12.7	OK	
1.021	S1.21	0.000	0.12		12.7	OK	

Hydrobrake set to 7.5l/s at 3m Design Head to represent 50% blockage

Online Controls for Surface Water

Hydro-Brake® Optimum Manhole: S1.19, DS/PN: 1.019, Volume (m³): 8.4

Unit Reference	MD-SHE-0102-7500-3000-7500
Design Head (m)	3.000
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	35.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.000	7.5	Kick-Flo®	0.913	4.3
Flush-Flo™	0.446	5.4	Mean Flow over Head Range	-	5.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.9	2.000	6.2	4.000	8.6	7.000	11.2
0.200	4.9	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.6
0.300	5.3	1.200	4.9	2.400	6.7	5.000	9.5	8.000	11.9
0.400	5.4	1.400	5.2	2.600	7.0	5.500	10.0	8.500	12.3
0.500	5.4	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.6
0.600	5.3	1.800	5.9	3.500	8.1	6.500	10.8	9.500	13.0

Storage Structures for Surface Water

Tank or Pond Manhole: S1.19, DS/PN: 1.019

Invert Level (m) 35.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	472.0	3.000	472.0	3.001	0.0

Tank Size:
45m x 10.5m x 3m

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	120 Summer	1	+20%					67.997	-0.218	0.000
1.001	S1.1	60 Winter	1	+20%					65.829	-0.216	0.000
1.002	S1.2	15 Winter	1	+20%					64.776	-0.209	0.000
1.003	S1.3	15 Winter	1	+20%					63.397	-0.198	0.000
2.000	S2.0	120 Summer	1	+20%					62.412	-0.278	0.000
1.004	S1.4	15 Winter	1	+20%					62.084	-0.266	0.000
3.000	S3.0	120 Summer	1	+20%					62.595	-0.200	0.000
1.005	S1.5	120 Winter	1	+20%					60.125	-0.265	0.000
4.000	S4.0	15 Winter	1	+20%					64.729	-0.174	0.000
5.000	S5.0	15 Summer	1	+20%					65.315	-0.190	0.000
4.001	S4.1	15 Winter	1	+20%					64.317	-0.215	0.000
4.002	S4.2	15 Winter	1	+20%	100/15 Summer				62.868	-0.182	0.000
4.003	S4.3	15 Winter	1	+20%	100/15 Summer				62.629	-0.179	0.000
6.000	S6.0	15 Winter	1	+20%					61.601	-0.208	0.000
4.004	S4.4	15 Winter	1	+20%					59.975	-0.205	0.000
4.005	S4.5	15 Winter	1	+20%	100/15 Summer				59.411	-0.179	0.000
4.006	S4.6	15 Winter	1	+20%	30/15 Summer				59.199	-0.142	0.000
1.006	S1.6	15 Winter	1	+20%	100/15 Summer				58.126	-0.174	0.000
1.007	S1.7	15 Winter	1	+20%	100/15 Summer				57.250	-0.170	0.000
1.008	S1.8	15 Winter	1	+20%	100/15 Summer				56.301	-0.169	0.000
1.009	S1.9	15 Winter	1	+20%					54.882	-0.218	0.000
1.010	S1.10	15 Winter	1	+20%					50.175	-0.290	0.000
1.011	S1.11	15 Winter	1	+20%					49.242	-0.293	0.000
1.012	S1.12	15 Winter	1	+20%					46.926	-0.269	0.000
7.000	S7.0	60 Winter	1	+20%					54.285	-0.200	0.000
7.001	S7.1	120 Summer	1	+20%					53.754	-0.199	0.000
7.002	S7.2	120 Winter	1	+20%					52.751	-0.194	0.000
8.000	S8.0	15 Winter	1	+20%					56.047	-0.167	0.000
8.001	S8.1	15 Winter	1	+20%					53.660	-0.165	0.000
7.003	S7.3	15 Winter	1	+20%					51.167	-0.158	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.01		0.5	OK	
1.001	S1.1	0.01		0.6	OK	
1.002	S1.2	0.01		1.0	OK	
1.003	S1.3	0.03		2.5	OK	
2.000	S2.0	0.01		1.2	OK	
1.004	S1.4	0.03		3.4	OK	
3.000	S3.0	0.03		1.6	OK	
1.005	S1.5	0.03		5.2	OK	
4.000	S4.0	0.11		6.9	OK	
5.000	S5.0	0.06		3.8	OK	
4.001	S4.1	0.18		31.8	OK	
4.002	S4.2	0.32		31.9	OK	
4.003	S4.3	0.34		32.2	OK	
6.000	S6.0	0.02		0.9	OK	
4.004	S4.4	0.22		33.8	OK	
4.005	S4.5	0.34		35.8	OK	
4.006	S4.6	0.54		35.4	OK	
1.006	S1.6	0.36		39.0	OK	
1.007	S1.7	0.39		39.8	OK	
1.008	S1.8	0.40		40.7	OK	
1.009	S1.9	0.17		40.6	OK	
1.010	S1.10	0.12		42.2	OK	
1.011	S1.11	0.11		42.0	OK	
1.012	S1.12	0.18		44.3	OK	
7.000	S7.0	0.03		1.1	OK	
7.001	S7.1	0.03		1.7	OK	
7.002	S7.2	0.04		2.5	OK	
8.000	S8.0	0.15		11.0	OK	
8.001	S8.1	0.16		11.5	OK	
7.003	S7.3	0.19		13.6	OK	

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

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)
7.004	S7.4	15 Winter	1	+20%					49.057	-0.158
9.000	S9.0	15 Summer	1	+20%					48.509	-0.139
9.001	S9.1	15 Winter	1	+20%					48.449	-0.151
9.002	S9.2	15 Winter	1	+20%					48.083	-0.152
9.003	S9.3	15 Winter	1	+20%					47.903	-0.149
7.005	S7.5	15 Winter	1	+20%					47.656	-0.275
7.006	S7.6	15 Winter	1	+20%					47.474	-0.301
1.013	S1.13	15 Winter	1	+20%					45.257	-0.333
1.014	S1.14	15 Winter	1	+20%					43.554	-0.336
1.015	S1.15	15 Winter	1	+20%					41.457	-0.323
10.000	S10.0	120 Summer	1	+20%					41.658	-0.220
1.016	S1.16	15 Winter	1	+20%	100/15 Summer				40.113	-0.277
11.000	S11.0	15 Winter	1	+20%					45.030	-0.165
11.001	S11.1	15 Summer	1	+20%					41.496	-0.159
11.002	S11.2	15 Summer	1	+20%					40.191	-0.144
1.017	S1.17	15 Winter	1	+20%	30/15 Summer				39.827	-0.207
12.000	S12.0	15 Winter	1	+20%					39.779	-0.205
12.001	S12.1	15 Winter	1	+20%	100/15 Summer				39.605	-0.172
13.000	S13.0	15 Winter	1	+20%					39.326	-0.252
12.002	S12.2	15 Winter	1	+20%					39.220	-0.237
12.003	S12.3	15 Winter	1	+20%					39.121	-0.245
12.004	S12.4	15 Winter	1	+20%	100/15 Summer				38.920	-0.246
1.018	S1.18	15 Winter	1	+20%	30/15 Summer				38.824	-0.187
1.019	S1.19	1440 Winter	1	+20%	1/60 Winter				$\boxed{36.073}$	0.448
1.020	S1.20	120 Winter	1	+20%					31.470	-0.195
1.021	S1.21	8640 Summer	1	+20%					25.472	-0.193

Note S1.19 represents Tank and Hydrobrake MH

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.19		14.2	OK	
9.000	S9.0	0.000	0.31		9.7	OK	
9.001	S9.1	0.000	0.23		9.3	OK	
9.002	S9.2	0.000	0.23		9.2	OK	
9.003	S9.3	0.000	0.25		9.2	OK	
7.005	S7.5	0.000	0.16		22.6	OK	
7.006	S7.6	0.000	0.09		22.6	OK	
1.013	S1.13	0.000	0.15		65.7	OK	
1.014	S1.14	0.000	0.14		65.9	OK	
1.015	S1.15	0.000	0.18		66.3	OK	
10.000	S10.0	0.000	0.00		0.3	OK	
1.016	S1.16	0.000	0.30		68.1	OK	
11.000	S11.0	0.000	0.16		14.9	OK	
11.001	S11.1	0.000	0.19		14.9	OK	
11.002	S11.2	0.000	0.27		15.0	OK	
1.017	S1.17	0.000	0.56		76.9	OK	
12.000	S12.0	0.000	0.22		16.6	OK	
12.001	S12.1	0.000	0.36		28.8	OK	
13.000	S13.0	0.000	0.06		5.4	OK	
12.002	S12.2	0.000	0.29		33.1	OK	
12.003	S12.3	0.000	0.26		32.7	OK	
12.004	S12.4	0.000	0.26		32.3	OK	
1.018	S1.18	0.000	0.64		109.0	OK	
1.019	S1.19	0.000	0.08		5.3	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.04		5.3	OK	
1.021	S1.21	0.000	0.05		5.3	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	60 Winter	30	+20%					68.005	-0.210	0.000
1.001	S1.1	60 Winter	30	+20%					65.841	-0.204	0.000
1.002	S1.2	15 Winter	30	+20%					64.789	-0.196	0.000
1.003	S1.3	15 Summer	30	+20%					63.417	-0.178	0.000
2.000	S2.0	60 Winter	30	+20%					62.427	-0.263	0.000
1.004	S1.4	15 Summer	30	+20%					62.107	-0.243	0.000
3.000	S3.0	60 Winter	30	+20%					62.607	-0.188	0.000
1.005	S1.5	60 Winter	30	+20%					60.148	-0.242	0.000
4.000	S4.0	15 Winter	30	+20%					64.755	-0.148	0.000
5.000	S5.0	15 Winter	30	+20%					65.333	-0.172	0.000
4.001	S4.1	15 Winter	30	+20%					64.375	-0.157	0.000
4.002	S4.2	15 Winter	30	+20%	100/15 Summer				62.962	-0.088	0.000
4.003	S4.3	15 Winter	30	+20%	100/15 Summer				62.728	-0.080	0.000
6.000	S6.0	15 Winter	30	+20%					61.611	-0.198	0.000
4.004	S4.4	15 Winter	30	+20%					60.044	-0.136	0.000
4.005	S4.5	15 Winter	30	+20%	100/15 Summer				59.534	-0.056	0.000
4.006	S4.6	15 Winter	30	+20%	30/15 Summer				59.402	0.061	0.000
1.006	S1.6	15 Winter	30	+20%	100/15 Summer				58.229	-0.071	0.000
1.007	S1.7	15 Winter	30	+20%	100/15 Summer				57.367	-0.053	0.000
1.008	S1.8	15 Winter	30	+20%	100/15 Summer				56.470	0.000	0.000
1.009	S1.9	15 Winter	30	+20%					54.937	-0.163	0.000
1.010	S1.10	15 Winter	30	+20%					50.228	-0.237	0.000
1.011	S1.11	15 Winter	30	+20%					49.294	-0.241	0.000
1.012	S1.12	15 Winter	30	+20%					46.996	-0.199	0.000
7.000	S7.0	60 Winter	30	+20%					54.297	-0.188	0.000
7.001	S7.1	60 Winter	30	+20%					53.769	-0.184	0.000
7.002	S7.2	60 Winter	30	+20%					52.770	-0.175	0.000
8.000	S8.0	15 Winter	30	+20%					56.078	-0.136	0.000
8.001	S8.1	15 Winter	30	+20%					53.693	-0.132	0.000
7.003	S7.3	15 Summer	30	+20%					51.207	-0.118	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.01		1.2	OK	
1.001	S1.1	0.02		1.3	OK	
1.002	S1.2	0.04		2.9	OK	
1.003	S1.3	0.10		7.0	OK	
2.000	S2.0	0.04		2.9	OK	
1.004	S1.4	0.08		9.7	OK	
3.000	S3.0	0.06		3.8	OK	
1.005	S1.5	0.08		13.5	OK	
4.000	S4.0	0.25		15.2	OK	
5.000	S5.0	0.13		8.5	OK	
4.001	S4.1	0.46		83.5	OK	
4.002	S4.2	0.84		83.2	OK	
4.003	S4.3	0.88		82.6	OK	
6.000	S6.0	0.03		2.1	OK	
4.004	S4.4	0.57		87.2	OK	
4.005	S4.5	0.88		92.3	OK	
4.006	S4.6	1.39		91.6	SURCHARGED	
1.006	S1.6	0.94		100.3	OK	
1.007	S1.7	0.98		101.1	OK	
1.008	S1.8	1.01		103.4	OK	
1.009	S1.9	0.43		103.3	OK	
1.010	S1.10	0.29		106.9	OK	
1.011	S1.11	0.27		106.7	OK	
1.012	S1.12	0.44		111.0	OK	
7.000	S7.0	0.07		2.7	OK	
7.001	S7.1	0.08		4.3	OK	
7.002	S7.2	0.11		6.2	OK	
8.000	S8.0	0.33		24.3	OK	
8.001	S8.1	0.36		25.8	OK	
7.003	S7.3	0.45		31.7	OK	

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

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)
7.004	S7.4	15 Summer	30	+20%					49.097	-0.118
9.000	S9.0	15 Summer	30	+20%					48.562	-0.086
9.001	S9.1	15 Summer	30	+20%					48.491	-0.109
9.002	S9.2	15 Winter	30	+20%					48.123	-0.112
9.003	S9.3	15 Winter	30	+20%					47.946	-0.106
7.005	S7.5	15 Winter	30	+20%					47.713	-0.218
7.006	S7.6	15 Winter	30	+20%					47.512	-0.263
1.013	S1.13	15 Winter	30	+20%					45.332	-0.258
1.014	S1.14	15 Winter	30	+20%					43.625	-0.265
1.015	S1.15	15 Winter	30	+20%					41.534	-0.246
10.000	S10.0	30 Winter	30	+20%					41.664	-0.214
1.016	S1.16	15 Winter	30	+20%	100/15 Summer				40.279	-0.111
11.000	S11.0	15 Winter	30	+20%					45.063	-0.132
11.001	S11.1	15 Summer	30	+20%					41.531	-0.124
11.002	S11.2	15 Summer	30	+20%					40.240	-0.095
1.017	S1.17	15 Winter	30	+20%	30/15 Summer				40.084	0.050
12.000	S12.0	15 Winter	30	+20%					39.832	-0.152
12.001	S12.1	15 Winter	30	+20%	100/15 Summer				39.705	-0.072
13.000	S13.0	15 Winter	30	+20%					39.352	-0.226
12.002	S12.2	15 Winter	30	+20%					39.313	-0.144
12.003	S12.3	15 Winter	30	+20%					39.208	-0.158
12.004	S12.4	15 Winter	30	+20%	100/15 Summer				39.160	-0.006
1.018	S1.18	15 Winter	30	+20%	30/15 Summer				39.103	0.092
1.019	S1.19	2160 Winter	30	+20%	1/60 Winter				$\boxed{36.973}$	1.348
1.020	S1.20	2160 Winter	30	+20%					31.471	-0.194
1.021	S1.21	2160 Winter	30	+20%					25.473	-0.192

Note S1.19 represents Tank and Hydrobrake MH

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.45		33.4	OK	
9.000	S9.0	0.000	0.69		21.4	OK	
9.001	S9.1	0.000	0.50		20.5	OK	
9.002	S9.2	0.000	0.50		20.3	OK	
9.003	S9.3	0.000	0.55		20.4	OK	
7.005	S7.5	0.000	0.37		51.3	OK	
7.006	S7.6	0.000	0.19		50.5	OK	
1.013	S1.13	0.000	0.37		161.7	OK	
1.014	S1.14	0.000	0.35		161.5	OK	
1.015	S1.15	0.000	0.43		160.8	OK	
10.000	S10.0	0.000	0.01		0.7	OK	
1.016	S1.16	0.000	0.74		164.8	OK	
11.000	S11.0	0.000	0.36		33.1	OK	
11.001	S11.1	0.000	0.41		33.1	OK	
11.002	S11.2	0.000	0.61		33.4	OK	
1.017	S1.17	0.000	1.32		181.3	SURCHARGED	
12.000	S12.0	0.000	0.48		36.9	OK	
12.001	S12.1	0.000	0.89		70.4	OK	
13.000	S13.0	0.000	0.14		12.0	OK	
12.002	S12.2	0.000	0.69		79.5	OK	
12.003	S12.3	0.000	0.62		78.7	OK	
12.004	S12.4	0.000	0.53		66.8	OK	
1.018	S1.18	0.000	1.48		249.7	SURCHARGED	
1.019	S1.19	0.000	0.09		5.5	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.05		5.5	OK	
1.021	S1.21	0.000	0.05		5.5	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 19
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.200 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.222 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 0.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 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.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1.0	60 Winter	100	+20%					68.010	-0.205	0.000
1.001	S1.1	60 Winter	100	+20%					65.844	-0.201	0.000
1.002	S1.2	60 Summer	100	+20%					64.796	-0.189	0.000
1.003	S1.3	15 Summer	100	+20%					63.423	-0.172	0.000
2.000	S2.0	60 Winter	100	+20%					62.432	-0.258	0.000
1.004	S1.4	60 Summer	100	+20%					62.117	-0.233	0.000
3.000	S3.0	60 Winter	100	+20%					62.613	-0.182	0.000
1.005	S1.5	60 Summer	100	+20%					60.158	-0.232	0.000
4.000	S4.0	15 Winter	100	+20%					64.767	-0.136	0.000
5.000	S5.0	15 Winter	100	+20%					65.341	-0.164	0.000
4.001	S4.1	15 Winter	100	+20%					64.399	-0.133	0.000
4.002	S4.2	15 Winter	100	+20%	100/15 Summer				63.108	0.058	0.000
4.003	S4.3	15 Winter	100	+20%	100/15 Summer				62.831	0.023	0.000
6.000	S6.0	15 Winter	100	+20%					61.614	-0.195	0.000
4.004	S4.4	15 Winter	100	+20%					60.068	-0.112	0.000
4.005	S4.5	15 Winter	100	+20%	100/15 Summer				59.695	0.105	0.000
4.006	S4.6	15 Winter	100	+20%	30/15 Summer				59.483	0.142	0.000
1.006	S1.6	15 Winter	100	+20%	100/15 Summer				58.345	0.045	0.000
1.007	S1.7	15 Winter	100	+20%	100/15 Summer				57.484	0.064	0.000
1.008	S1.8	15 Winter	100	+20%	100/15 Summer				56.550	0.080	0.000
1.009	S1.9	15 Winter	100	+20%					54.956	-0.144	0.000
1.010	S1.10	15 Winter	100	+20%					50.245	-0.220	0.000
1.011	S1.11	15 Winter	100	+20%					49.310	-0.225	0.000
1.012	S1.12	15 Winter	100	+20%					47.017	-0.178	0.000
7.000	S7.0	60 Winter	100	+20%					54.304	-0.181	0.000
7.001	S7.1	60 Winter	100	+20%					53.775	-0.178	0.000
7.002	S7.2	60 Summer	100	+20%					52.778	-0.167	0.000
8.000	S8.0	15 Winter	100	+20%					56.091	-0.123	0.000
8.001	S8.1	15 Winter	100	+20%					53.708	-0.117	0.000
7.003	S7.3	15 Summer	100	+20%					51.225	-0.100	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1.0	0.02		1.6	OK	
1.001	S1.1	0.03		1.7	OK	
1.002	S1.2	0.06		4.0	OK	
1.003	S1.3	0.12		9.1	OK	
2.000	S2.0	0.05		3.8	OK	
1.004	S1.4	0.11		13.1	OK	
3.000	S3.0	0.08		5.0	OK	
1.005	S1.5	0.11		18.4	OK	
4.000	S4.0	0.33		19.7	OK	
5.000	S5.0	0.16		11.0	OK	
4.001	S4.1	0.59		108.0	OK	
4.002	S4.2	1.05		104.2	SURCHARGED	
4.003	S4.3	1.11		104.6	SURCHARGED	
6.000	S6.0	0.04		2.7	OK	
4.004	S4.4	0.71		108.9	OK	
4.005	S4.5	1.08		113.0	SURCHARGED	
4.006	S4.6	1.72		113.8	SURCHARGED	
1.006	S1.6	1.15		123.7	SURCHARGED	
1.007	S1.7	1.22		124.8	SURCHARGED	
1.008	S1.8	1.23		126.2	SURCHARGED	
1.009	S1.9	0.53		126.3	OK	
1.010	S1.10	0.36		130.3	OK	
1.011	S1.11	0.34		130.7	OK	
1.012	S1.12	0.54		134.8	OK	
7.000	S7.0	0.09		3.5	OK	
7.001	S7.1	0.10		5.6	OK	
7.002	S7.2	0.14		8.1	OK	
8.000	S8.0	0.43		31.4	OK	
8.001	S8.1	0.47		33.4	OK	
7.003	S7.3	0.59		41.0	OK	

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

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)
7.004	S7.4	15 Summer	100	+20%					49.115	-0.100
9.000	S9.0	15 Summer	100	+20%					48.589	-0.059
9.001	S9.1	15 Winter	100	+20%					48.511	-0.089
9.002	S9.2	15 Winter	100	+20%					48.143	-0.092
9.003	S9.3	15 Winter	100	+20%					47.967	-0.085
7.005	S7.5	15 Winter	100	+20%					47.736	-0.195
7.006	S7.6	15 Winter	100	+20%					47.527	-0.248
1.013	S1.13	15 Winter	100	+20%					45.356	-0.234
1.014	S1.14	15 Winter	100	+20%					43.647	-0.243
1.015	S1.15	15 Winter	100	+20%					41.562	-0.218
10.000	S10.0	30 Winter	100	+20%					41.667	-0.211
1.016	S1.16	15 Winter	100	+20%	100/15 Summer				40.461	0.071
11.000	S11.0	15 Winter	100	+20%					45.078	-0.117
11.001	S11.1	15 Summer	100	+20%					41.547	-0.108
11.002	S11.2	15 Summer	100	+20%					40.265	-0.070
1.017	S1.17	15 Winter	100	+20%	30/15 Summer				40.148	0.114
12.000	S12.0	15 Winter	100	+20%					39.905	-0.079
12.001	S12.1	15 Winter	100	+20%	100/15 Summer				39.830	0.053
13.000	S13.0	15 Winter	100	+20%					39.412	-0.166
12.002	S12.2	15 Winter	100	+20%					39.407	-0.050
12.003	S12.3	15 Winter	100	+20%					39.362	-0.004
12.004	S12.4	15 Winter	100	+20%	100/15 Summer				39.282	0.117
1.018	S1.18	15 Winter	100	+20%	30/15 Summer				39.204	0.193
1.019	S1.19	2160 Winter	100	+20%	1/60 Winter				37.420	1.795
1.020	S1.20	2160 Winter	100	+20%					31.473	-0.192
1.021	S1.21	2160 Winter	100	+20%					25.475	-0.190

Note S1.19 represents Tank and Hydrobrake MH

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.004	S7.4	0.000	0.58		43.2	OK	
9.000	S9.0	0.000	0.90		27.7	OK	
9.001	S9.1	0.000	0.65		26.7	OK	
9.002	S9.2	0.000	0.65		26.2	OK	
9.003	S9.3	0.000	0.70		26.2	OK	
7.005	S7.5	0.000	0.47		65.9	OK	
7.006	S7.6	0.000	0.25		64.8	OK	
1.013	S1.13	0.000	0.46		199.3	OK	
1.014	S1.14	0.000	0.44		198.9	OK	
1.015	S1.15	0.000	0.53		197.9	OK	
10.000	S10.0	0.000	0.01		1.0	OK	
1.016	S1.16	0.000	0.91		204.6	SURCHARGED	
11.000	S11.0	0.000	0.47		42.8	OK	
11.001	S11.1	0.000	0.53		42.8	OK	
11.002	S11.2	0.000	0.79		43.2	OK	
1.017	S1.17	0.000	1.70		232.7	SURCHARGED	
12.000	S12.0	0.000	0.61		46.5	OK	
12.001	S12.1	0.000	1.07		84.4	SURCHARGED	
13.000	S13.0	0.000	0.18		15.4	OK	
12.002	S12.2	0.000	0.82		94.7	OK	
12.003	S12.3	0.000	0.69		87.1	OK	
12.004	S12.4	0.000	0.64		80.5	SURCHARGED	
1.018	S1.18	0.000	1.81		306.7	SURCHARGED	
1.019	S1.19	0.000	0.10		6.2	SURCHARGED	

Note S1.19 represents Tank and Hydrobrake MH

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.020	S1.20	0.000	0.05		6.2	OK	
1.021	S1.21	0.000	0.06		6.2	OK	

APPENDIX IV: Irish Water Correspondence

- Irish Water Completed Pre-Connection Enquiry Form
- Irish Water Confirmation of Feasibility Letter (with Appendices)
- Irish Water Completed Diversion Application Form
- Irish Water Statement of Design Acceptance Letter

Pre-connection enquiry form

Business developments, mixed use developments, housing developments

UISCE ÉIREANN : IRISH WATER

This form is to be filled out by applicants enquiring about the feasibility of a water and/or wastewater connection to Irish Water infrastructure. If completing this form by hand, please use BLOCK CAPITALS and black ink.

Please refer to the **Guide to completing the pre-connection enquiry form** on page 13 of this document when completing the form.

*** Denotes mandatory/ required field. Please note, if mandatory fields are not completed the application will be returned.**

Section A | Applicant details

1 *Applicant details:

Registered company name (if applicable):

Trading name (if applicable):

Company registration number (if applicable):

If you are not a registered company/business, please provide the applicant's name:

LAND DEVELOPMENT AGENCY

*Contact name: ROBERT FARRELL

*Postal address: 77 SIR JOHN ROGERSONS QUAY, BLOCK C GRAND CANAL DOCKLANDS, DUBLIN

*Eircode: D02NP08

*Telephone: 0035316856566

Mobile: 0035387655433 3

*Email: rfarrell@lda.ie

2 Agent details (if applicable):

Contact name: BRIAN MAHONY

Company name (if applicable): BARRETT MAHONY

Postal address: SANDWITH HOUSE 52-54 LOWER SANDWITH STREET

Eircode: D02WR26

Telephone: 016773200

Email: bmahony@bmce.ie

3 ***Please indicate whether it is the applicant or agent who should receive future correspondence in relation to the enquiry:**

Applicant [ ] Agent [X]

Section B | Site details

4 ***Site address:** St KEVINS HOSPITAL,
1 ROSE HILL UPPER,
SUNDAYS WELL, CO. CORK

5 ***Irish Grid co-ordinates of site:** Eastings (X) 165026 Northings (Y) 071661

Eg. co-ordinates of GPO, O'Connell St., Dublin: E(X) 315,878 N(Y) 234,619

6 ***Local Authority:**

Local Authority that granted planning permission (if applicable):

N/A

7 ***Has full planning permission been granted?** Yes [ ] No [X]

If 'Yes', please provide the current or previous planning reference number:

Section C | Development details

8 **Please outline the domestic and/or industry/business use proposed:**

Property type	Number of units	Property type	Number of units	Property type	Number of units
House	100	Apartments	170	Agricultural	
Office		School		Retail unit	
Residential care home		Institution		Industrial unit	
Hotel		Factory		Other	
Other (please specify type)					

9 ***Approximate start date of proposed development:** 01 / 01 / 2021

10 ***Is the development multi-phased?** Yes [ ] No [X]

If 'Yes', application must include a master-plan identifying the development phases and the current phase number.

If 'Yes', please provide details of variations in water demand volumes and wastewater discharge loads due to phasing requirements.

11 ***Please indicate the type of connection required by ticking the appropriate box below:**

Water [ ] Please go to Section D

Wastewater [ ] Please go to Section E

Both [X] Please complete both Sections D and E

Section D | Water connection and demand details

12	***Is there an existing connection to public water mains at the site?**	Yes X	No ☐
12.1	If yes, is this enquiry for an additional connection to one already installed?	Yes X	No ☐
12.2	If yes, is this enquiry to increase the size of an existing connection?	Yes ☐	No X

13 **Approximate date water connection is required:** 01/05/2021

14 ***What diameter of water connection is required to service the development?** 150 mm

15 ***Is more than one connection required to the public infrastructure to service this development?** Yes X No ☐

If 'Yes', how many? 02

16 **Please indicate the business water demand (shops, offices, schools, hotels, restaurants, etc.):**

Post-development peak hour water demand	N/A	**l/s**
Post-development average hour water demand	N/A	**l/s**

Please include calculations on the attached sheet provided. Where there will be a daily/weekly/seasonal variation in the water demand profile, please provide all such details.

17 **Please indicate the industrial water demand (industry-specific water requirements):**

Post-development peak hour water demand	N/A	**l/s**
Post-development average hour water demand	N/A	**l/s**

Please include calculations on the attached sheet provided. Where there will be a daily/weekly/seasonal variation in the water demand profile, please provide all such details.

18 **What is the existing ground level at the property boundary at connection point (if known) above Malin Head Ordnance Datum?**

70.00 m

19 **What is the highest finished floor level of the proposed development above Malin Head Ordnance Datum?**

69.00 m

20 **Is on-site water storage being provided?** Yes X No ☐

Please include calculations on the attached sheet provided.

21 **Are there fire flow requirements?** Yes [X] No [ ]

Additional fire flow requirements over and above those identified in Q16-17	20	l/s

Please include calculations on the attached sheet provided, and include confirmation of requirements from the Fire Authority.

22 **Do you propose to supplement your potable water supply from other sources?** Yes [ ] No [X]

If 'Yes', please indicate how you propose to supplement your potable water supply from other sources (see **Guide to completing the application form** on page 12 of this document for further details):

Section E | Wastewater connection and discharge details

23 ***Is there an existing connection to a public sewer at the site?** Yes [X] No [ ]

23.1 If yes, is this enquiry for an additional connection to the one already installed? Yes [X] No [ ]

23.2 If yes, is this enquiry to increase the size of an existing connection? Yes [ ] No [X]

24 ***Approximate date that wastewater connection is required:** 01 / 05 / 2021

25 ***What diameter of wastewater connection is required to service the development?** 225 mm

26 ***Is more than one connection required to the public infrastructure to service this development?** Yes [ ] No [X]

If 'Yes', how many?

27 **Please indicate the commercial wastewater hydraulic load (shops, offices, schools, hotels, restaurants, etc.):**

Post-development peak discharge	N/A	**l/s**
Post-development average discharge	N/A	**l/s**

Please include calculations on the attached sheet provided.

28 **Please indicate the industrial wastewater hydraulic load (industry-specific discharge requirements):**

Post-development peak discharge	N/A	**l/s**
Post-development average discharge	N/A	**l/s**

Please include calculations on the attached sheet provided.

29 Wastewater organic load:

Characteristic	**Max concentration (mg/l)**	**Average concentration (mg/l)**	**Maximum daily load (kg/day)**
Biochemical oxygen demand (BOD)	DOMESTIC	WASTE	ONLY
Chemical oxygen demand (COD)			
Suspended solids (SS)			
Total nitrogen (N)			
Total phosphorus (P)			
Other			

Temperature range	
pH range	

30 *Storm water run-off will only be accepted from brownfield sites that already have a storm/surface water connection to a combined sewer. In the case of such brownfield sites, please indicate if the development intends discharging surface water to the combined wastewater collection system:

Yes [ ] No [X]

If 'Yes', please give reason for discharge and comment on adequacy of SUDS/attenuation measures proposed.

31 *Do you propose to pump the wastewater? Yes [ ] No [X]

If 'Yes', please include justification for your pumped solution with this application.

32 What is the existing ground level at the property boundary at connection point (if known) above Malin Head Ordnance Datum?

27.00 m

33 What is the lowest finished floor level on site above Malin Head Ordnance Datum? 42.00 m

34 What is the proposed invert level of the pipe exiting the property to the public road?

25.15 m

Section F | Supporting documentation

Please provide the following additional information (all mandatory):

>	Site location map: A site location map to a scale of 1:1000, which clearly identifies the land or structure to which the enquiry relates. The map shall include the following details: i. The scale shall be clearly indicated on the map. ii. The boundaries shall be delineated in red. iii. The site co-ordinates shall be marked on the site location map.	X
>	Details of planning and development exemptions (if applicable).	
>	Calculations (calculation sheets provided below).	x
>	Site layout map to a scale of 1:500 showing layout of proposed development, water network and wastewater network layouts, additional water/wastewater infrastructure if proposed, connection points to Irish Water infrastructure.	x
>	Conceptual design of the connection asset from the proposed development to the existing Irish Water infrastructure, including service conflicts, gradients, pipe sizes and invert levels.	x
>	Any other information that might help Irish Water assess this pre-connection enquiry.	

Section G | Declaration

I/We hereby make this application to Irish Water for a water and/or wastewater connection as detailed on this form.

I/We understand that any alterations made to this application must be declared to Irish Water.

The details that I/we have given with this application are accurate.

I/We have enclosed all the necessary supporting documentation.

Any personal data you provide will be stored and processed by Irish Water and may be transferred to third parties for the purposes of the water and/or wastewater connection process. I hereby give consent to Irish Water to store and process my personal data and to transfer my personal data to third parties, if required, for the purposes of the connection process.

If you wish to revoke consent at any time or wish to see Irish Water's full Data Protection Notice, please see **https://www.water.ie/privacy-notice/**

Signature: Brian Mahony   Date: 13/01/2020

Your full name (in BLOCK CAPITALS):

BRIAN MAHONY

Irish Water will carry out a formal assessment based on the information provided on this form.
Any future connection offer made by Irish Water will be based on the information that has been provided here.

Please submit the completed form to **newconnections@water.ie** or alternatively, post to:

Irish Water
PO Box 860
South City Delivery Office
Cork City

Please note that if you are sending us your application form and any associated documentation by email, the maximum file size that we can receive in any one email is 35MB.

Please note, if mandatory fields are not completed the application will be returned.

Irish Water is subject to the provisions of the Freedom of Information Act 2014 (“FOIA”) and the codes of practice issued under FOIA as may be amended, updated or replaced from time to time. The FOIA enables members of the public to obtain access to records held by public bodies subject to certain exemptions such as where the requested records may not be released, for example to protect another individual’s privacy rights or to protect commercially sensitive information. Please clearly label any document or part thereof which contains commercially sensitive information. Irish Water accepts no responsibility for any loss or damage arising as a result of its processing of freedom of information requests.

Calculations

Water demand

BM
BARRETT MAHONY
CONSULTING ENGINEERS
CIVIL & STRUCTURAL

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland
Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

PROJECT TITLE:	ST. KEVINS HOSPITAL, CORK	BY: TMH
CALCULATION:	WATER DEMAND	PAGE: 1
APPENDIX:	B	DATE: 09/01/2020

SUMMARY:		Total Peak Demand	Avg. Day / Peak Week Demand
A:	Residential	7.910 l/s	1.582 l/s

A: **RESIDENTIAL**

The water demand for the proposed development has been calculated using the guidelines given in the Irish Water Code of Practice for Water Infrastructure (Dec. 17) Section 3.7.2 assuming a per-capita consumption of 150 l/head/day and using the Irish Water assumed average occupancy of 2.7 persons/unit. The average day/peak week demand is taken as 1.25 times the average daily domestic demand. The peak demand factor is taken as 5 times the average day/peak week demand.

No. of Units = 270
No. of Occupants = 270 x 2.7 = 729

Avg. Daily Demand = No. of Occupants x Allowance per head
Avg. Daily Demand = 729 x 150 = 109,350 l/day

$$\text{Avg. Day / Peak Week Demand} = \frac{\text{Daily Flow}}{\text{Flow Duration}} \times 1.25 = \frac{109{,}350\ \text{l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{1.582\ l/s}$$

Peak Demand = Average Flow x 5
Peak Demand = 1.582 l/s x 5 = **7.910 l/s**

On-site storage

24 hour storage to be provided for each unit in the event of water shut-off

Fire flow requirements

From Kilkenny Fire and Rescue Service "Specifications for fire hydrants and fire fighting water supplies", Section 2.1:

Multi Occupied housing developments with units of more than 2 floors should have a water supply capable of delivering a minimum of 20-35l/s through any single hydrant on the development.

BM
BARRETT MAHONY
CONSULTING ENGINEERS
CIVIL & STRUCTURAL

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland
Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

PROJECT TITLE:	ST. KEVINS HOSPITAL, CORK	BY: TMH
CALCULATION:	FOUL WATER DEMAND	PAGE: 1
APPENDIX:	A	DATE: 09/01/2020

SUMMARY:		Total Peak Flow	Total Average Flow
A:	Residential: Subject Site	8.353 l/s	1.392 l/s

A: **RESIDENTIAL: SUBJECT SITE**

The foul effluent from the proposed dwellings is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure (Dec. 2017) assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit.

No. of Units = 270

No. of Occupants = 270 x 2.7 = 729.0

Daily Flow = No. of Occupants x Dry Weather Flow + Infiltration (10%)

Daily Flow = 729.0 x 150 + 729.0 x 150 x 0.1 = 120,285 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{120{,}285\ \text{l/day}}{24 \times 60 \times 60} = \mathbf{1.392\ l/s}$$

Peak Flow = Average Flow x 6

Peak Flow = 1.392 l/s x 6 = **8.353 l/s**

Flow balancing and pumping

N/A

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Robert Farrell
77 Sir John Rogersons Quay,
Block C,
Grand Canal Docklands,
Dublin 12
DO2 NP08

7 February 2020

Dear Robert Farrell,

Re: Connection Reference No CDS20000237 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 270 unit(s) at St Kevins Hospital, 1 Rose Hill Upper, Co. Cork.

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at St Kevin's Hospital, 1 Rose Hill Upper, Co. Cork.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Water Network:

There is a significant amount of water infrastructure within this site including a number of critical drinking water trunk mains. Please see GIS maps in **Appendix A**.

Irish Water is currently undertaking the Shanakiel Rising and Distribution mains project as part of its Capital Investment Plan. This project will replace the existing rising mains with a new rising main system from Lee Road Water Treatment Plant to Shanakiel/Harbour View and Churchfield including new pumping station @ Shanakiel Reservoir site and Harbour View Rd Reservoir Site. The project is currently at design/procurement stage with no expected start date available as of yet.

As part of this project Irish Water plan to reroute a number of trunk watermains and distribution watermains in corridor on your site. **Appendix B** shows the wayleaves Irish Water has in place for this project. **Appendix C** highlights the mains that will be de-commissioned after the new project is completed.

Irish Water do not plan to undertake any works on the remaining water mains on the site. It will be necessary to liaise with Irish Water with regard to the layout of the site to ensure that appropriate separation distances are maintained between any proposed structures and the existing watermains. A Diversion of the water network infrastructure may be required subject to layout proposal of the development and separation distances. For further information related to diversion please visit www.water.ie/connections/developer-services/diversions.

Combined network:

There is a DN375 combined wastewater and storm sewer running through the site, see **Appendix D**. From the information provided to Irish Water, the proposed development will not encroach on this sewer. However the Developer should be aware of the appropriate separation distances between any proposed structures and the existing sewer.

The development has to incorporate Sustainable Drainage Systems/ Attenuation in the management of storm water and to reduce surface water inflow into the receiving combined sewer. Full details of these have to be agreed with LA Drainage Division. Details of this agreement / design to be provided to Irish Water at Connection Application stage.

Strategic Housing Development:

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore: In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure must be submitted to Irish Water for assessment.

General:

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact from the design team on or email . For further information, visit **www.water.ie/connections.**

Yours sincerely,

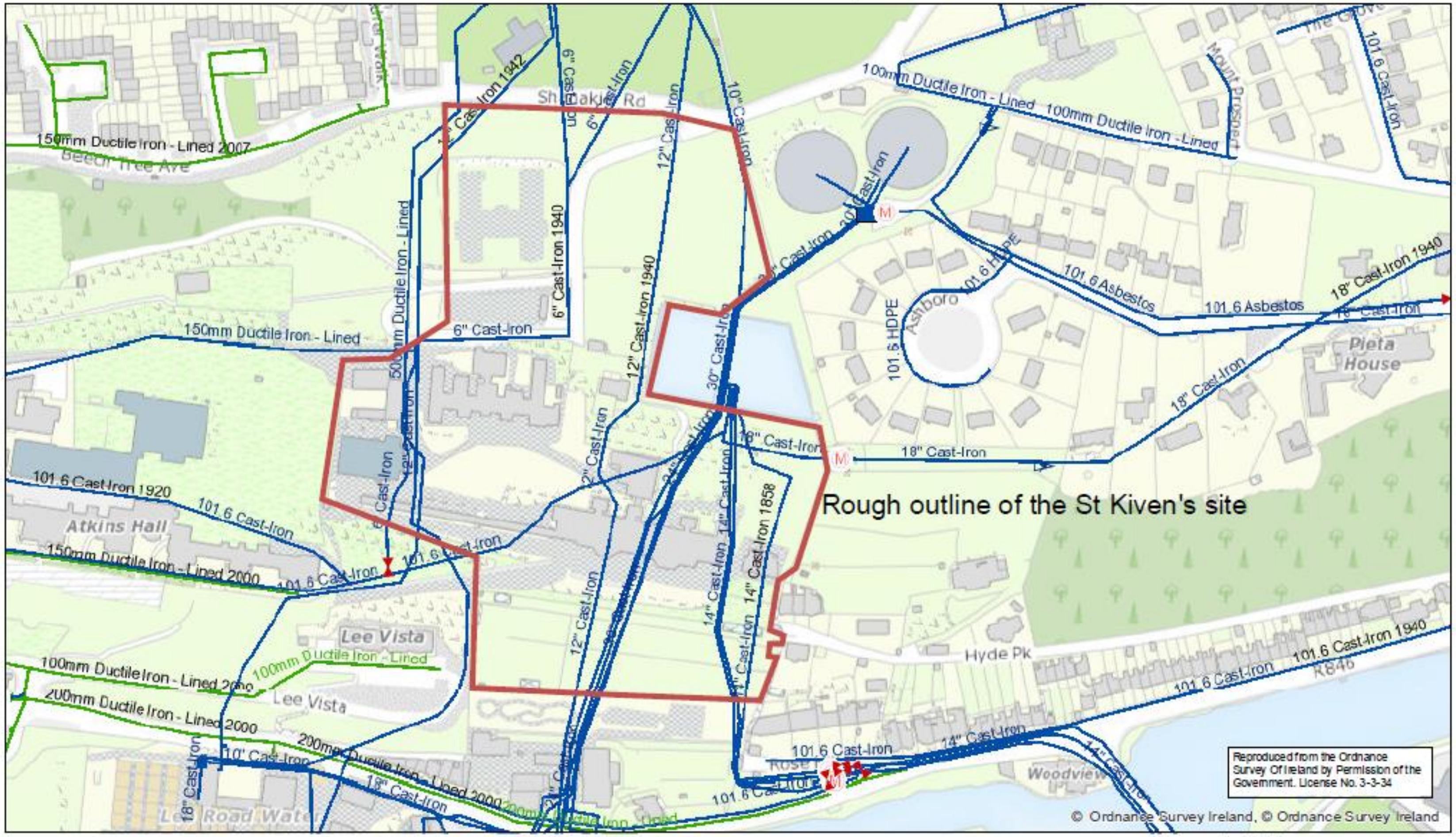
M O'Dwyer

Maria O'Dwyer

Connections and Developer Services

Appendix A – Existing Water Mains in St Kevin’s Hospital Site

Irish Water Web Map



February 4, 2020

1:4,514

0 0.0375 0.075 0.15 mi

0 0.05 0.1 0.2 km

Legend

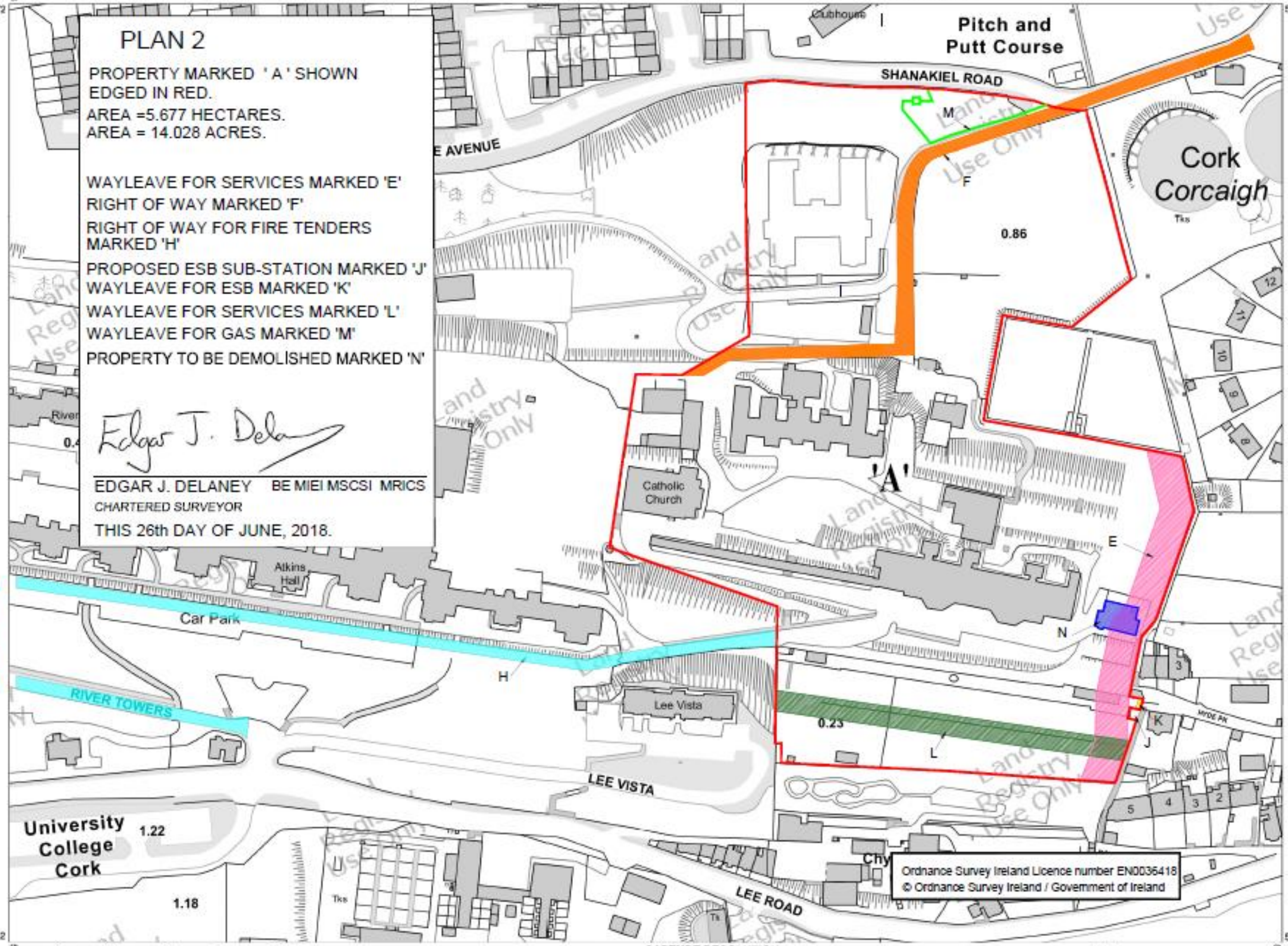
Flow Control Valves		Boundary Valves	Boundary Meter	Reservoir
Non-return	PRV	Open	District (Boundary Meter)	Potable
Hydro	PSV	Closed	Treatment Plant	Raw Water
Orifice Plate	Other	Part Closed		Pump Stations

Appendix B – Wayleaves

Land Registry Compliant Map

PLAN 2

FOCUS
Focus Surveys Ltd.



OUTPUT SCALE: 1:2,500

CAPTURE RESOLUTION:
The map objects are only accurate to the resolution at which they were captured.
Output scale is not indicative of data capture scale.
Further information is available at:
http://www.osi.ie; search 'Capture Resolution'

Ordnance Survey Ireland
National Mapping Agency

CENTRE COORDINATES:
ITM 564830,571757

PUBLISHED: 23/04/2018
ORDER NO.: 50004686_1

MAP SERIES:	MAP SHEETS:
1:1,000	6382-06
1:1,000	6382-07
1:1,000	6382-11
1:1,000	6382-12

COMPILED AND PUBLISHED BY:
Ordnance Survey Ireland,
Phoenix Park,
Dublin 8,
Ireland.

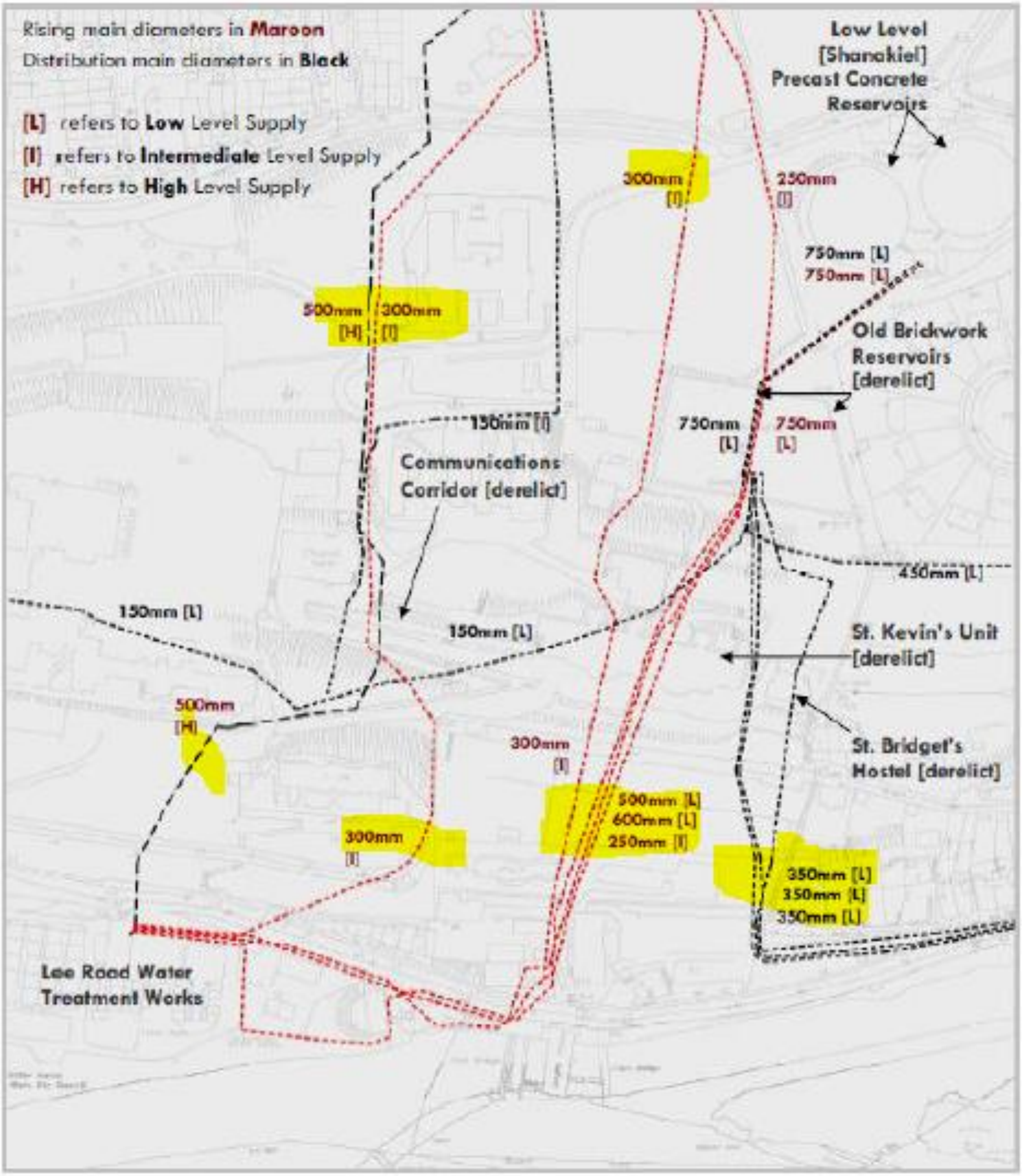
The representation on this map of a road, track or footpath is not evidence of the existence of a right of way.

Ordnance Survey maps never show legal property boundaries, nor do they show ownership of physical features.

LEGEND:
http://www.osi.ie;
search 'Large Scale Legend'

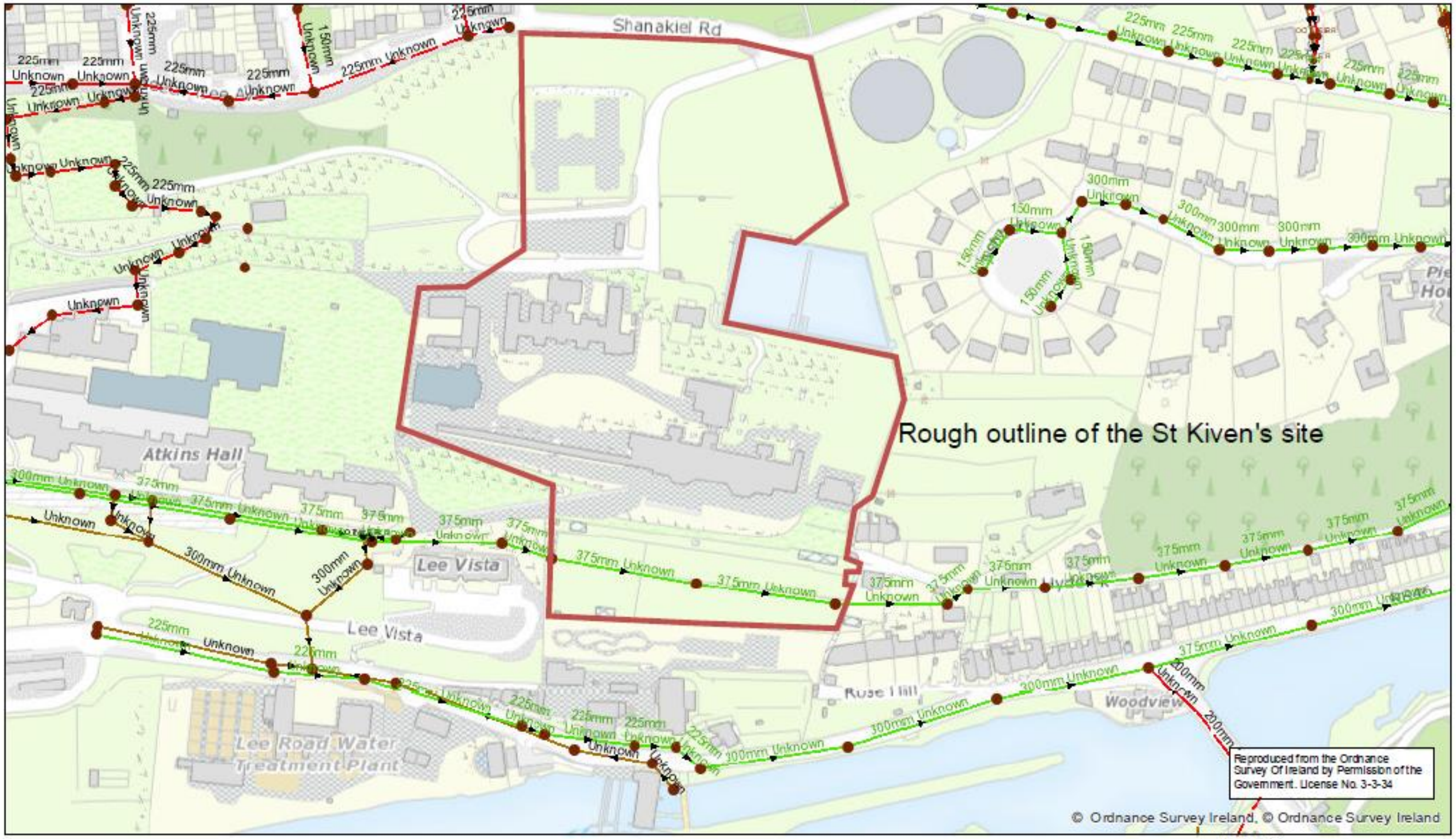
Appendix C – The mains that will be de-commissioned highlighted

Figure 4.1: Layout of the Existing Rising and Distribution Mains



Appendix D – Sewer Network

Irish Water Web Map



February 4, 2020

Legend

Sewer Discharge Points
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Sewer Clean Outs
- Rodding Eye
- Flushing Structure
- Other; Unknown
- Sewer Flow Control Valves
- Treatment plant
- Pump station

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

1:4,514

0 0.0375 0.075 0.15 mi

0 0.05 0.1 0.2 km

Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

UISCE ÉIREANN : IRISH WATER

Diversion Application form
Water and/or Wastewater diversions

This form should be completed by a person or organisation who wishes to apply to Irish Water for the diversion of a water and/or wastewater asset. Please use BLOCK CAPITALS and black ink when completing this form.

*** Denotes mandatory/required fields. Please note, if mandatory fields are not completed the diversion application will be returned.**

Section A | Applicant details

1 WPRN number (If known): –

2 *Applicant details:

Registered company name (if applicable): LAND DEVELOPMENT AGENCY

Trading name (if applicable):

Company registration number (if applicable):

If you are not a registered company/business, please provide the applicant's name:

*Contact name: ROBERT FARRELL

*Postal address: SECOND FLOOR
ASHFORD HOUSE
TARA STREET DUBLIN 2

Eircode: D02VX67

*Telephone: 00353191 03400

*Email: RFARELL@LDA.IE

3 Agent details (if applicable):

Contact name: PETER O'DWYER

Company name (if applicable): BARRETT MAHONY

Postal address: SANDWITH HOUSE
52-54 SANDWITH STREET LOWER
DUBLIN 2

Eircode: D02WR26

Telephone: 0035316773200

Email: PODWYER@BMCE.IE

4 ***Please indicate whether it is the applicant or the agent who should receive future correspondence in relation to the diversion application:**

Applicant ☐ Agent ☑

Section B | Site details for the proposed diversion

5 ***Site address:** ST. KEVINS HOSPITAL AND GROUNDS, SHANAKIEL COUNTY CORK

6 ***Irish Grid co-ordinates of site:** E(X) 165026 N(Y) 071661

E.g. co-ordinates of GPO, O'Connell St., Dublin: E(X) 315,878 N(Y)234,619

7 **Local Authority:**

Local Authority that granted planning permission (if applicable):

N/A

8 **Planning reference** (current reference and any previous planning reference that may be applicable):

ABP-307259-20

Note: Enter "EXEMPT" for exempted developments.

9 ***Confirmation of Land Ownership:**

Please confirm the name and address of the land owner where the diversion will be completed:

MY LAND

Note: Enter "My Land" if this is the case.

10 ***Are there potential contaminated land issues?** Yes ☐ No ☑

Section C | Diversion details

11 ***Type of Asset to be diverted?** Water main ☑ Wastewater Sewer ☐

12 **Material of Asset to be diverted?** Ductile Iron ☐ uPVC ☐ PE ☐ Cast Iron ☑ A/C ☐
Concrete ☐ Clay ☐ Brick ☐ Other ☐ **(If known)**

13 **Diameter of Asset to be diverted?** 6" ~~mm~~ **(If known)**

14 **Approximate length of diversion required?** 108m+309m **(If known)**

REFER TO BMCE DWG: 19305-BMD-ZZ-XX-DR-C-1010 ENCLOSED WITH THIS APPLICATION

15 **Approximate date diversion is required to commence:** 01 / 06 / 2021

IMPORTANT TO NOTE:

- If the site also requires a connection to the public water or wastewater infrastructure please ensure that the appropriate application is made in tandem with this Diversion application on https://www.water.ie/connections/get-connected/
- Irish Water retains the right to appoint a 3rd party checker to monitor the delivery of the diversion works if deemed necessary.
- Irish Water retains the right to appoint and manage the necessary designers and contractors to deliver the diversion works if deemed necessary.
- If the proposed diversion relates to a wastewater sewer and the proposal is acceptable to Irish Water, then a CCTV survey for the extent of existing wastewater sewer to be diverted maybe required prior to Irish Water entering into a diversion agreement and Irish Water will advise.
- Please submit all information set out in Section D – Supporting Documentation with the application including details of surveys carried out.

Section D | Supporting documentation

Please provide clear and legible versions of the following documents:

- *Site location map: A site location map to a scale of 1:1000, which clearly identifies the land or structure to which the diversion application relates. The map shall also include the following details: ✓
  - a) The scale shall be clearly indicated on the map. ✓
  - b) The site boundaries shall be delineated in red. ✓
  - c) Irish Grid site co-ordinates shall be marked on the site location map. ✓
  - d) Details of Planning Permission or Planning Exemption for the development (if applicable). ✓
  - e) Details of wayleaves, easements, covenants, etc. for pipework on the site. ✓

- *Site layout map: A site layout map to a scale of 1:500, which clearly identifies the land or structure to which the diversion application relates. The map shall also include the following details: ✓
  - f) The Irish water infrastructure you propose to abandon identified with a black cross. ✓
  - g) The line and invert level of the proposed diversion. ✓
  - h) Separation distances between the proposed diversion and infrastructure and structures on the site. ✓
  - i) Details of any easements or covenants which may affect the site. (if applicable) ✓
  - j) Topographical levels shown of the site. ✓

- *Two Longitudinal Sections - Existing and Proposed pipelines: The Longitudinal Sections shall include the following details: EXISTING WATERMAIN LEVELS UNKNOWN –
  - k) The line and invert level of the existing infrastructure on the site that is to be diverted. The line and invert level of the proposed diversion infrastructure. –
  - l) The line and level of any third party infrastructure that is within the proposed zone of influence and notifications in accordance with Irish Water's Codes of Practice and to demonstrate compliance with separation distance requirements in Irish Water's Codes of Practice. –
  - m) Existing Ground Level. –
  - n) Proposed Finished Ground Level. –
  - o) Any other information that might assist Irish Water to assess this diversion application. –

NOTE: ALL PROPOSED DIVERSIONS TO ACHIEVE MIN. 1.2M COVER.

NOTE: Irish Water reserves that right to request additional information from the applicant to assist the assessment of the diversion application.

Section E | Declaration

I/We hereby make this application to Irish Water for a water and/or wastewater diversion as detailed on this form.

I/We understand that any alterations made to this application must be declared to Irish Water.

The details that I/we have given with this application are accurate.

I/We have enclosed all the necessary supporting documentation.

Any personal data you provide will be stored and processed by Irish Water and may be transferred to third parties for the purposes of the water and/or wastewater diversion process. I hereby give consent to Irish Water to store and process my personal data and to transfer my personal data to third parties, if required, for the purposes of the diversion process.
Where the Land Owner details provided in Question 9 of Section B is not the Applicant, you, the Applicant, confirm that the Land Owner(s) has consented to you providing their personal data and to Irish Water collecting, using, transferring and disclosing the personal data as described in the Privacy Notice.
If you wish to revoke consent at any time or wish to see Irish Water's full Data Protection Notice, please see https://www.water.ie/privacy-notice/

Signature: Peter O'Dwyer   Date: 23/11/2020

Your full name (in BLOCK CAPITALS):

PETER O'DWYER

Irish Water will carry out a formal assessment based on the information provided on this form.

Any determination made by Irish Water will be based on the information that has been provided here.

Please submit the completed form to **diversions@water.ie**

For office use only:

Customer Number

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Robert Farrell
77 Sir John Rogersons Quay
Block C Grand Canal Docklands
Co. Dublin DO2NP08

4 December 2020

Re: Design Submission for St Kevins Hospital, 1 Rose Hill Upper, Co. Cork (the "Development")
(the "Design Submission") / Connection Reference No: CDS20000237

Dear Robert Farrell,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Alvaro Garcia
Email: agarcia@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

19305-BMD-ZZ-XX-DR-C-1000
19305-BMD-ZZ-XX-DR-C-1001
19305-BMD-ZZ-XX-DR-C-1010
19305-BMD-ZZ-XX-DR-C-1050
19305-BMD-ZZ-XX-DR-C-1052
19305-BMD-ZZ-XX-DR-C-1060
19305-BMD-ZZ-XX-DR-C-1100

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

CIVIL LEGEND

EX. FOUL MANHOLE	Ex.F	
EX. FOUL PIPE	PIPE DESCRIPTION	
NEW FOUL MANHOLE	F	
NEW FOUL PIPE (uPVC)	PIPE DESCRIPTION	
EX. SURFACE WATER MANHOLE	Ex.S	
EX. SURFACE WATER PIPE	PIPE DESCRIPTION	
NEW SURFACE WATER MANHOLE	S	
NEW SURFACE WATER PIPE	PIPE DESCRIPTION	
EX. COMBINED MANHOLE	Ex.C	
EX. COMBINED PIPE	PIPE DESCRIPTION	
FOUL INSPECTION CHAMBER		
ROAD GULLEY	RG	
SITE BOUNDARY		
I.W. WAYLEAVE FOR FUTURE SERVICES		

NOTES ON WASTEWATER DRAINAGE:

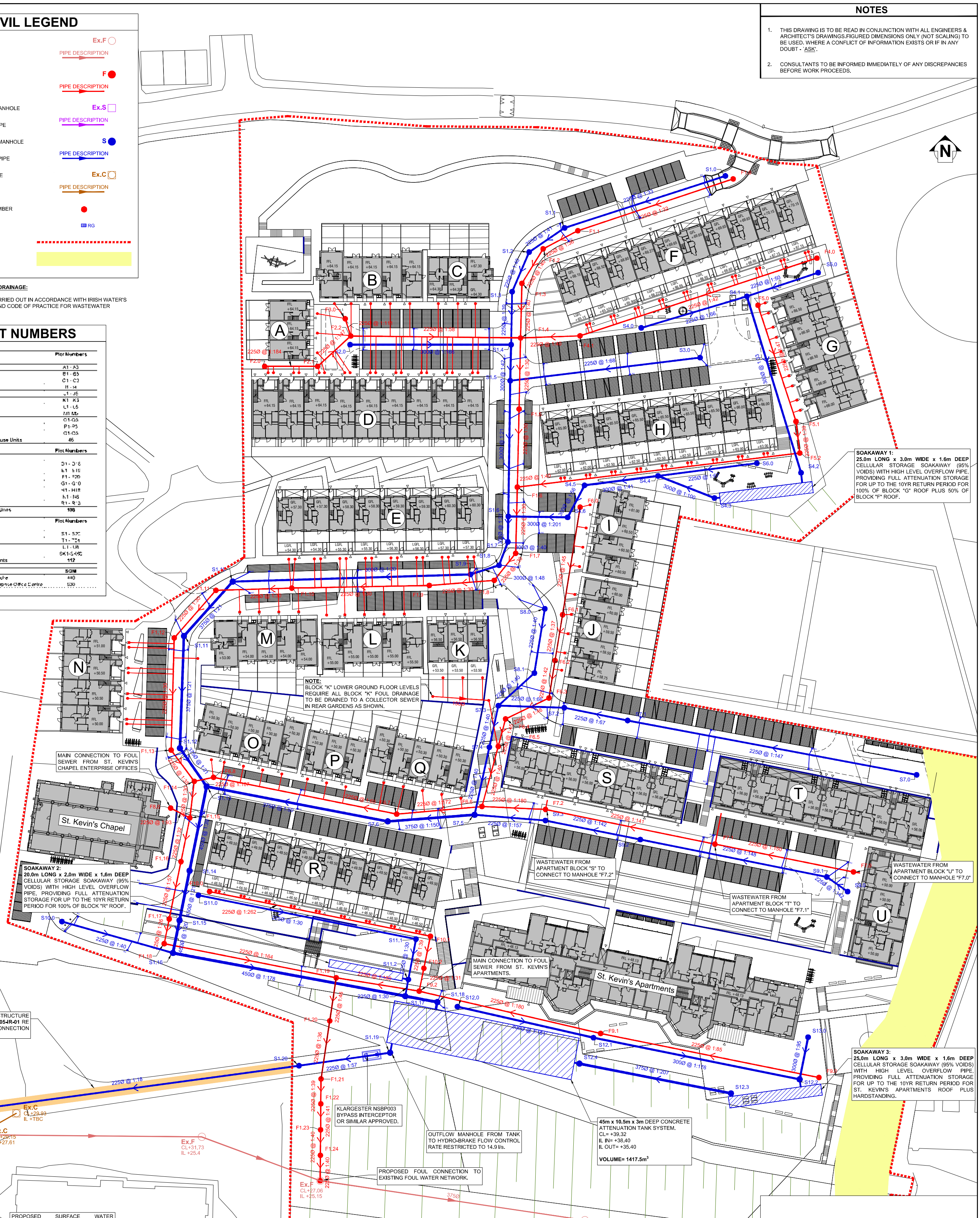
1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS AND CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE.

PLOT NUMBERS

Type	Plot Numbers
Townhouses	
Block A	A1 - A3
Block B	B1 - B5
Block C	C1 - C2
Block I	I1 - I4
Block J	J1 - J6
Block K	K1 - K3
Block L	L1 - L5
Block M	M1 - M5
Block O	O1 - O5
Block P	P1 - P3
Block Q	Q1 - Q5
Total no. of Townhouse Units	46
Type	**Plot Numbers**
Duplex Units	
Block D	D1 - D16
Block E	E1 - E16
Block F	F1 - F20
Block G	G1 - G10
Block H	H1 - H18
Block N	N1 - N8
Block R	R1 - R13
Total no. of Duplex Units	108
Type	**Plot Numbers**
Apartments	
Block S	S1 - S20
Block T	T1 - T24
Block U	U1 - U8
St Kevin' hospital	SK1-SK60
Total no. of Apartments	112
Non Residential	**SQM**
St Kevin' hospital Creche	440
St Kevin' Chapel Enterprise Office Centre	530

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.



PROPOSED DRAINAGE LAYOUT

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL4	03.12.20	ISSUED FOR I.W. SoDA	MJ / MJ	TMH / BM
PL3	27.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	POD / BM
PL2	23.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	POD / BM
PL1	21.04.20	ISSUED FOR PLANNING	MJ / MJ	TMH / BM

DRAWING STAGE
PLANNING

BM
BARRETT MAHONY
Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164
London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural . Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

CLIENT
LAND DEVELOPMENT AGENCY

PROJECT TITLE	BM PROJECT No.	
ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT	19305	
MODEL REFERENCE	MODEL REV.	SUITABILITY
19305-BMD-ZZ-XX-C3D-C-1000	P1	S0

DRAWING TITLE
PROPOSED DRAINAGE PLAN LAYOUT

DRAWING No. **19305-BMD-ZZ-XX-DR-C-1000** ISSUE **PL4**

NEW FOUL DRAINAGE MANHOLE

MANHOLE	COVER LEVEL	INVERT LEVEL	'E' EASTING	'N' NORTHING
Ex. F	+27.23	IN FROM F1.24: +25.76	564897.4630	571652.2610
F1.0	+71.29	OUT: +67.75	565008.1075	571920.5033
F1.1	+68.26	IN FROM F1.0: +66.40 OUT: +66.40	564966.4848	571906.6368
F1.2	+67.34	IN FROM F1.1: +66.11 OUT: +65.14	564957.1924	571901.7827
F1.3	+66.19	IN FROM F1.2: +64.86 OUT: +63.38	564951.5072	571892.5411
F1.4	+64.81	IN FROM F1.3: +63.02 IN FROM F2.2: +61.88 IN FROM F4.1: +62.82 OUT: +61.56	564951.1369	571877.9279
F1.5	+62.81	IN FROM F1.4: +60.92 OUT: +60.08	564950.7488	571858.8999
F1.6	+60.82	IN FROM F1.5: +59.38 IN FROM F5.2: +59.43 OUT: +58.24	564950.2808	571837.9812
F1.7	+59.07	IN FROM F1.6: +57.65 OUT: +57.09	564949.8255	571820.2584
F1.8	+58.22	IN FROM F1.7: +56.78 OUT: +55.95	564944.1104	571813.0281
F1.9	+56.82	IN FROM F1.8: +55.37 OUT: +54.12	564926.6944	571811.6581
F1.10	+54.35	IN FROM F1.9: +52.89 OUT: +52.00	564889.8678	571810.9453
F1.11	+52.78	IN FROM F1.10: +51.32 OUT: +50.37	564869.5455	571810.3507
F1.12	+51.26	IN FROM F1.11: +49.81 OUT: +48.84	564858.3775	571797.5974
F1.13	+49.30	IN FROM F1.12: +47.84 OUT: +47.22	564857.5457	571767.5806
F1.14	+48.67	IN FROM F1.13: +46.93 IN FROM F6.8: +45.82 OUT: +45.64	564863.7430	571759.2055
F1.15	+47.96	IN FROM F1.14: +45.31 IN FROM F8.0: +46.33 OUT: +45.31	564862.5728	571749.4205
F1.16	+47.16	IN FROM F1.15: +44.94 OUT: +43.10	564860.1805	571737.7248
F1.17	+44.08	IN FROM F1.16: +42.82 OUT: +41.36	564857.0372	571722.3567
F1.18	+43.24	IN FROM F1.17: +41.11 OUT: +40.02	564855.6869	571715.7551

NEW FOUL DRAINAGE MANHOLE

MANHOLE	COVER LEVEL	INVERT LEVEL	'E' EASTING	'N' NORTHING
F1.19	+41.40	IN FROM F1.18: +39.74 IN FROM F9.2: +38.83 OUT: +37.98	564901.7562	571706.6165
F1.20	+39.65	IN FROM F1.19: +37.72 OUT: +35.92	564900.0292	571695.0837
F1.21	+36.58	IN FROM F1.20: +35.48 OUT: +32.98	564897.7020	571679.5428
F1.22	+34.26	IN FROM F1.21: +32.81 OUT: +30.31	564897.6434	571672.8515
F1.23	+31.59	IN FROM F1.22: +30.14 OUT: +28.60	564897.5825	571665.9019
F1.24	+29.66	IN FROM F1.23: +28.43 OUT: +25.93	564897.5227	571659.0814
F2.0	+64.00	OUT: +62.78	564882.5945	571870.3173
F2.1	+64.00	IN FROM F2.0: +62.70 OUT: +62.70	564896.7836	571870.3052
F2.2	+64.05	IN FROM F3.0: +62.66 IN FROM F2.1: +62.62 OUT: +62.66	564905.6527	571878.4549
F3.0	+63.86	OUT: +62.70	564904.1741	571883.0637
F4.0	+67.00	OUT: +64.81	565030.5206	571899.2876
F4.1	+65.52	IN FROM F4.0: +63.22 OUT: +63.22	564967.0717	571878.4884
F5.0	+66.50	OUT: +63.08	565014.7337	571886.6817
F5.1	+65.00	IN FROM F5.0: +62.39 OUT: +62.39	565024.9294	571855.5495
F5.2	+63.68	IN FROM F5.1: +62.17 OUT: +61.35	565025.9484	571847.1102
F6.0	+60.85	OUT: +57.56	564967.1014	571832.6256
F6.1	+59.81	IN FROM F6.0: +56.91 OUT: +55.71	564962.3930	571803.8143
F6.2	+58.71	IN FROM F6.1: +55.37 OUT: +55.37	564960.3915	571791.5674
F6.3	+56.38	IN FROM F6.2: +55.13 OUT: +53.42	564958.7479	571781.5103
F6.4	+54.60	IN FROM F6.3: +53.14 OUT: +51.08	564947.1324	571775.9238

NEW FOUL DRAINAGE MANHOLE

MANHOLE	COVER LEVEL	INVERT LEVEL	'E' EASTING	'N' NORTHING
F6.5	+53.10	IN FROM F6.4: +50.92 OUT: +49.11	564945.1614	571768.5461
F6.6	+49.61	IN FROM F7.2: +48.07 IN FROM F6.5: +48.70 OUT: +47.93	564940.8045	571752.4620
F6.7	+49.73	IN FROM F6.6: +47.79 OUT: +47.79	564917.9634	571750.4307
F6.8	+48.58	IN FROM F6.7: +47.03 OUT: +45.87	564868.9023	571760.2823
F7.0	+49.85	OUT: +48.82	565040.3144	571734.9440
F7.1	+49.63	IN FROM F7.0: +48.57 OUT: +48.49	565003.2037	571742.4067
F7.2	+49.52	IN FROM F7.1: +48.17 OUT: +48.17	564957.8290	571751.6851
F8.0	+47.82	OUT: +46.39	564857.4097	571752.0465
F9.0	+41.72	OUT: +39.94	565031.0667	571679.9151
F9.1	+41.24	IN FROM F9.0: +39.23 OUT: +39.23	564972.5946	571691.7072
F9.2	+41.24	IN FROM F9.1: +38.96 IN FROM F10.2: +40.06 OUT: +38.96	564923.9939	571703.0352
F10.0	+46.35	OUT: +45.12	564867.8392	571729.7021
F10.1	+45.76	IN FROM F10.0: +44.89 OUT: +42.85	564927.0026	571717.7381
F10.2	+43.16	IN FROM F10.1: +42.63 OUT: +40.26	564925.2492	571709.1695

FOUL DRAINAGE SCHEDULE

SCALE @ A1: N.T.S.
SCALE @ A3: N.T.S.

NOTES

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ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL3	03.12.20	ISSUED FOR I.W. SoDA	MJ / MJ	TMH / BM
PL2	27.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	POD / BM
PL1	23.11.20	ISSUED FOR I.W. SoDA	NMM / MJ	TMH / BM

DRAWING STAGE **PLANNING**

BM
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CLIENT
LAND DEVELOPMENT AGENCY

PROJECT TITLE
ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT

BM PROJECT No. **19305**

MODEL REFERENCE **19305-BMD-ZZ-XX-C3D-C-1000** | MODEL REV. **P1** | SUITABILITY **S0**

DRAWING TITLE
FOUL DRAINAGE SCHEDULE

DRAWING No. **19305-BMD-ZZ-XX-DR-C-1001** | ISSUE **PL3**

CIVIL LEGEND

- WATERMAIN
- SLUICE VALVE — SV
- AIR VALVE — AV
- FIRE HYDRANT — H
- MAGNETIC FLOW WATER METER — M
- BOUNDARY BOX
- SITE BOUNDARY
- I.W. WAYLEAVE FOR FUTURE SERVICES
- EXISTING IRISH WATER ASSET TO BE DIVERTED/DECOMMISSIONED BY DEVELOPER HIGHLIGHTED THUS
- EXISTING IRISH WATER ASSET TO BE DIVERTED/DECOMMISSIONED BY IRISH WATER HIGHLIGHTED THUS

NOTES ON WATERMAIN:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS AND CODE OF PRACTICE FOR WATER INFRASTRUCTURE.

NOTES

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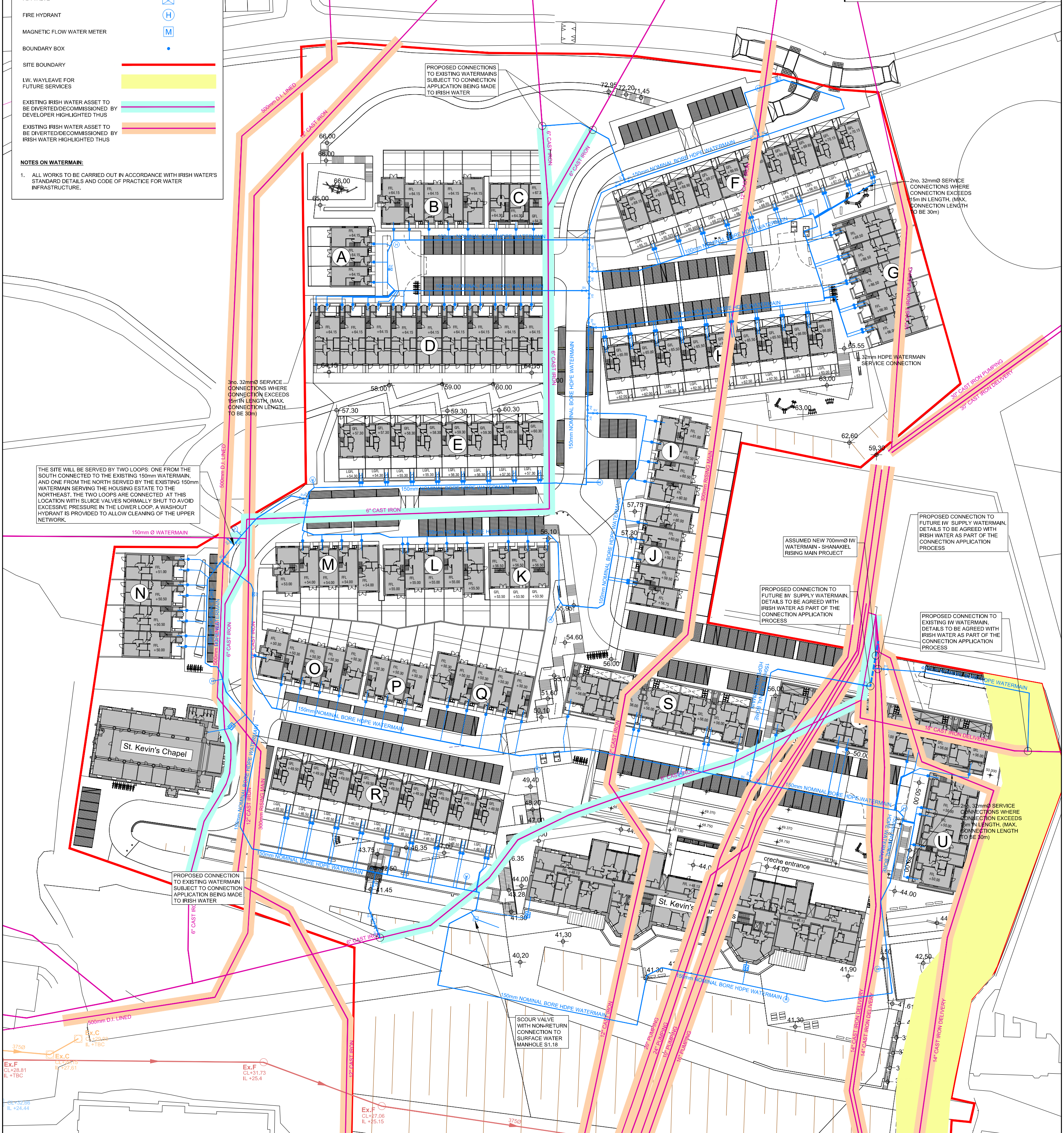

PLOT NUMBERS

Type	Plot Numbers
Townhouses	
Block A	A1 - A3
Block B	B1 - B5
Block C	C1 - C3
Block I	I1 - I4
Block J	J1 - J5
Block K	K1 - K3
Block L	L1 - L5
Block M	M1 - M5
Block O	O1 - O5
Block P	P1 - P3
Block Q	Q1 - Q5
Total no. of Townhouse Units	46
Type	**Plot Numbers**
Duplex Units	
Block D	D1 - D16
Block E	E1 - E15
Block F	F1 - F20
Block G	G1 - G10
Block H	H1 - H18
Block N	N1 - N9
Block R	R1 - R13
Total no. of Duplex Units	108
Type	**Plot Numbers**
Apartments	
Block S	S1 - S20
Block T	T1 - T24
Block U	U1 - U8
St Kevin' Hospital	SK1-SK60
Total no. of Apartments	112
Non Residential	**SQM**
St Kevin' Hospital Creche	440
St Kevin' Chapel Enterprise Office Centre	630

PROPOSED WATERMAIN LAYOUT

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL5	03.12.20	ISSUED FOR I.W. SoDA	NMM / MJ	TMH / BM
PL4	01.12.20	ISSUED FOR I.W. SoDA	NMM / MJ	TMH / BM
PL3	23.11.20	ISSUED FOR I.W. SoDA	NMM / MJ	TMH / BM
PL2	28.10.20	ISSUED FOR COMMENT	NMM / MJ	TMH / BM
PL1	29.04.20	ISSUED FOR PLANNING	NMM / MJ	TMH / BM

DRAWING STAGE **PLANNING**

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LAND DEVELOPMENT AGENCY

PROJECT TITLE	BM PROJECT No.
ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT	19305

MODEL REFERENCE	MODEL REV.	SUITABILITY
19305-BMD-ZZ-XX-DR-C-1010	P1	S0

DRAWING TITLE
PROPOSED WATERMAIN LAYOUT

DRAWING No.	ISSUE
19305-BMD-ZZ-XX-DR-C-1010	PL5

NOTES

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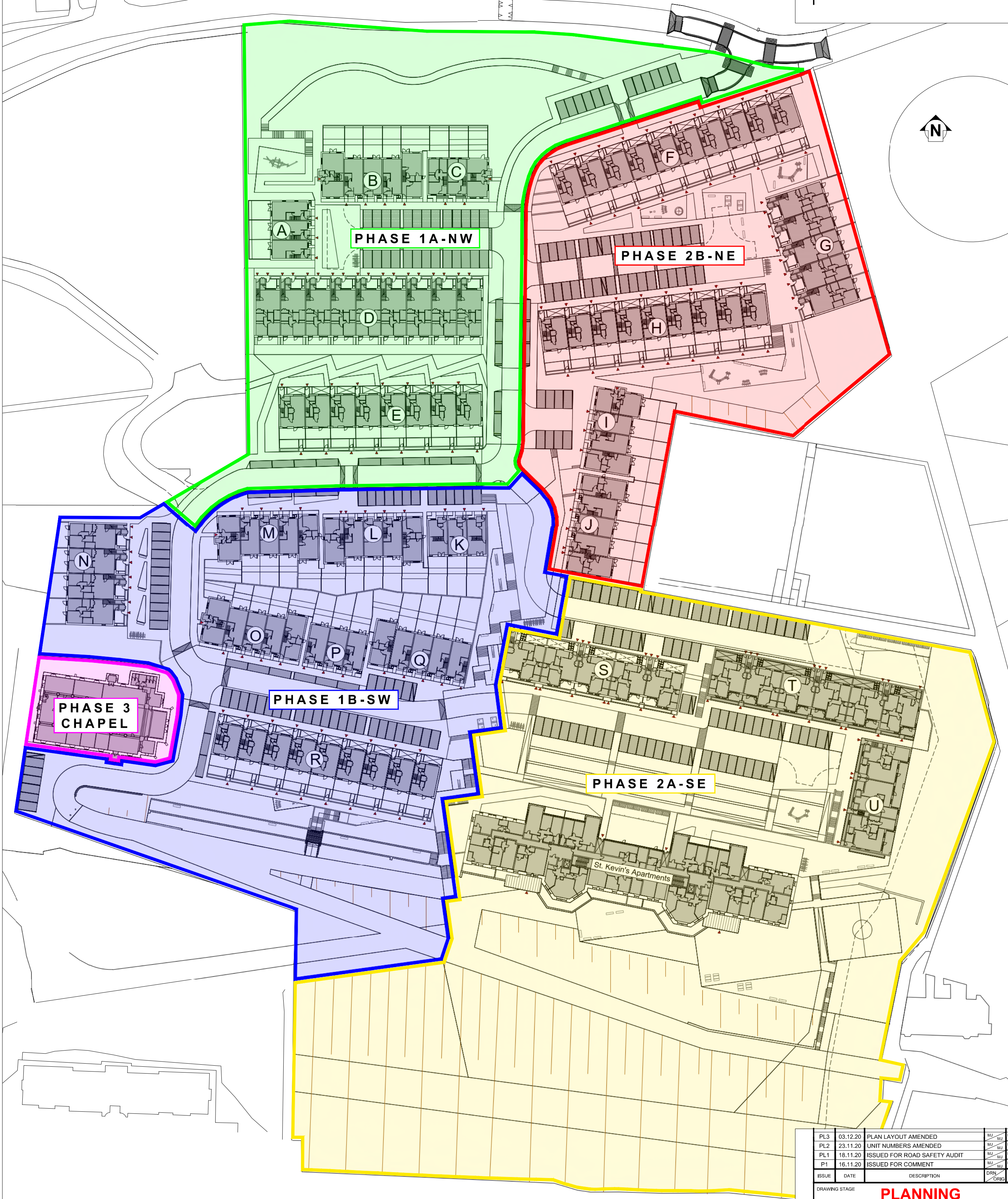

PHASE	NO. OF DWELLING UNITS
PHASE 1A-NW	45no. UNITS
PHASE 1B-SW	52no. UNITS
PHASE 2A-SE	112no. UNITS
PHASE 2B-NE	57no. UNITS
PHASE 3	ENTERPRISE OFFICE CENTRE (630sq.m)

PROPOSED PHASING PLAN

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL3	03.12.20	PLAN LAYOUT AMENDED	MJ / MJ	POD / BM
PL2	23.11.20	UNIT NUMBERS AMENDED	MJ / MJ	POD / BM
PL1	18.11.20	ISSUED FOR ROAD SAFETY AUDIT	MJ / MJ	POD / BM
P1	16.11.20	ISSUED FOR COMMENT	MJ / MJ	POD / BM

DRAWING STAGE
PLANNING

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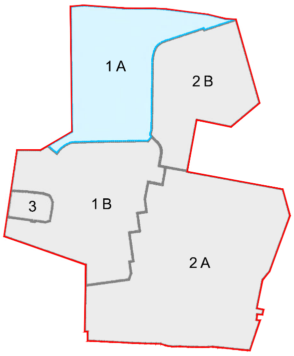
PROJECT TITLE	BM PROJECT No.	
ST. KEVINS, SHANAKIEL, CORK	19305	
MODEL REFERENCE	MODEL REV.	SUITABILITY
19305-BMD-ZZ-XX-DR-C-1050	P1	S0

DRAWING TITLE
PROPOSED PHASING PLAN

DRAWING No. 19305-BMD-ZZ-XX-DR-C-1050
ISSUE PL3



SHD PHASING KEYPLAN

SCALE @ A1: 1:2500
SCALE @ A3: 1:5000

NOTES

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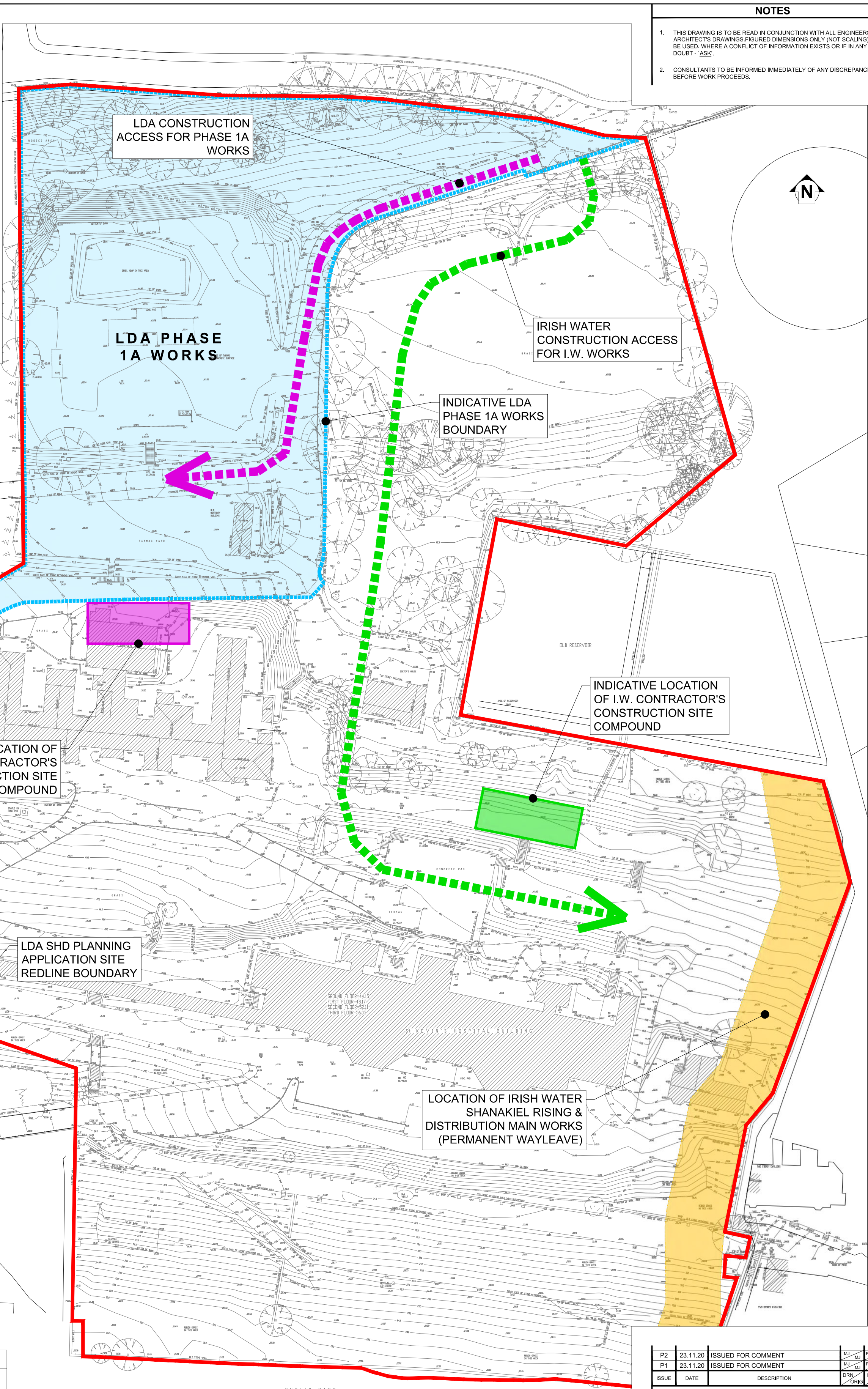

LEGEND

	LDA SHD PLANNING APPLICATION SITE REDLINE BOUNDARY
	INDICATIVE LDA PHASE 1A WORKS BOUNDARY
	PROPOSED LDA PHASE 1A WORKS AREA
	LDA CONSTRUCTION ACCESS FOR PHASE 1A WORKS
	INDICATIVE LOCATION OF LDA CONTRACTOR'S CONSTRUCTION SITE COMPOUND
	IRISH WATER CONSTRUCTION ACCESS FOR I.W. WORKS
	INDICATIVE LOCATION OF I.W. CONTRACTOR'S CONSTRUCTION SITE COMPOUND
	LOCATION OF IRISH WATER SHANAKIEL RISING & DISTRIBUTION MAIN WORKS

PROPOSED CONSTRUCTION ACCESS ARRANGEMENTS FOR SIMULTANEOUS LDA & IW WORKS

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
P2	23.11.20	ISSUED FOR COMMENT	MJ / MJ	POD / BM
P1	23.11.20	ISSUED FOR COMMENT	MJ / MJ	POD / BM

DRAWING STAGE **FOR INFORMATION**

BM BARRETT MAHONY

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PROJECT TITLE	BM PROJECT No.
ST. KEVINS, SHANAKIEL, CORK	**19305**

MODEL REFERENCE	MODEL REV.	SUITABILITY
19305-BMD-ZZ-XX-DR-C-1052	P1	S0

DRAWING TITLE
PROPOSED CONSTRUCTION ACCESS ARRANGEMENTS FOR SIMULTANEOUS LDA & IW WORKS

DRAWING No.	ISSUE
19305-BMD-ZZ-XX-DR-C-1052	**P2**

NOTES

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SITE LOCATION MAP

SCALE @ A1: 1:1000
SCALE @ A3: 1:2000

ISSUE	DATE	DESCRIPTION	DRN / NMM	ORIG / MJ	P.E. / TMH	P.D. / BM
PL1	23.11.20	ISSUED FOR I.W. SoDA				

DRAWING STAGE **PLANNING**

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PROJECT TITLE
ST. KEVINS, SHANAKIEL, CORK

BM PROJECT No.
19305

MODEL REFERENCE
19305-BMD-ZZ-XX-DR-C-1060

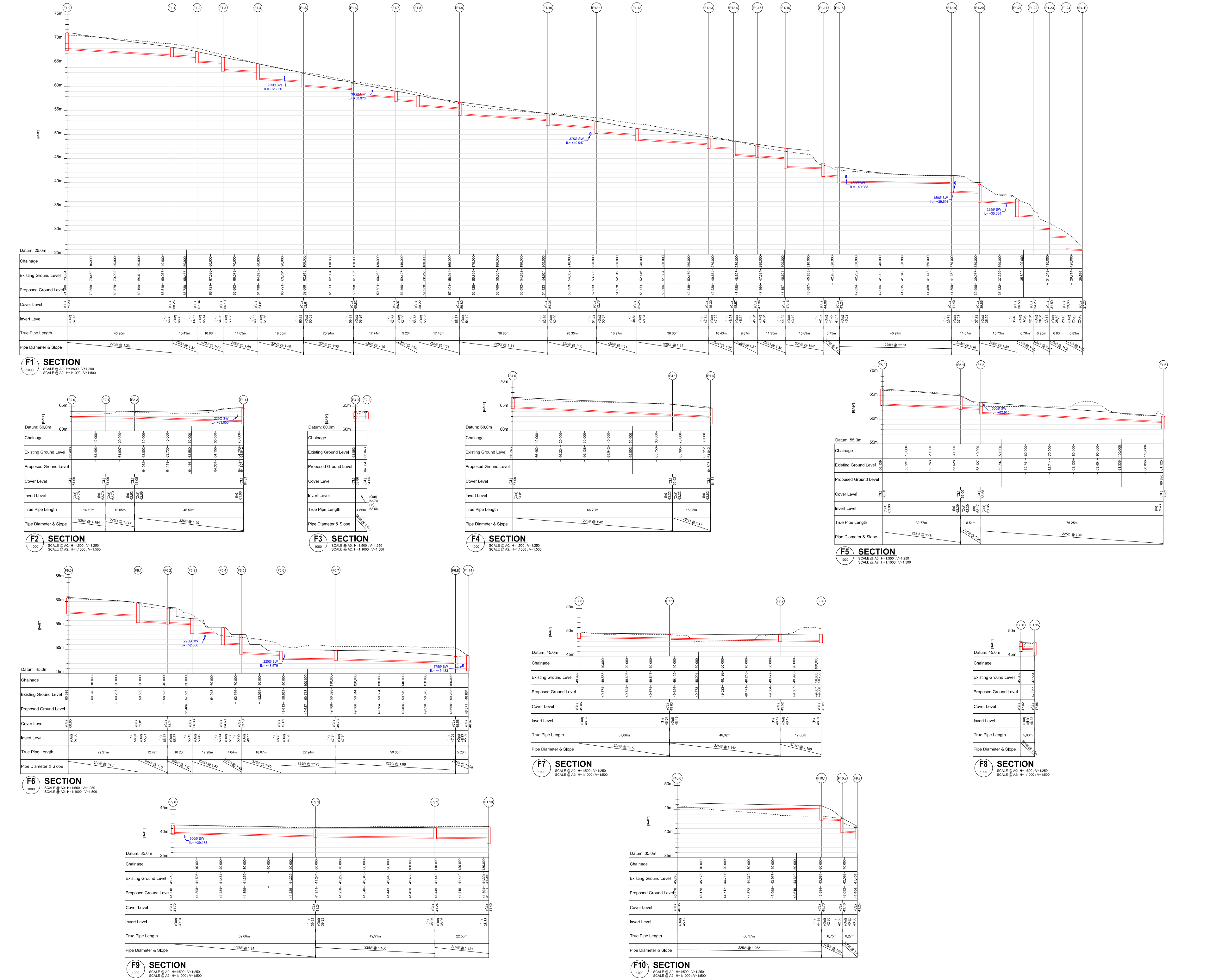
MODEL REV. P1

SUITABILITY S0

DRAWING TITLE
SITE LOCATION MAP

DRAWING No.
19305-BMD-ZZ-XX-DR-C-1060

ISSUE PL1



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PL3	03.12.20	ISSUED FOR I.W. SoDA	MJ / MJ	TMH / BM
PL2	23.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	TMH / BM
PL1	10.11.20	ISSUED FOR PLANNING	MJ / MJ	TMH / BM

DRAWING STAGE
PLANNING

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PROJECT TITLE
ST. KEVIN'S STRATEGIC HOUSING DEVELOPMENT

BM PROJECT No.
19305

MODEL REFERENCE
19305-BMD-ZZ-XX-C3D-C-1000

MODEL REV. **P1**
SUITABILITY **S0**

DRAWING TITLE
FOUL DRAINAGE LONG SECTIONS

DRAWING No.
19305-BMD-ZZ-XX-DR-C-1101

ISSUE **PL3**

APPENDIX V: Stage 1 Road Safety Audit

- Audit Report & Signed Feedback Form

St Kevin’s Strategic Housing Development

At the former St. Kevin’s Hospital and Grounds, Shanakiel, Cork

Proposed Residential Development

Client: Land Development Agency

Stage 1 Road Safety Audit - Final

RSA STKEVINS S1 KS 312 December 2020

ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT

AT THE FORMER ST. KEVIN'S HOSPITAL AND GROUNDS, SHANAKIEL, CORK

PROPOSED RESIDENTIAL DEVELOPMENT

Description:

Stage 1 Road Safety Audit - Final

Author:

Ken Swaby

Francis Fidgeon

Audit Brief Submitted By:

Barrett Mahony Consulting Engineers

Distribution:

Barrett Mahony Consulting Engineers

1 AUDIT INFORMATION

1.1 Title RSA STKEVINS S1

1.2 **Audit Reference Number** RSA STKEVINS S1 KS 312

1.3 Project Code STKEVINS

1.4 Date Audit Completed 7th December 2020

1.5 Audit Team

Team Leader Ken Swaby, ILTP

Team Member Francis Fidgeon, CST Group

1.6 Audit Attended By

Team Leader Ken Swaby

Team Member Francis Fidgeon

1.7 Information Received

ITEM		Supplied	Comments
A	Plans	Yes	Barrett Mahony Consulting Engineers Drawings: 19305-BMD-ZZ-XX-DR-C-1020, rev. PL2 - Proposed Roads Plan Layout 19305-BMD-ZZ-XX-DR-C-1021, rev. PL2 - Proposed Signage & Road Markings 19305-BMD-ZZ-XX-DR-C-1022, rev. PL2 - Proposed Entrance Junction Plan Layout 19305-BMD-ZZ-XX-DR-C-1023, rev. PL2 - Vehicle Tracking Assessment - Fire Tender 19305-BMD-ZZ-XX-DR-C-1024, rev. PL2 - Vehicle Tracking Assessment - Refuse Vehicle 19305-BMD-ZZ-XX-DR-C-1025, rev. PL2 - Sightlines Assessment at Entrance Junction 19305-BMD-ZZ-XX-DR-C-1050, rev. PL1 - Proposed Phasing Plan 19305-BMD-ZZ-XX-DR-C-1051, rev. PL2 - Pedestrian and Cyclist Accessibility & Connectivity Plan Layout AECOM Landscape Architect Drawings: 60619639-SHT-20-L-1000 - Landscape Framework Plan 60619639-SHT-20-L-1001, rev. 1 - Detail Area Plan 1/3 60619639-SHT-20-L-1002, rev. 1 - Detail Area Plan 2/3 60619639-SHT-20-L-1003, rev. 1 - Detail Area Plan 3/3
B	Traffic Count Data	No	
C	Speed Count Data	No	
D	Accident Data	No	
E	Design Standards	No	

ITEM		Supplied	Comments
F	Design Brief	No	
G	Other Data	No	

2 INTRODUCTION

2.1.1 This is a Stage 1 Road Safety Audit which examines the road safety implications of the proposed St Kevin's Strategic Housing Development, Shanakiel, Cork, and its connection to the wider road network.

2.1.2 The extent of this audit is the proposed residential development, the proposed new junction to Beechtree Avenue at the northern side of the development site and the approaches to the junction.

2.1.3 The audit is based upon drawings provided by the design team, as included above under paragraph 1.7.

2.1.4 The Feedback Form for this audit is included in **Appendix A** of this report.

2.1.5 This Stage 1 Road Safety Audit has been conducted in accordance with the Transport Infrastructure Ireland publications;

- Road Safety Audit, GE-STY-01024, December 2017,
- Road Safety Audit Guidelines, GE-STY-01027, December 2017

2.1.6 A site visit was carried out by Francis Fidgeon on 23rd October 2020 at approximately 16:00 in daylight conditions. The weather was fine and dry. A site visit was carried out by Ken Swaby on 30th October 2020 at approximately 14:30. The weather was fine and dry.

2.1.7 This audit specifically examines the road safety aspects of the proposed development. It is not an appraisal of policy or strategic issues associated with the planning of the development and it does not examine or verify the compliance of the design to any other design criteria or guidelines. The designer and all concerned stakeholders must therefore defend all actions taken on the basis that such care was taken, as was in all circumstances reasonably required, to ensure that the roadway was not unsafe for road users. It is important, therefore that where possible the recommendations in this report are acted upon.

3 ITEMS RESULTING FROM PREVIOUS ROAD SAFETY AUDITS

The audit team is not aware of any previous Road Safety Audits that may have been completed for these proposals, or this site.

4 ITEMS RESULTING FROM STAGE 1 ROAD SAFETY AUDIT

4.1 Gradient of Beechtree Avenue near proposed junction

Problem

The gradient of Beechtree Avenue near the proposed main access junction is steep and may not allow eastbound motorists travelling downhill on Beechtree Avenue to safely slow down, yield or come to a stop within the junction. This will be more of an issue in snow/frost conditions. Collisions such as rear-end collisions may occur.

Recommendation

Relocate the junction east where the existing Beechtree Avenue gradient is shallower. Ensure appropriately shallow gradients through and approaching the junction to facilitate safe movements by all road users.

Alternatively, if the junction is to remain in the location currently proposed, regrade / realign Beechtree Avenue to ensure appropriately shallow gradients through and approaching the junction to facilitate safe movements by all road users. Ensure that this does not result in existing steep gradients on any section of Beechtree Avenue becoming steeper.

4.2 Junction visibility at Beechtree Avenue

Problem

At the proposed main access junction visibility to the left for motorists exiting the proposed development is limited, with a 2-metre setback distance from the carriageway used for visibility splays. This may result in some vehicles protruding beyond the carriageway edge to gain visibility and crossing the path of traffic approaching from the right and sideswipe collisions. In addition, the 45-metre visibility length to the left may not be sufficient due to the steep approach gradient on Beechtree Avenue, particularly during wintry conditions.

Recommendation

Provide additional setback and sufficient visibility.

4.3 Junction visibility at Beechtree Avenue – future vegetation overgrowth

Problem

Further to Item 4.2 above, at the proposed main access junction visibility to the left for motorists exiting the proposed development may be further reduced in future by foliage overgrowth. This may lead to vehicles emerging into the path of oncoming traffic.

Recommendation

Ensure that the proposed roadside boundary treatment can be safely maintained to an extent that the required visibility along Beechtree Avenue is not obstructed by vegetation.

It is further recommended that the design team liaises with the local authority to ensure that appropriate roadside maintenance procedures are in place so that the required visibility along Beechtree Avenue is not obstructed by vegetation.

4.4 Visibility at proposed pedestrian crossing on Beechtree Avenue

Problem

Pedestrians crossing at the western crossing of the proposed main access junction from the northern side of Beechtree Avenue may have limited visibility to approaching traffic from Shanakiel Road and vice versa due to the horizontal alignment and existing wall to the northern side. Pedestrians may cross into the path of oncoming traffic.

Recommendation

Ensure adequate visibility is provided at all proposed pedestrian crossing locations.

4.5 Potential visibility restrictions due to alignment, existing wall and planting

Problem

At the bend in Beechtree Avenue immediately east of the proposed main development access junction the forward visibility for traffic travelling from Shanakiel Road to opposing traffic travelling from the Beechtree Avenue residential estate and vice versa appears limited due to the horizontal alignment and existing wall to the northern side. The proposed trees to the northern side of Beechtree Avenue in the vicinity of the proposed junction may further obscure forward visibility for motorists. Inadequate forward visibility may result in head-on collisions.

Furthermore, visibility for pedestrians crossing from the northern side of Beechtree Avenue to approaching traffic from both directions and vice versa may be obscured due to the proposed trees. Pedestrians may cross into the path of oncoming traffic.

Recommendation

Ensure adequate visibility is provided for road users in the vicinity of the proposed access junction.

Ensure the proposed roadside treatment does not obscure visibility for road users in the vicinity of the proposed access junction.

4.6 Traffic calming deflections

Problem

The proposed traffic calming measures at the approaches to the proposed main access junction appear to require road users to navigate horizontal and vertical deflections simultaneously. This may lead to motorists or cyclists approaching the junction misjudging the deflections and losing control resulting in collisions such as head-on collisions.

Recommendation

Provide adequate separation between vertical and horizontal deflections.

4.7 Priority may be unclear and road width/alignment may be misjudged at Traffic Calming Pinch-Points

Problem

In the vicinity of the proposed main development access junction, it may be unclear to motorists at the proposed pinch-points, which are reduced to 4 metres in width by an equal amount on both sides, if they are to yield to opposing traffic or attempt to progress through the pinch-points simultaneous to opposing traffic.

Furthermore, road users that attempt to progress through the pinch-points simultaneous to opposing traffic may misjudge the available road width or their alignment and collide with opposing traffic or mount kerbs / overrun footpaths.

Recommendation

Ensure the configuration of the proposed road narrowing through the junction is appropriate and where vehicles are required to yield to opposing traffic ensure priority is clear for road users.

4.8 Sharp bend in access road in immediate vicinity of main development access junction

Problem

The layout at the proposed main development access junction results in a sharp bend in the development access road immediately adjacent to Beechtree Avenue to cater for the skew angle between the access road and Beechtree Avenue. This sharp bend, in such close proximity to the main access junction, could result in traffic entering the development and taking the line of least resistance in the absence of opposing traffic and crossing the centreline. Complacency could result in traffic entering and unexpectantly encountering an exiting vehicle, and head-on collision. This is compounded by the narrow carriageway at this location.

Recommendation

Redesign the layout without a sharp bend in close proximity to the main access junction. Ensure the design is appropriate to deter motorists from adopting inappropriate alignments at this location.

4.9 Steep gradients of footpaths and roads within proposed development site

Problem

The drawings provided for audit show some footpaths and roads within the proposed development site having steep gradients. Steeper gradients may lead to slips or loss-of-control type collisions for non-motorised users or loss-of-control type collisions for motorists, particularly during adverse weather conditions. Furthermore, steep footpaths may lead to wheelchair users becoming tired and losing control.

At junctions, minor roads with steeper uphill gradients could result in vehicles rolling back into 2-wheeled users or stalling immediately after take-off and sideswipe collisions.

Recommendation

Ensure that footpaths and roads within the proposed development site have appropriately shallow gradients to facilitate safe access by the relevant road users.

Provide adequate safe facilities for wheelchair users.

4.10 Location of pedestrian crossing on development access road at Beechtree Avenue

Problem

The proposed main development access junction layout may require a vehicle exiting the development to stop across the pedestrian crossing of the southern arm to gain visibility. Non-motorised users crossing at this location may be blocked and may attempt to reroute across the carriageway at an inappropriate location and be struck. Furthermore, as the exit lane is on a gradient the exiting vehicle may inadvertently roll back into the path of a pedestrian crossing behind.

Recommendation

Relocate the pedestrian crossing of the southern arm of the junction further to the south to an appropriately safe location. Ensure the safety of the pedestrian crossing is not adversely affected by the proximity of the horizontal and vertical deflection treatments in this area.

4.11 Vehicle swept path assessments

Problem

Some vehicle swept path assessments have been submitted for audit. Those submitted show refuse vehicles crossing footpaths in some areas, including in the vicinity of St. Kevin's Chapel, Block G and Block U when performing turnabout manoeuvres. Pedestrians may be struck.

Recommendation

Ensure that the facilities proposed are appropriate for all relevant vehicles to safely navigate the site, including junctions, and perform turnabout manoeuvres within the confines of the carriageway.

4.12 Restricted forward visibility due to parking

Problem

Some parking bays, particularly those on bends in the alignment, may obstruct forward visibility when occupied. This may lead to traffic progressing without appropriate knowledge of other road users or hazards in the carriageway. An example is shown in Figure 1 below.

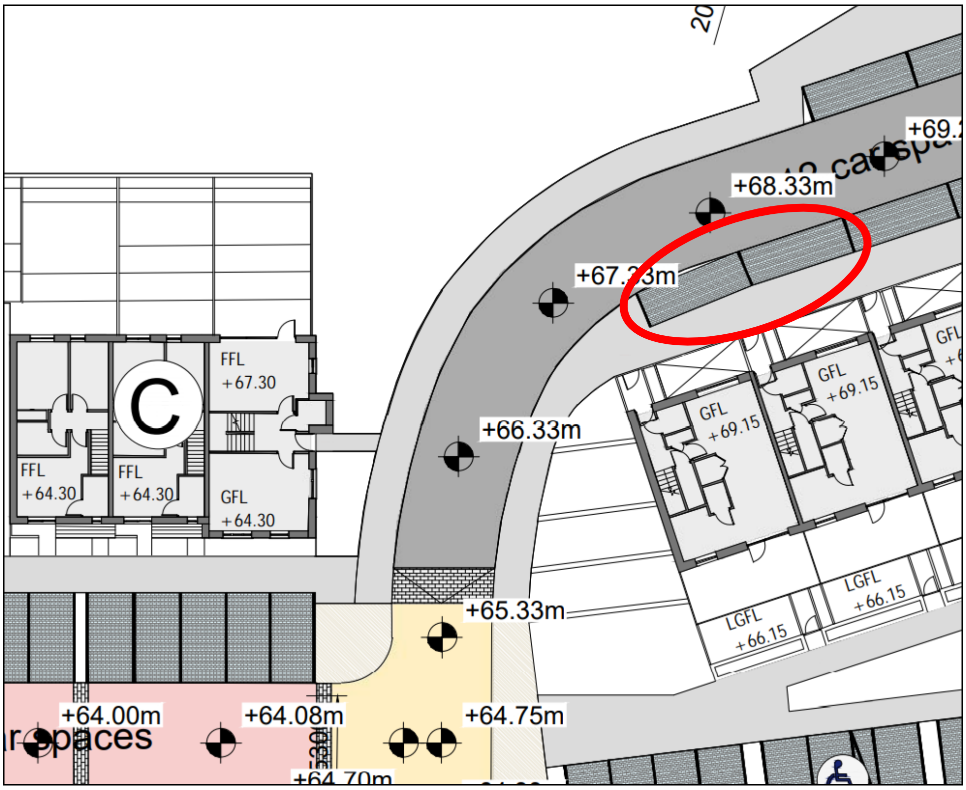

Figure 1: Parking Bay on Bend in Alignment

Recommendation

Ensure that adequate forward visibility can be maintained with all roadside features fully occupied.

4.13 Restricted visibility for parking

Problem

Some parking bays, particularly those on bends in the alignment, may have reduced visibility to oncoming traffic when attempting to access or egress the parking bay. This may lead to vehicles emerging into the path of oncoming traffic. An example is shown in Figure 1 above.

Recommendation

Ensure that adequate visibility can be attained when using all parking facilities within the site.

4.14 Junction visibility near St. Kevin's Chapel

Problem

For traffic yielding at the southern arm of the junction in the vicinity of St. Kevin's Chapel, occupied parking bays, some of which are shown in Figure 2, may obstruct the visibility splay to the right. This may lead to vehicles emerging into the path of oncoming traffic.

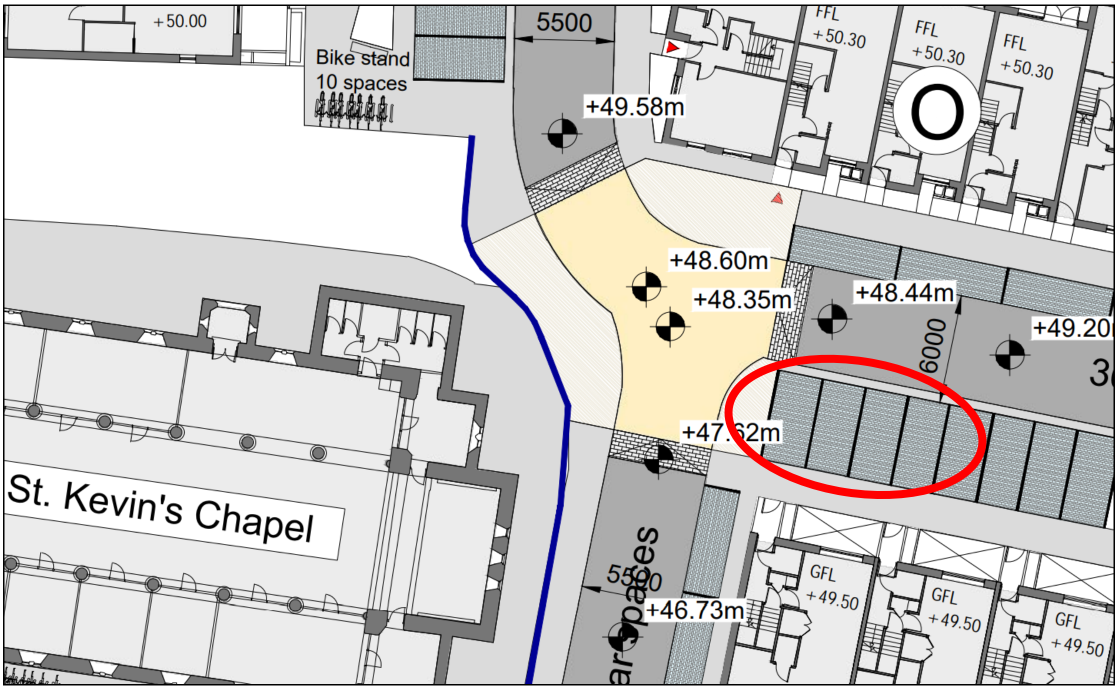

Figure 2: Occupied Parking Bays may Obstruct Visibility Splay

Recommendation

Ensure that adequate junction visibility can be maintained with all roadside features fully occupied.

4.15 Visibility restrictions due to planting

Problem

Planting may obstruct forward visibility on bends and visibility splays at junctions, for example at the junctions shown in Figure 3. This may lead to traffic progressing without appropriate knowledge of other road users or hazards in the carriageway and result in collision.

Figure 3: Planting may Obstruct Visibility Splays at Junctions

Recommendation

Ensure that adequate forward visibility can be maintained with all landscaping at its anticipated maximum growth, and that appropriate visibility can be maintained from all junction accesses.

4.16 Location, nature and extent of Shared Areas and Homezones

Problem

The location and extent of Shared Areas and Homezones are unclear from the drawings provided for audit. In addition, the engineering and landscape architecture drawings submitted show some inconsistencies in the location and extent of Shared Areas and Homezones. For example, an area north of Block T is labelled as both ‘In-Situ Concrete Footpath’ and ‘Hammerhead’ on different drawings. An area west of Block G is also labelled as both ‘In-Situ Concrete Footpath’ and ‘Homezone’ on different drawings.

It is also unclear from the information provided for audit if the proposed Shared Areas and Homezones have appropriate features, surface treatments and signage to clearly distinguish the shared facilities from other parts of the proposed road network and to clearly indicate the nature and extent of the shared facilities to all road users, including visually impaired users. This may lead to road users misinterpreting the shared nature of the facilities and result in collisions, such as pedestrian-vehicle collisions.

Recommendation

Ensure that Shared Areas and Homezones are appropriately designed, including with appropriate features, surface treatments and signage, to clearly distinguish the shared facilities from other parts of the proposed road network and to clearly indicate the nature and extent of the shared facilities to all road users, including visually impaired users.

It is recommended that the Shared Area and Homezone designs are consistent on design drawings and are subject to a Stage 2 Road Safety Audit at detailed design stage.

4.17 Yield control at main access

Problem

The form of junction priority proposed for the main development access junction is a yield arrangement. This may lead to motorists failing to stop appropriately for mainline traffic and trying to merge with them and result in sideswipe collision.

Recommendation

Provide STOP control.

4.18 Parallel parking on steep gradients

Problem

The proposals include parallel car parking spaces located on steep gradients. This may lead to vehicles inadvertently rolling into other road users, including when motorists are accessing or egressing these car parking spaces.

Recommendation

Relocate parallel car parking from locations where steep gradients remain.

Where parallel car parking spaces are to be provided, locate them on appropriately shallow gradients.

4.19 Parking on northern side of main access road

Problem

5 parking spaces are proposed to the northern side of the main access road in proximity to Beechtree Avenue. Users will have to cross the main access road to reach the buildings and are at greater risk of being struck, particularly as this is close to the main development junction and may have a large volume of traffic.

Furthermore, traffic accessing the spaces immediately on arriving at the development may have to wait for exiting traffic to clear and be rear-ended by following estate traffic not expecting the vehicle in front to stop immediately after entering the development.

Recommendation

Relocate the parking from the northern side of the main development access road.

4.20 Parking on main access road immediately after entering the estate

Problem

The parallel car parking immediately after entry to the estate does not have a turn-around area nearby. Motorists may decide to turn within the carriageway. The carriageway is only 5.5 metres wide and may result in several reversing manoeuvres. In addition, this location is close to the main development access junction and may also have a large volume of traffic. Traffic waiting to pass may mean turners make an erratic movement and reverse into other road users such as pedestrians. Otherwise parkers may travel to the nearest junction to change direction and collide with road users such as pedestrians during their manoeuvring.

Furthermore, these parallel car parking spaces are located on steep gradients, which appear to be up to 10%. This may lead to vehicles inadvertently rolling into other road users, including when motorists are accessing or egressing these car parking spaces.

Recommendation

Relocate the parallel parking to a location where safe turning is provided and there is an appropriately shallow gradient.

Alternatively, if parking is to be provided in this area on the main development access road relocate the parking from the immediate vicinity of the main access junction, provide safe turning for parkers and provide appropriately shallow gradients for parallel parking.

4.21 Parking on main access road in immediate vicinity of ramp and carriageway narrowing

Problem

The proposals include car parking located on the main development access road in the immediate vicinity of the proposed ramp and carriageway narrowing treatments to the south of the main development access junction. Vehicles entering the estate waiting for vehicles to access or egress this parking may have to stop across the ramp and/or within the narrowed section of carriageway. This may lead to them inadvertently rolling off the ramp and colliding with the vehicle accessing / egressing the parking. In addition, motorists may feel uncomfortable in stopping within the narrowed section of carriageway and may hastily attempt to progress through this section of road into the estate and collide with the vehicle accessing / egressing the parking.

Recommendation

Relocate the parking from the vicinity of the ramp and carriageway narrowing treatments.

4.22 Phasing

Problem

Phase 1 is proposed without a turning head. Larger vehicles would have to reverse over long distances and turn in parking areas. This may lead to collision with pedestrians/cyclists/other vehicles which could result in injury.

Recommendation

Ensure all phasing is reviewed to include appropriate temporary turning areas if required.

4.23 Drainage

Problem

Some roads/areas have no longitudinal fall. No drainage proposals have been presented for audit. Ponding/flooding could result in motorists taking evasive action and travelling unexpectantly to the opposite side and head-on collision. Furthermore, ice could form on ponded areas and present a slip hazard.

Recommendation

Ensure adequate drainage is provided throughout.

4.24 No details of dropped kerb / tactile paving pedestrian crossing facilities

Problem

With the exception of the proposed main development access junction, dropped kerb / tactile paving pedestrian crossing facilities within the proposed development site do not appear to be shown on the drawings provided for audit, including along the proposed primary and secondary pedestrian routes. Without appropriate facilities pedestrians may enter the carriageway at inappropriate locations and be struck by traffic.

Recommendation

Ensure that appropriate and continuous pedestrian facilities are included to guide vulnerable users through the proposed development.

5 FURTHER OBSERVATIONS

The design proposals should be appropriate to ensure motorists accessing or egressing parallel parking spaces can turn safely and at appropriate and desirable locations. This could include, for example, turning heads where appropriate.

6 COMMENTS

It is recommended that the proposed development is subject to a Stage 2 Road Safety Audit at detailed design stage.

7 CONCLUSIONS

It is recommended that the specific issues raised in this report be taken into account and that appropriate measures be put in place where practicable to mitigate the concerns raised.

This Stage 1 Road Safety Audit Report recommends various actions, which should be considered for inclusion in the detailed design process. Where recommendations are not incorporated into the design this should be documented in an Exception Report and forwarded to the ILTP Road Safety Audit Team. The Design Team should document and provide the rationale for incidences where the audit recommendations have not been incorporated or where alternatives are put forward.

The Design Team should respond to all issues raised in this Stage 1 Road Safety Audit Report through returning a signed copy of the Road Safety Audit Feedback Form.

8 ROAD SAFETY AUDIT TEAM STATEMENT

8.1 Statement

We certify that the drawings and documents provided with the Audit Brief have been examined. The examination has been carried out with the sole purpose of identifying any features of the scheme that could be improved or modified in order to improve the safety of the scheme. The problems that we have identified have been noted in the report, together with suggestions for improvement, which we recommend should be considered for implementation.

8.2 Signatures

8.2.1 Audit Team Leader Signature

Name: Ken Swaby

Position: Transport Engineer

Date: 07 / 12 / 2020

Organisation: ILTP Consulting

Signed: Ken Swaby

8.2.2 Audit Team Member Signature

Name: Francis Fidgeon

Position: Transport Engineer

Date: 07 / 12 / 2020

Organisation: CST Group

Signed: Francis Fidgeon

APPENDIX A ROAD SAFETY AUDIT FEEDBACK FORM

Road Safety Audit Reference RSA STKEVINS S1 KS 312

Audit Stage Stage 1

Date Road Safety Audit Completed 7th December 2020

Para No. in Report	Problem Accepted (Y/N)	Recommendation Accepted (Y/N)	Comments / Alternative Measures (Describe)	Alternative Measures Accepted by Auditor? (Y/N)
4.1	Y	Y		
4.2	Y	Y		
4.3	Y	Y		
4.4	Y	Y		
4.5	Y	Y		
4.6	Y	Y		
4.7	Y	Y		
4.8	Y	N	It is proposed to retain the alignment of the development access road on the approach to the junction but appropriate measures will be put in place to the agreement of Cork City Council Roads Department to deter motorists from adopting inappropriate alignments.	Yes – The measures agreed with Cork City Council should be subject to a Stage 2 Road Safety Audit.
4.9	Y	Y		
4.10	Y	N	It is proposed to retain the pedestrian crossing on the southern arm of the junction at the location shown, to correspond with pedestrian desire lines at the junction. This is in accordance with guidance in DMURS and is as agreed with Cork City Council Roads Department during Pre-Planning meetings. The junction has been designed with primary focus on creating a pedestrian-friendly environment, respecting natural desire lines. We	Yes

Para No. in Report	Problem Accepted (Y/N)	Recommendation Accepted (Y/N)	Comments / Alternative Measures (Describe)	Alternative Measures Accepted by Auditor? (Y/N)
			note the road safety measures here which include a revision to design levels to make gradients shallower at the junction. In addition, the junction is a raised table shared surface, which includes contrasting materials proposed at designated pedestrian courtesy crossings on the shared surface, and these imply a priority for pedestrians over vehicular traffic. It is also noted that an additional crossing for pedestrians has now been located 25m from the end of the shared surface ramp to facilitate pedestrians crossing the main development access road.	
4.11	Y	Y		
4.12	Y	Y		
4.13	Y	Y		
4.14	Y	Y		
4.15	Y	Y		
4.16	Y	Y		
4.17	Y	Y		
4.18	Y	Y		
4.19	Y	N	The previous inclusion of parallel parking spaces on the northern side of the main development access road has now been omitted. As an alternative, these have been replaced with 12no. perpendicular spaces, set back 1m from the edge of the carriageway on the northern side of the access road. Gradients on this section of road to the north of Block F have also been amended to make these shallower. This alternative proposal also includes provision for safe	Noted – The audit team considers that the car parking in proximity to the main development access junction should be located on the same side of the main access road as the residential units so parking users are not required to cross the road in this area to travel between the parking and buildings. The

Para No. in Report	Problem Accepted (Y/N)	Recommendation Accepted (Y/N)	Comments / Alternative Measures (Describe)	Alternative Measures Accepted by Auditor? (Y/N)
			pedestrian access between parking bays and Block F dwelling entrances, through inclusion of a traffic-calming raised pedestrian crossing. Furthermore, the design team believes this alternative addresses problems raised in Para 4.20 of the audit, in that provision of perpendicular spaces over parallel spaces, alleviates the risk of erratic turning and reversing manoeuvres.	response by the design team is noted however at this audit stage. The parking configuration and wider design layout in this area should be reviewed at detailed design stage to ensure they are appropriate and safe for all road users, including pedestrians, and address the safety concerns raised in this audit item. The design team should ensure that there is no parking immediately on arriving at the development as set out in the audit problem. The Stage 2 Road Safety Audit should also reassess this Stage 1 audit item and comment appropriately. It is also recommended that the proposed road and footpath gradients in this area and the wider site are reviewed at detailed design stage.
4.20	Y	Y		
4.21	Y	Y		
4.22	Y	Y		
4.23	Y	Y		
4.24	Y	Y		

Signed:

Peter O'Dwyer

Peter O'Dwyer (Barrett Mahony Consulting Engineers Ltd.)
Design Team Leader

Date **07/12/2020**

Signed:

Robert Farrell

Robert Farrell (Land Development Agency)
Employer

Date 07/12/2020

(Please Complete and return to the Auditor)

Audit Signed Off;

Ken Swaby

Ken Swaby
Audit Team Leader

Date **10/12/2020**

APPENDIX VI: Easements

- Letter from LDA's Solicitors Regarding Easements Available to Applicant

ARTHUR COX

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Our Reference: 3847/BR/LA268/008

30 November 2020

Attn. Robert Farrell
Land Development Agency
Second Floor
Ashford House
Tara Street
Dublin 2

Re: St. Kevin's Hospital Shanakiel, Cork (the "Property") shown outlined in red on the drawing 19305-BMD-ZZ-XX-DR-C-1000 attached hereto (the "Plan")

Dear Sirs,

We refer to your proposed Strategic Housing Development application to An Bord Pleanála for planning permission to develop the Property.

We have reviewed the title to the Property and it is our opinion that the requisite easements are available to the owner of the Property to enter upon adjoining lands for the purposes of construction of and use of drainage services along the route shown coloured orange on the Plan to the manhole shown coloured green on the Plan.

Yours faithfully

Arthur Cox.

ARTHUR COX

CIVIL LEGEND

EX. FOUL MANHOLE	Ex.F	
EX. FOUL PIPE	PIPE DESCRIPTION	
NEW FOUL MANHOLE	F	
NEW FOUL PIPE (uPVC)	PIPE DESCRIPTION	
EX. SURFACE WATER MANHOLE	Ex.S	
EX. SURFACE WATER PIPE	PIPE DESCRIPTION	
NEW SURFACE WATER MANHOLE	S	
NEW SURFACE WATER PIPE	PIPE DESCRIPTION	
EX. COMBINED MANHOLE	Ex.C	
EX. COMBINED PIPE	PIPE DESCRIPTION	
FOUL INSPECTION CHAMBER		
ROAD GULLEY	RG	
SITE BOUNDARY		
I.W. WAYLEAVE FOR FUTURE SERVICES		

NOTES ON WASTEWATER DRAINAGE:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS AND CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE.

PLOT NUMBERS

Type	Plot Numbers
Townhouses	
Block A	A1 - A3
Block B	B1 - B5
Block C	C1 - C3
Block I	I1 - I4
Block J	J1 - J5
Block K	K1 - K3
Block L	L1 - L5
Block M	M1-M5
Block O	O1-O5
Block P	P1-P3
Block Q	Q1-Q5
Total no. of Townhouse Units	46

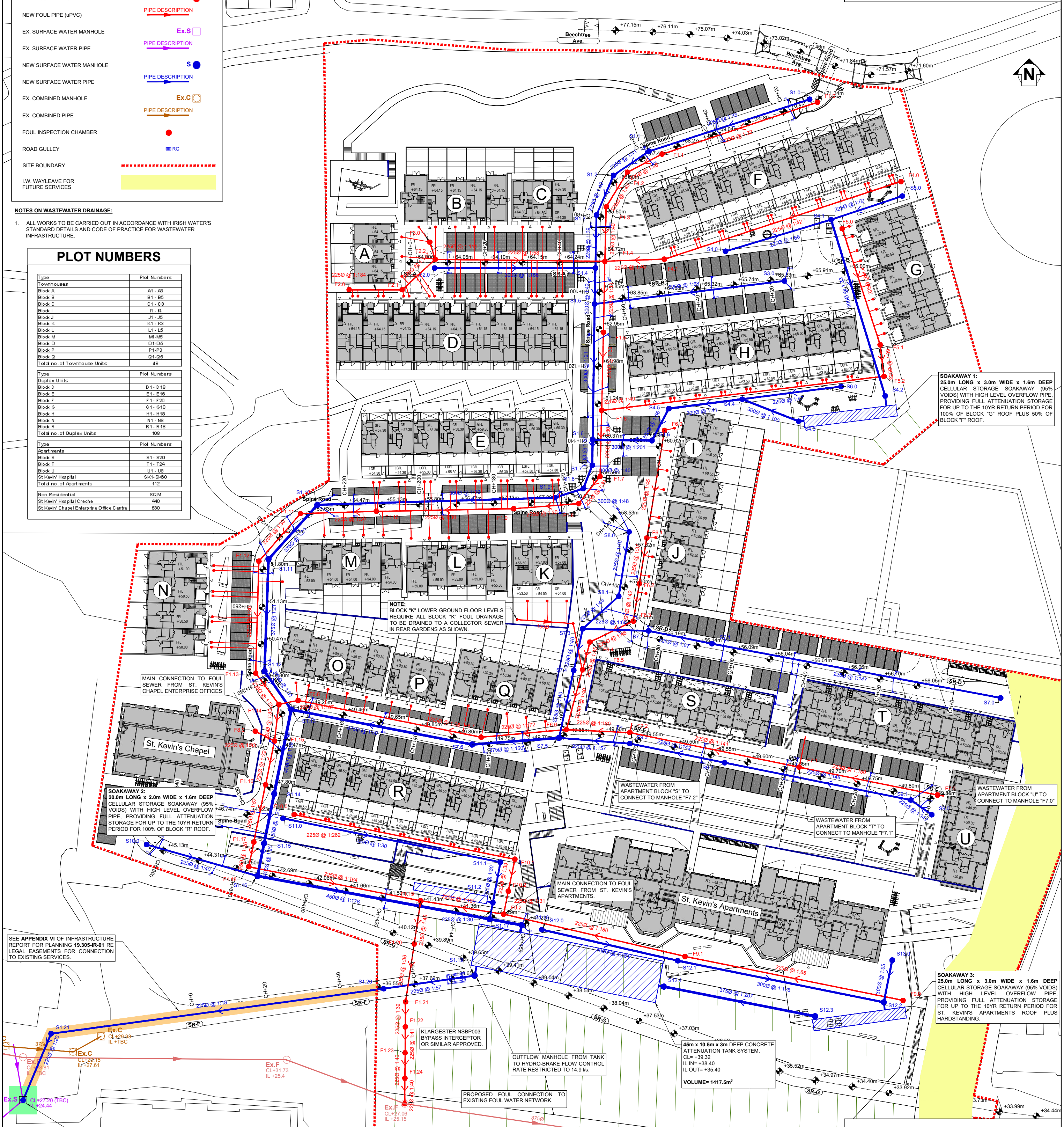
Type	Plot Numbers
Duplex Units	
Block D	D1 - D18
Block E	E1 - E16
Block F	F1 - F20
Block G	G1 - G10
Block H	H1 - H18
Block N	N1 - N8
Block R	R1 - R18
Total no. of Duplex Units	108

Type	Plot Numbers
Apartments	
Block S	S1 - S20
Block T	T1 - T24
Block U	U1 - U8
St Kevin' Hospital	SK1- SK60
Total no. of Apartments	112

Non Residential	SQM
St Kevin' Hospital Creche	440
St Kevin' Chapel Enterprise Office Centre	630

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - 'ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.



PROPOSED DRAINAGE LAYOUT

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL4	08.12.20	ISSUED FOR PLANNING	MJ / MJ	TMH / BM
PL4	03.12.20	ISSUED FOR I.W. SoDA	MJ / MJ	TMH / BM
PL3	27.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	POD / BM
PL2	23.11.20	ISSUED FOR I.W. SoDA	MJ / MJ	POD / BM
PL1	21.04.20	ISSUED FOR PLANNING	MJ / MJ	TMH / BM

DRAWING STAGE **PLANNING**

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CLIENT
LAND DEVELOPMENT AGENCY

PROJECT TITLE
ST KEVIN'S STRATEGIC HOUSING DEVELOPMENT

BM PROJECT No. **19305**

MODEL REFERENCE 19305-BMD-ZZ-XX-C3D-C-1000 | MODEL REV. P1 | SUITABILITY S0

DRAWING TITLE
PROPOSED DRAINAGE PLAN LAYOUT

DRAWING No. **19305-BMD-ZZ-XX-DR-C-1000** | ISSUE **PL4**