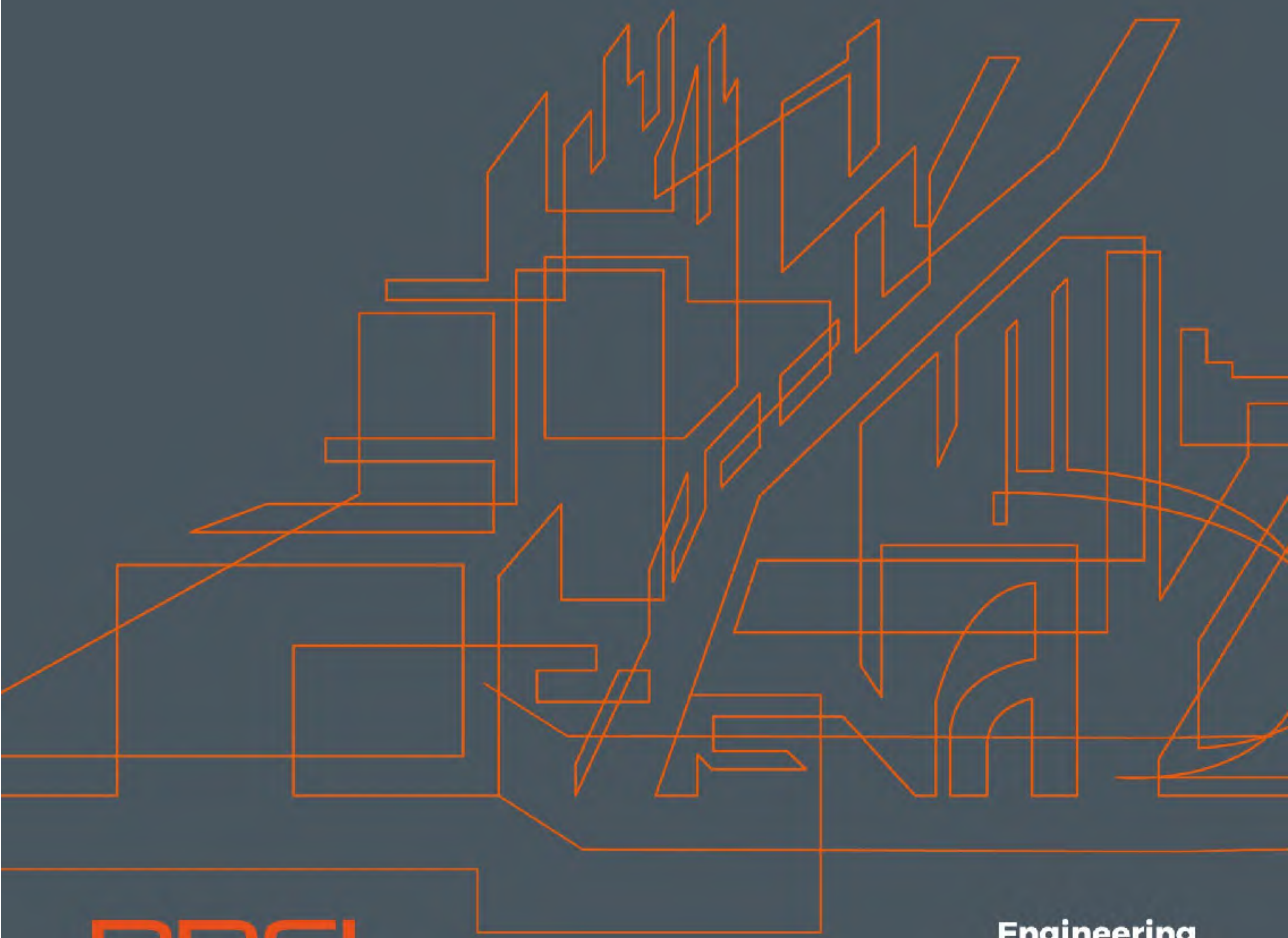
# Kishoge Part 10 Application

## Site 3 - Infrastructure Design Report

KSG3-DBFL-XX-XX-RP-C-0001

**March 2025**



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# 1 INTRODUCTION

## 1.1 Background

This infrastructure design report has been prepared by DBFL Consulting Engineers for the planning application for the Kishoge Site 3 development. The proposed development is part of the Clonburris Strategic Development Zone (SDZ) within the administrative area of South Dublin County Council (SDCC).

The proposed development is located within Development Area: Kishoge North-West (Sub-Sectors KNW-S1, KNW-S2, KNW-S3) and Development Area 6: Kishoge Urban Centre (KUC-S1) within the SDZ, as indicated in Figure 1.1. The overall KNW comprises of sub-sectors that will be primarily low to medium density residential areas, while KUC-S1 to the southeast will be medium to high density mixed use, retail community and residential areas.

The proposed development will benefit from the trunk infrastructure proposed as part of the Clonburris Infrastructure Development for which planning has been granted in February 2025 under planning reference SDZ24A/0033W. The Clonburris Northern Link Street (NLS) includes trunk road, drainage, watermain and utility infrastructure to serve the Clonburris Strategic Development Zone lands to the north of the Kildare/Cork Railway line which includes the subject site.

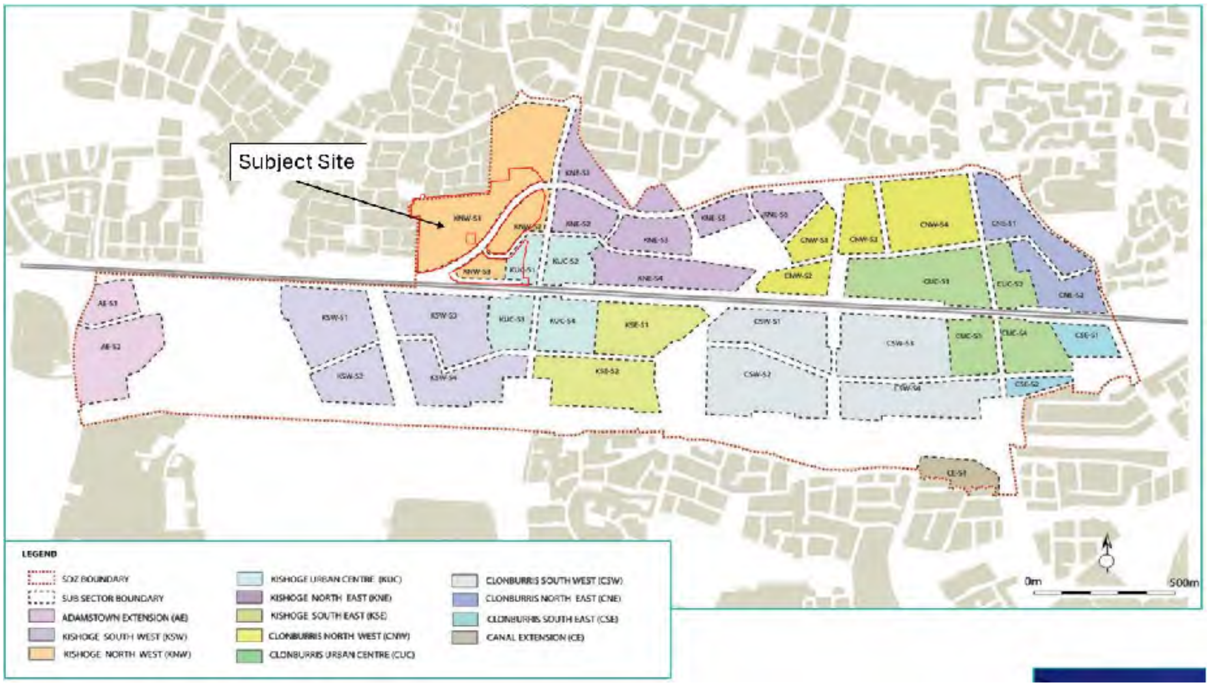



*Figure 1.1 Subject Site within Clonburris SDZ*

## 1.2 Objectives

This report aims to consider the proposed development main infrastructure elements, including the following:

- Road layout / Site access.
- Surface water servicing and strategy.
- Foul sewer servicing and strategy.
- Water supply and servicing.
- Flood risk

## 1.3 Location

The overall Clonburris SDZ lands, of approximately 280 Ha, is located to the west of Dublin City Centre and the M50, between the N4 and N7 national primary routes. The Kildare/Cork Railway line bisects the SDZ lands centrally and the Grand Canal forms the southern boundary.

The subject site for this application is situated in the northern area of the SDZ lands to the north of the Kildare/Cork Railway line. Adamstown Avenue, which connects to Thomas Omer Way to the East, bisects the subject site, while the Grange Castle Road (R136) is situated immediately adjacent to the east of the subject site. The permitted Clonburris Northern Link Street (NLS) which links Adamstown Avenue to Ninth Lock Road will provide access to the southeast part of the subject site, while the northwestern part of the site will be accessed via Adamstown Avenue. The Adamstown SDZ is located to the northwest of the subject site. See Figure 1.2 below for the site locality plan.

The proposed Clonburris Northern Link Street (NLS), for which planning has been granted in February 2025, runs through the southeast of the proposed development.

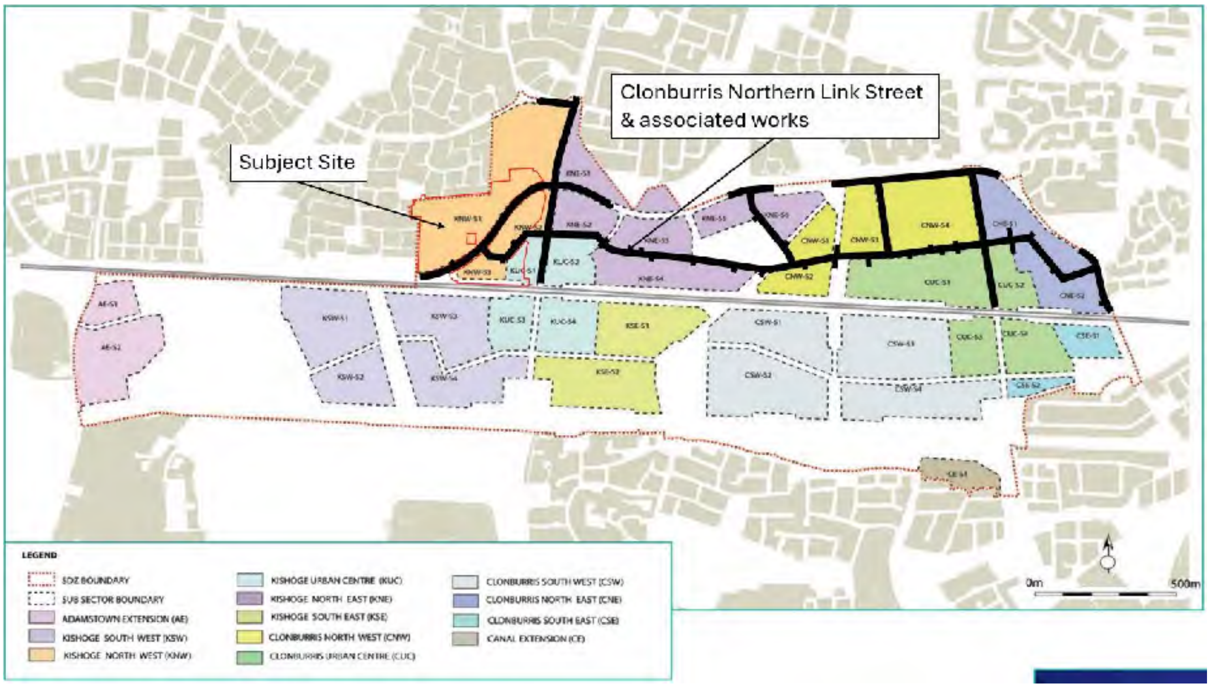



*Figure 1.2 Subject Site showing link to Clonburris Northern Link Street works*

## 1.4 Topography

Overall, the topography of the site is relatively flat throughout. There is a general fall from southeast to northwest across the site as displayed in Figure 1.3 below.

The existing site levels to the northwest of Adamstown Avenue generally ranges between 55.50m AOD to 58.00m AOD. An existing vegetated embankment forming a boundary between the northeast section of the site and Adamstown Avenue reaches a maximum level of 60.50m AOD.

The existing site levels to the southeast of Adamstown Avenue generally ranges between 57.50 to 60.00m AOD. There are two soil mounds in the southeast section with a maximum level of 62.50m AOD. An existing vegetated embankment with forms a boundary between the east of the site and Grange Castle Road reaches a maximum level of 67.00m AOD.

A topographical survey is provided as a background to the layout drawings issued with this report to indicate the natural ground levels of the site.

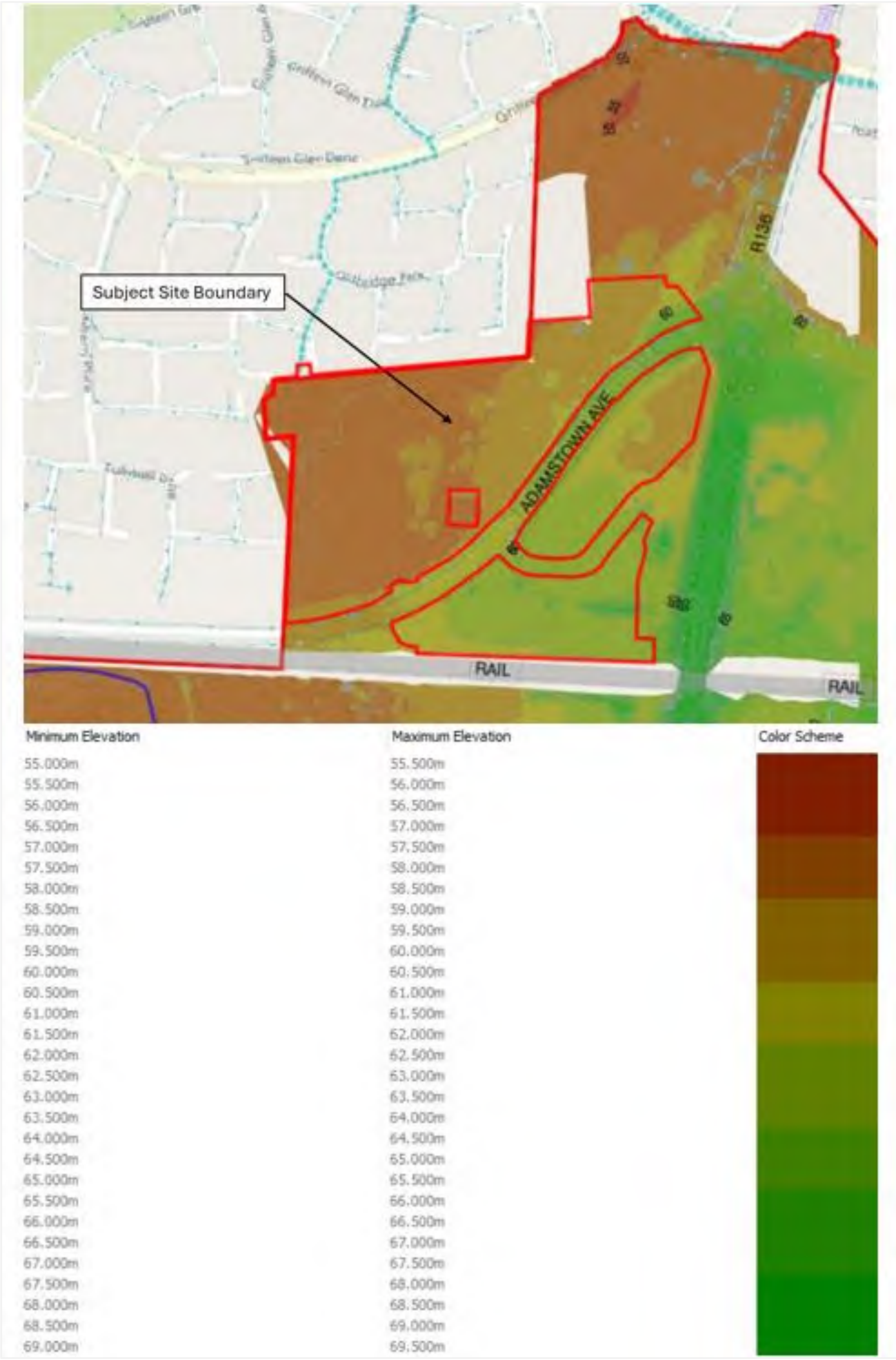



*Figure 1.3 Topographical Elevation Heat Map*

## 1.5 Proposed Development

The proposed development comprises 580no. residential units in a mix of house, apartment, duplex and triplex units comprising 1-bedroom, 2-bedroom and 3-bedroom typologies; 2-storey childcare facility; All associated and ancillary site development and infrastructural works including surface level car parking, bicycle parking, hard and soft landscaping and boundary treatment works, including public, communal and private open space, public lighting, bin stores and foul and water services. Vehicular access to the site will be from Adamstown Avenue and the Northern Link Street, proposed under concurrent application Reg. Ref. SDZ24A/0033W.

## 1.6 Existing Ground Conditions

A site investigation was undertaken by IGSL to ascertain the existing ground conditions. The detailed investigation attached as Appendix E included the following:

- Carry out 29 no. Trial Pits to a maximum depth of 3.40m BGL.
- Carry out 7 no. Soakaways to determine a soil infiltration value to BRE digest 365.
- Carry out 21 no. Plate Bearing Tests to determine the modulus of subgrade reaction and equivalent CBR values.
- Carry out 6 no. Rotary Core Boreholes to be a maximum depth of 7.50 BGL.
- Carry out 29 no. Slit Trenches to ascertain the location of existing underground services.
- Groundwater Monitoring
- Geotechnical & Environmental Laboratory testing.
- Report with recommendations.

The sequence of strata encountered were relatively consistent across site and comprised of:

**Made Ground:**

Made Ground deposits were occasionally encountered beneath the topsoil or on the surface of exploratory pits to the northwest of Adamstown Avenue and were present to a maximum depth of 2.50m BGL. These deposits can be described generally as *'Dark brown or dark grey sandy gravelly CLAY with occasional cobble content and organic matter, occasional plastic and steel, rare fragments of concrete blocks and rubbish'.*

Made Ground deposits were encountered in all but one of exploratory pits to the southeast of Adamstown Avenue. There were variable thicknesses of Made Ground exposed during pitting. Overall, the generally CLAY soil contained rare plastic/rubbish, wood, red brick and concrete fragments and cobbles and boulders.

**Topsoil:**

Topsoil was encountered in all the exploratory holes except TP12, TP13, TP23, TP25, TP26 and TP27. Where naturally occurring topsoil was unearthed, it was found to be present in layers ranging from 200mm to 450mm thick. A gradational lower transition was present whereby the topsoil was underlain by a SILT/CLAY subsoil, almost devoid of gravel.

**Glacial Deposits:**

A fine-grained light brown occasionally mottled orange-brown SILT/CLAY subsoil layer, generally firm in consistency, was found underlying the topsoil. Occasionally this was noted as firm to stiff with grey-brown mottling also observed.

Where indigenous deposits were encountered, the soils increased in strength to stiff and were found to contain an increasing gravel-sized clast content with depth. Colour change to grey was observed with depth.

A stiff dark grey layer completed many of the pits. This was increasingly gravelly, with angular cobble and boulder-sized fragments frequently noted. Towards the base of this layer, the increased volume of angular tabular and platy material caused the layer to be described as a "Possible Weathered Rockhead" horizon. This was noted in six of the twenty-nine pits namely TP05, 06, 07 and 08 as well as TP16 and TP21.

**Bedrock:**

Rotary drilling revealed bedrock at depths ranging 2.30m to 2.70m north of Adamstown Avenue with rock coring commencing at the deeper depths of 4.30m and 4.50m south of the Avenue. However, in both RC05 and RC06 south of the roadway, a layer of "clayey COBBLES" was intercepted shy of rock. This may well be a layer of weathered rock.

# 2 ACCESS & ROADS

## 2.1 Overall Road and Access Layout

The overall road and access layout is in accordance with requirements defined in the Clonburris SDZ planning scheme.

The proposed development will be accessed from Adamstown Avenue and the Clonburris Northern Link Street (NLS). The northwestern part of the development will be accessed via Adamstown Avenue. The southeast will be accessed from the NLS, for which planning has been granted in February 2025. The NLS can be accessed via Adamstown Avenue to the west and Grange Castle Road to the east.

The NLS includes minor priority-controlled junctions along the street alignment to provide access to future development cells within the Clonburris SDZ including the subject site. The NLS within the subject site's boundary is to have 2 controlled pedestrian crossings.

The subject sites internal road layout has been designed with a number of junctions throughout the development with appropriate traffic calming measures, including raised tables and speed humps.

Filtered priority junctions have been incorporated at key locations to prioritise pedestrian and cyclist movements.

The proposed road hierarchy and typologies are generally consistent with those set out in section 7 of the Clonburris 'Transport Assessment & Transport Strategy' and in section 2.2.4 of Clonburris SDZ as shown in Figure 2.1 below. Generally, the proposed Local Streets will be 5.5m wide and the proposed Intimate Local Streets (homezones) will be 4.8m wide, with a 2.5m wide footpath on either side of the road. The development's internal layout has been designed to incorporate flat top table ramps at strategic locations to calm traffic at junctions. Long straight sections of road have been avoided where possible with bends in the road introduced to further act as traffic calming measures. Design speed limits of 30km/hr are applied throughout the development as per the Design Manual for Urban Roads and Streets (DMURS).

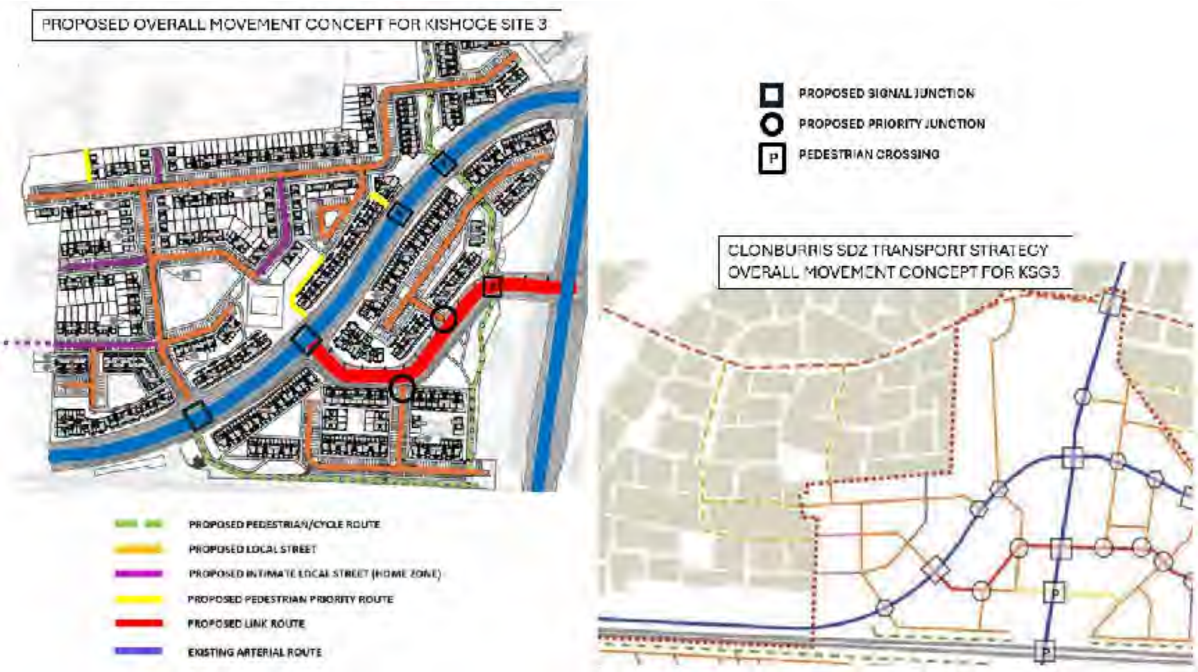



*Figure 2.1 Kishoge Site 3 Movement Concept and Roads Hierarchy*

The proposed street dimensions are designed in compliance with the Clonburris SDZ. Local streets are suggested to have a 5.0-5.5m wide carriageway with 2.4m parallel parking bays and 2.5-4.0m wide footpaths. Intimate local streets are suggested to have a maximum 4.8m wide shared surface carriageway with footpaths of no explicit dimensions indicated. Figure 2.2 from the SDZ illustrates example local streets including homezones.

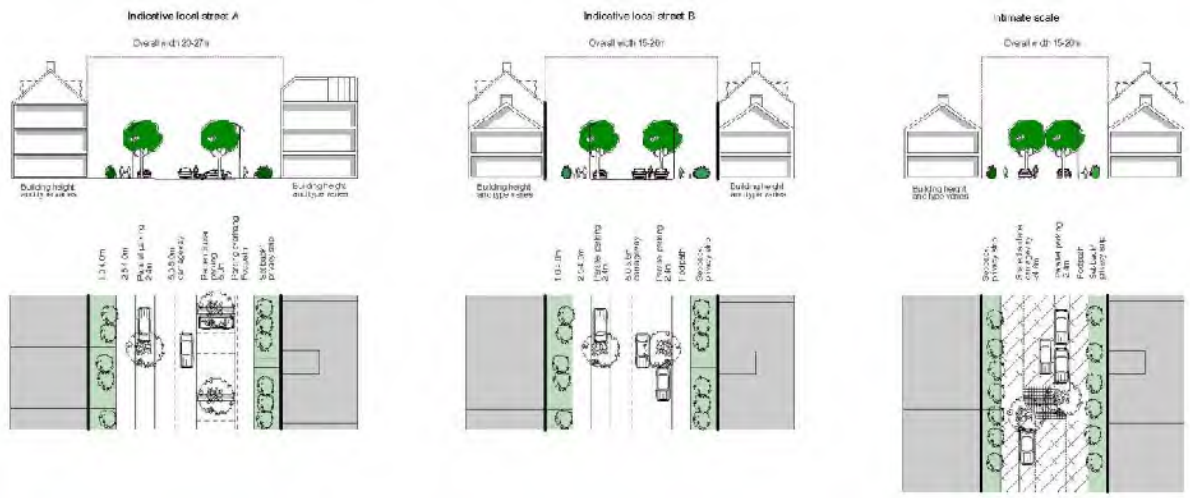


*Figure 2.2 Clonburris SDZ Example Local Streets*

The proposed development's road layouts are shown on drawing KSG3-DBFL-95-XX-DR-C-1201. The standard road cross-sections and construction details are shown on drawings KSG3-DBFL-95-XX-DR-C-5201 to 5204 and comprise the following:

- Local Streets – typically 5.5m wide carriageway with 2.5m footways and intermittent 2.5m wide private parking bays. Where required, to accommodate perpendicular parking space, the road width has been increased for sufficient vehicle manoeuvrability.
- Intimate Local Street / Home-Zone Streets – 4.8m wide homezone street with 2.5m footways and intermittent 2.5m wide parking bays. Road surfaces are to be in a different colour contrast and texture to Local Streets.

Corner radii of 3m are generally provided within the local streets, with the exception of certain turning heads which have larger corner radii to accommodate refuse and fire tender vehicles.

A Stage 1 Road Safety Audit has been conducted on the proposed roads layout as attached in Appendix A.

## 2.2 Pavement Design Standards

The main internal roads are designed in accordance with the Design Manual for Urban Roads and Streets (DMURS) and Local Authority taking in charge requirements. A 100mm high kerb separation is proposed between typical roads and footpaths. Refer to drawings KSG3-DBFL-95-XX-DR-C-5201 to 5204 for the proposed road construction details. Proposed capping for the roads is based on the SI investigation and CBRs will be taken on site to determine where additional capping will be required due to soft spots.

## 2.3 Vehicle Tracking

The proposed development has been tracked to show that the development's proposed streets and turning heads will accommodate a large refuse vehicle as shown on drawing KSG3-DBFL-95-XX-DR-C-1201. Refuse staging areas have been indicated on these drawings indicatively and reflect the proposed refuse collection areas of the refuse collection strategy.

## 2.4 Parking Strategy

Perpendicular parking bays are set to accommodate a targeted maximum 1:20 longitudinal gradient. Parallel parking bays have been designed to have a 1:40 crossfall (maximum 1:21) towards the carriageway to allow for excess surface water runoff to be routed to the catchpits provided. All parking bays are permeable paving to be maintained by an appointed management company.

All perpendicular parking spaces have been designed to allow for a minimum of 6m reverse manoeuvre space. Perpendicular parking bays will be 5.5m length on local streets, with none proposed on homezone streets. Parallel spaces will be 2.5m to allow sufficient space for parking.

For further details of the vehicle and cycle parking provided for the proposed development, refer to Chapter 14 of the EIAR.

## 2.5 Road Safety Audit

The Stage 1 Road Safety Audit was conducted for the subject site and completed in January 2025. The full Stage 1 Road Safety Audit is provided in Appendix D.

# 3 SURFACE WATER DRAINAGE

## 3.1 Existing Drainage

Overall, the topography of the site is relatively flat throughout. There is a general fall from southeast to northwest across the site as displayed in Figure 3.1.

The existing site is relatively flat throughout with a general existing fall from southeast to northwest across the site. Existing 225mm surface water drains run along either side of Adamstown Avenue. There are no existing significant field drains within the subject site boundary. Additional detail on existing drainage within the Clonburris SDZ is provided in the Clonburris SWMP.


*Figure 3.1 Existing Clonburris SDZ Field Drainage*

## 3.2 Surface Water Drainage Strategy

In accordance with the GDSDS it is proposed to use Sustainable Urban Drainage systems (SuDS) for managing stormwater for the proposed development along with traditional storm drainage networks. The aim of the SuDS strategy for the site will be to:

- Attenuate storm-water runoff.
- Reduce storm-water runoff.
- Reduce pollution impact.
- Replicate the natural characteristics of rainfall runoff for the site.

- Recharge the groundwater profile.

The proposed layout of the drainage and SuDS is detailed on drawing KSG3-DBFL-94-XX-DR-C-1311.

The Surface Water Management Plan (SWMP) agreed with SDCC includes several potential SuDS features to be implemented on individual sites within the SDZ. The following SuDS features are incorporated into the design for the subject site:

### 3.2.1 Bioretention Areas / Rain Gardens

Where possible, Bioretention areas have been implemented into the design as shown on drawing KSG3-DBFL-94-XX-DR-C-1311. Surface water generated from the adjacent roads and footpaths will discharge directly to these SuDS features via inlet kerbs detailed on drawing KSG3-DBFL-94-XX-DR-C-5303.

**Water Quality**

Surface water runoff from the adjacent roads/roofs is conveyed to the bioretention area which routes any surface water that has not infiltrated naturally into the ground or absorbed by the vegetation, to the surface water pipe network to be attenuated in the regional attenuation basins.

The build-up of the bioretention consists of a filter medium, a transition layer and a drainage layer as detailed on drawing KSG3-DBFL-94-XX-DR-C-5303. The min 150mm free draining topsoil on top of a min 50mm sharp sand layer will filter out pollutants and provide natural surface water flow control. The min 50mm grit transition layer prevents fine filter medium from entering the drainage layer. The 750mm drainage layer retains the surface water after it has filtered through the bioretention area build-up. The grated manholes will act as an overflow inlet from where the overflowed surface water is discharged into the surface water pipe network.

**Storage Volume**

The bioretention area build-up contributes to the local surface water storage volume, serving as a natural surface water source control.

**Biodiversity**

The bioretention areas will contribute to the biodiversity of the proposed development by adding habitat for wildlife. See the landscape architect drawings for further details on specific plants proposed in the bioretention areas.

**Amenity**

The bioretention areas are generally proposed along roads to receive runoff from adjacent roads and will contribute to aesthetics of the streetscape. Local bioretention areas are also proposed within the detention basins to receive surface water runoff from nearby roads to create local "wet" areas. This will encourage the growth of plants proposed in these areas, further adding to the biodiversity of the development and create enjoyable and aesthetically pleasing public open space areas.

### 3.2.2 Permeable Paving

The proposed design includes permeable finishes on all parking bays within the development as shown on drawing KSG3-DBFL-94-XX-DR-C-1311. Surface water runoff from the paved areas and from the house/duplex roofs is intercepted by the permeable build-up of the paved areas where it is intended to naturally infiltrate into the ground. If the porous build-up of the paving and the in-situ material beneath becomes saturated, surface water would drain overland and into the surface water pipe network.

**Water Quality**

Permeable paving reduces pollutants such as petrol and diesel as it contributes to its biodegrading process. It also assists in filtering solid particles out of surface water runoff, providing filtration before discharge into the surface water pipe network and ultimately the receiving watercourse. The build-up of the permeable paving is shown on drawings KSG3-DBFL-95-XX-DR-C-5203 to 5204.

**Storage Volume**

The permeable pavement build-up of the parking areas for the development is 500mm thick and has a 0.3 void ratio. This adds a significant amount of local surface water storage to the development before the eventual discharge into the regional attenuation structures, while adding further opportunity for groundwater infiltration.

**Biodiversity**

Permeable paving does not directly contribute to the biodiversity of the development, but the surface water treatment it provides maximises the biodiversity in the downstream watercourses at the discharge point.

**Amenity**

Permeable paving provides amenity in its functionality as it can be used for a range of activities, while also acting as a valuable component in the surface water treatment and storage train.

### 3.2.3 Tree Pits

Tree Pits are proposed to intercept road runoff throughout the entire development. Two types of Proposed SuDS tree pits are shown on drawing KSG3-DBFL-94-XX-DR-C-1311. Tree pits in local streets are generally placed behind the back of the footpath and intercept road runoff via a road gully with an overflow to the surface water pipe network. Tree pits in home zone areas are slightly lowered below the road surface to allow surface water to be directly intercepted at the base of the tree pit and infiltrate down to the tree root system. Once the tree pit is saturated, water would be routed to the surface water pipe network through an overflow as detailed on drawing KSG3-DBFL-94-XX-DR-C-5304.

**Water Quality**

Surface Water runoff will be filtered through the soil surrounding the tree root ball, removing pollutants. Pollutants are also naturally broken down during the transpiration process. This filtration process results in surface water with less pollutants being discharged into the surface water pipe network end the eventual receiving waters.

**Storage Volume**

The base of the tree pit provides storage within the porous soil and drainage layers, allowing for natural infiltration into the ground and absorption by the tree roots, reducing the amount of surface water discharged into the surface water pipe network via overflow pipes.

**Biodiversity**

The addition of SuDS on-street trees will increase the habitat for a variety of animal species and insects and act as bridge for wildlife in the post-developed urban landscape. Filtered water passing through the tree pit and into the receiving watercourse would also add to the biodiversity downstream. See the landscape architect detail for proposed species of the street trees.

**Amenity**

The street trees will add significant amenity benefits such as improving the aesthetics of the urban landscape. The canopies of the trees will also provide a cooling effect in the post developed streetscape.

## 3.3 Attenuation & Drainage

According to the overall Clonburris Surface Water Management Plan (SWMP), the majority of the proposed development site falls within SDZ surface water catchment with a portion of the proposed site to the northwest lying within a separate catchment discharging to separate existing infrastructure to the northwest.

The proposed site has been designed with 2no. separate surface water catchments. Catchment A outfalls to the existing OldBridge network. Catchment B outfalls into the separately proposed NLS works trunk sewer (Note – for the purpose of calculations, Catchment B has been split into 6no. segments for each connection point to the NLS trunk sewer). See Figure 3.2 below showing proposed surface water network and outfall points within Catchment A and Catchment B.

The proposed development within surface water Catchment A has 2no. local attenuation ponds with an allowable discharge of 15.35 l/s. The surface water from Catchment A will eventually discharge into OldBridge storm outfall with a maximum outflow of 14.5 l/s. (Figure 3.2 shows an overview of proposed surface water catchments).

Surface water Catchment B contains a local attenuation pond which discharges into the future NLS trunk storm network and finally discharging to the regional attenuation ATN 03.

Attenuation ATN 03 is an open attenuation pond providing a maximum storage capacity of 5100$m^3$ required for a 100-year storm for the subject site and other lands within surface water Catchment 1 of the SDZ.

Surface water from ATN 03 will continue to flow and discharge into the Griffeen River (See Figure 3.6 and Figure 3.7).

The drainage and attenuation systems for the NLS works have been approved under planning reference SDZ24A/0033W. Minor amendments to the plan footprints permitted under SDZ24A/0033W are proposed as part of the current application, however, the overall general arrangement and attenuation volumes are to be maintained as per the permitted application.

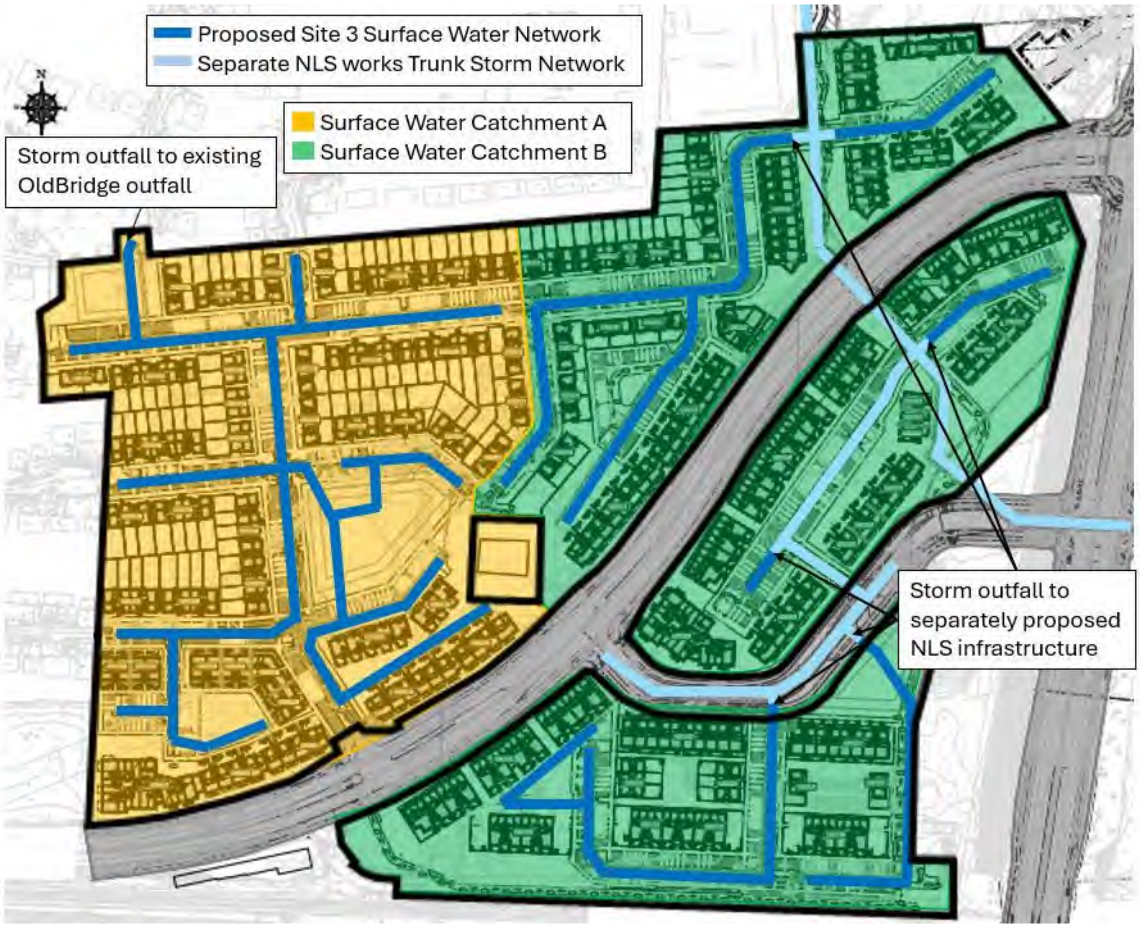



*Figure 3.2 Kishoge Site 3 Surface Water Sub-Catchments*

The gross area of the site surface water Catchment A that outfalls to the existing OldBridge network is 4.67ha with a calculated impermeable area of 3.03ha.

The gross area of the site surface water Catchment B is 7.55ha with a calculated impermeable area of 5.49ha of contributing to ATN 03. The calculations have also accounted for the future urban core with an assumed impermeability factor of 0.75.

The calculated impermeable area contributing to ATN 03 is therefore 5.49ha versus an allowance of 5.57ha, thus the development falls within the design allowances made in the regional attenuation sizing.

See Table 3.1 below for details of surface water effective areas.

(Note – for the purpose of surface water area calculations, Catchment B has been split into 6no. segments for each outfall/connection to the NLS trunk sewer. The total areas and impermeable areas of surface water Catchments A and Catchment B are included at the bottom of Table 3.1).

*Table 3.1 Surface Water Catchments Effective Areas*

| | Hardstanding Type | Gross Area (ha) | Runoff Co-efficient | Impermeable Area (ha) |
|---|---|---|---|---|
| Catchment A (Locally Attenuated) (Outfall to OldBridge) | Roof | 1.030 | 1.00 | 1.030 |
| | Permeable Paving | 0.308 | 0.80 | 0.246 |
| | Hard Surfacing | 1.084 | 1.00 | 1.084 |
| | Soft Landscpe & Public Open Space | 2.248 | 0.30 | 0.674 |
| | **Sub-Total (ha)** | **4.670** | | **3.034** |
| Catchment B1 (Outfall to ATN 03) | | | | |
| | Roof | 0.429 | 1.00 | 0.429 |
| | Permeable Paving | 0.145 | 0.80 | 0.116 |
| | Hard Surfacing | 0.581 | 1.00 | 0.581 |
| | Soft Landscpe & Public Open Space | 0.712 | 0.30 | 0.214 |
| | **Sub-Total (ha)** | **1.867** | | **1.339** |
| Catchment B2 (Outfall to ATN 03) | | | | |
| | Roof | 0.400 | 1.00 | 0.400 |
| | Permeable Paving | 0.100 | 0.80 | 0.080 |
| | Hard Surfacing | 0.573 | 1.00 | 0.573 |
| | Soft Landscpe & Public Open Space | 0.423 | 0.30 | 0.127 |
| | **Sub-Total (ha)** | **1.496** | | **1.180** |
| Catchment B3 (Outfall to ATN 03) | | | | |
| | Roof | 0.172 | 1.00 | 0.172 |
| | Permeable Paving | 0.033 | 0.80 | 0.027 |
| | Hard Surfacing | 0.229 | 1.00 | 0.229 |
| | Soft Landscpe & Public Open Space | 0.366 | 0.30 | 0.110 |
| | **Sub-Total (ha)** | **0.800** | | **0.537** |
| Catchment B4 (Outfall to ATN 03) | | | | |
| | Roof | 0.382 | 1.00 | 0.382 |
| | Permeable Paving | 0.086 | 0.80 | 0.068 |
| | Hard Surfacing | 0.359 | 1.00 | 0.359 |
| | Soft Landscpe & Public Open Space | 0.296 | 0.30 | 0.089 |
| | **SUB-TOTAL (ha)** | **1.123** | | **0.898** |
| Catchment B5 (Locally Attenuated) (Outfall to ATN 03) | | | | |
| | Roof | 0.135 | 1.00 | 0.135 |
| | Permeable Paving | 0.023 | 0.80 | 0.018 |
| | Hard Surfacing | 0.216 | 1.00 | 0.216 |
| | Soft Landscpe & Public Open Space | 0.472 | 0.30 | 0.141 |
| | *Future Urban Core | 0.652 | 0.75 | 0.489 |
| | **Sub-Total (ha)** | **1.497** | | **0.999** |
| Catchment B6 (Outfall to ATN 03) | | | | |
| | Roof | 0.163 | 1.00 | 0.163 |
| | Permeable Paving | 0.033 | 0.80 | 0.026 |
| | Hard Surfacing | 0.256 | 1.00 | 0.256 |
| | Soft Landscpe & Public Open Space | 0.313 | 0.30 | 0.094 |
| | **Sub-Total (ha)** | **0.766** | | **0.540** |
| | | | | |
| | Catchment A Total | 4.670 | | 3.034 |
| | Catchment B Total | 7.549 | | 5.494 |
| | | | | |
| | **TOTAL (ha)** | **12.218** | | **8.528** |

### 3.3.1 Compliance with Attenuation Design

Calculation of regional attenuation volumes is included within the SWMP and within the NLS infrastructure application. These regional features cater for the attenuation volumes required for individual developments such as the subject site, Kishoge Site 3.

In the absence of development plans for individual development parcels, the attenuation volumes required in the regional features were based on an assumed '% Impermeable' for each parcel. This section documents the proposed development's characteristics against those assumed for regional attenuation volume calculations to ensure the development falls within the design allowances.

*Table 3.2 Extract from Clonburris SWMP Summary Table*

| Sub-Catchment | Attenuation Ref | Catchment Area (ha) | Assumed Impermeable Area (from Runoff Factors) | Assumed % Impermeable (from Runoff Factors) | Storage Type | Allowable Outflow (l/s) (Sub-catchment) | Allowable Outflow (l/s) (Catchment) | Storage Volume Required (100 years, m3) |
|---|---|---|---|---|---|---|---|---|
| 1 | ATN03 | 18.9 | 9.28 | 49.1% | Pond | 58.59 | 58.59 | 5,100 |
| 2A | ATN05 | 5.2 | 2.47 | 47.5% | Modular | 16.12 | 149.11 | 1,250 |
| 2B | ATN04 | 6.8 | 4.56 | 67.1% | Pond | 21.8 | 170.19 | 3,000 |
| 3 | ATN06 | 42.9 | 23.52 | 54.8% | Pond | 132.99 | 132.99 | 14,500 |
| 4AA | ATN10 | 13.5 | 7.12 | 52.7% | Pond | 41.85 | 41.85 | 4,000 |
| 4B | ATN07 | 33.08 | 17.93 | 54.2% | Modular & Basin | 102.55 | 102.55 | 10,000 |
| 4BB | ATN08 | 9.02 | 7.02 | 77.8% | Modular & Basin | 27.98 | 130.53 | 4,430 |
| 4CCc | ATN11c | 7.29 | 3.21 | 44.0% | Modular | 22.60 | 155.00 | 2,200 |
| 4CCb | ATN11b | 1.60 | 1.04 | 65.0% | Modular | 4.97 | 158.11 | 715 |
| 4CCa | ATN11a | 1.76 | 1.15 | 65.3% | Pond | 5.46 | 163.56 | 785 |
| 5 | ATN02 | 67.52 | 35.49 | 52.6% | Pond | 209.31 | 209.31 | 21,300 |
| 6 | ATN01 | 14.43 | 8.46 | 58.6% | Pond | 44.74 | 44.74 | 4,930 |
| 7 | ATN09 | 11.8 | 2.94 | 24.9% | Pond | 36.58 | 36.58 | 1,250 |

The SDZ surface water Catchment 1 has an overall area of 18.9ha with an assumed impermeable area of 9.28ha as detailed in the Surface Water Management Plan, shown in Table 3.2 above. Kishoge Site 3 within the SDZ Catchment 1 spans approximately 60.03% of the overall Catchment 1. Therefore, the impermeable area contribution for the subject site assumed for regional attenuation sizing would be approximately 60.03% of 9.28ha = 5.57ha.

## 3.4 Design Standards

Drainage is designed in accordance with the Greater Dublin Regional Code of Practice for Drainage Works and the agreed Clonburris Joint Infrastructure Works. Surface water pipework was sized using the MicroDrainage Windes drainage modelling software. The following parameters apply to the design:

- Return period for pipe network 30 years
- Return period for attenuation 100 years

- Time of entry 4 minutes
- Allowable Outflow for the SDZ 3.1 l/s/ha
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity 1.0 m/s
- Standard Average Annual Rainfall 777mm (Met Éireann)
- M5-60 16.7mm (Met Éireann)
- Ratio R (M5-60/M5-2D) 0.275 (Met Éireann)
- Storage System Storm Return Event GDSDS Volume 2, Criterion 3
  - 30-year no flooding on site
  - 100-year check no internal property flooding. Flood routing plan. FFL freeboard above 100-year flood level
- Climate Change 20% for rainfall intensities
- Runoff Factors

Surface water sewers have been designed in accordance with IS EN 752 and the recommendations of the Greater Dublin Strategic Drainage Study', (GDSDS).

Standard drainage details, as outlined on DBFL drawings KSG3-DBFL-94-XX-DR-C-5301 to 5304 are in accordance with the Greater Dublin Regional Code of Practice for Drainage Works.

The minimum pipe diameter for public surface water sewers is 225mm. Private drains within the proposed development will comply with Irish Water/ GDSDS minimum requirements.

Surface water sewer modelling results for the main drainage networks are included in Appendix A.

## 3.5 Climate Change

Rainfall values for the proposed development are sourced from Met Eireann to calculate the FSR input hydrograph for the drainage design as required by the GDSDS. The design rainfall intensities were increased by a factor of 20% to take account of climate change, as required by the GDSDS for attenuation storage design.

Under the site-specific Flood Risk Assessment (FRA) carried out for Site 3, design rainfall intensities were increased by a factor of 30% for climate change to test the flood risk to the existing ESB substation. In depth details can be found within the FRA report KSG3-DBFL-XX-XX-RP-C-0004.

## 3.6 Pluvial Flooding Provision

The surface water network, attenuation storage and site levels are designed to accommodate a 100-year storm event and includes climate change provision. Floor levels of houses are set above the 100-year flood levels by a minimum of 0.5m for protection. Locally around the existing ESB substation, excess surface water will be routed around its perimeter towards the nearby proposed attenuation pond through the shaping of site levels and bioretention strips to suit. For storms greater than 100-year events, the development has been designed to provide overland flood routes along the various development roads without affecting building floor levels.

## 3.7 Surface Water Quality Provision

Run-off rates from the regional attenuation systems are controlled by vortex flow control devices. Surface water management proposals for the development also incorporate the following to reduce its impact:

- Designed in accordance with the 'Greater Dublin Strategic Drainage Study' GDSDS and the Clonburris joint infrastructure works surface water management plan requirements.
- Incorporates SUDS features e.g. permeable paving in high-risk parking areas at the front of houses.
- On-line attenuation/infiltration facilities with an oil separator prior to discharge to a public surface water sewer has been included in the trunk infrastructure under planning reference SDZ24A/0033W.

## 3.8 Flood Risk Assessment

As part of the Clonburris SDZ Draft Planning Scheme, South Dublin County Council commissioned a Strategic Flood Risk Assessment (SFRA) for the lands which was completed by JBA Consulting and is listed as a supporting document to the planning scheme (https://clonburris.ie/wp-content/uploads/2022/03/Clonburris-SDZ-SFRA.pdf). The subject sites land was accounted for in the Clonburris SDZ Strategic Flood Risk Assessment. It was predicted that the subject site was at low risk of flooding (Flood Zone C) for events up to the Q1000 event. The study also found there is no existing development within the subject site that is at potential risk of flooding.

As part of the strategic flood risk assessment, historic and predicted flood risk mapping published by the OPW on the Flood Hazard Mapping Website http://www.floodinfo.ie was reviewed.

Historical flood/maps data indicate there are no recorded flood events within the proposed site boundary. There are two recorded recurring flood events within 2km of the proposed site. The first is a recurring flood event at the Cappaghmore Culvert located approximately 1.8m to the east of the site. The second is located at the Beech Row Bungalows approximately 1.5km to the east of the site. There are no recorded recurring flood events within close proximity to the site. The nearest recurring flood event is at Beech Row, approximately 2km to the east of the subject site.

The Eastern CFRAM (Catchment Flood Risk Assessment and Management) study details the predicted risk for a variety of fluvial and coastal flood scenarios. The mapping does not include the watercourse reaches affected by the proposed scheme and only maps downstream flooding. The proposed development is therefore outside of the Q100 and Q1000 flood extents and within Flood Zone C (low risk of flooding).

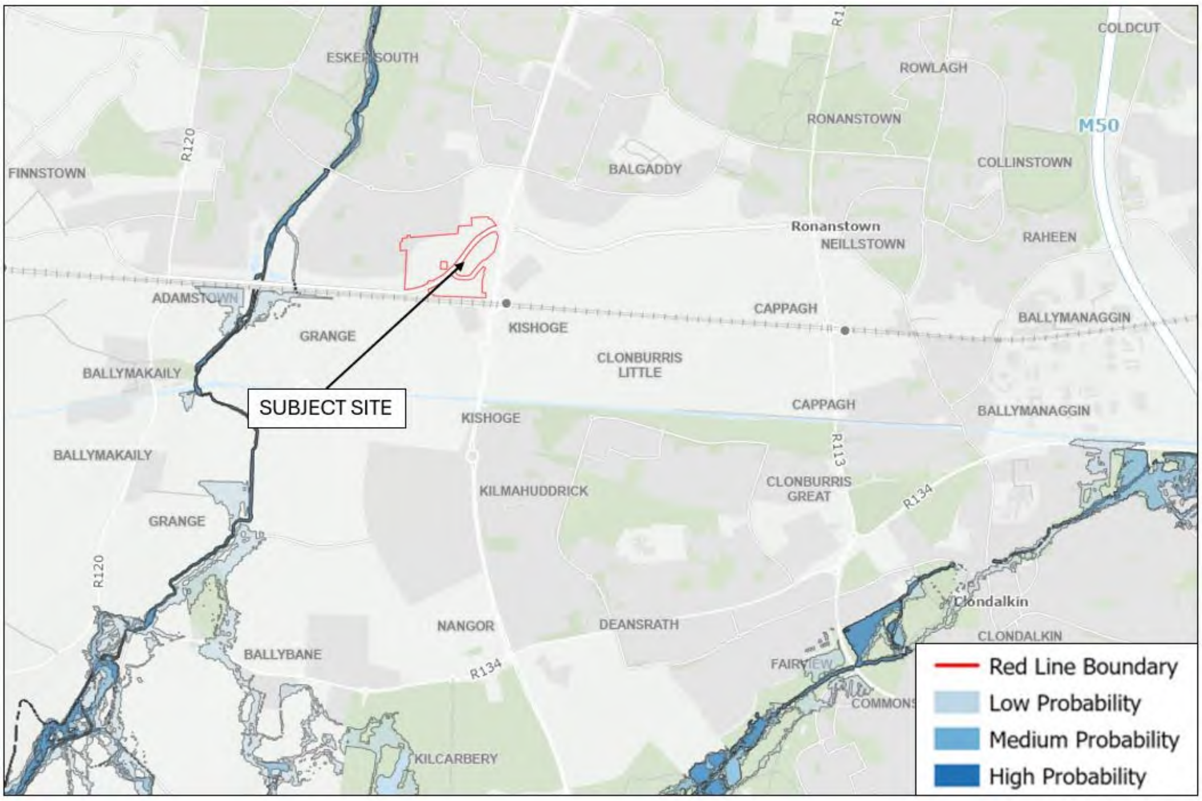



*Figure 3.3 Extract of CFRAMS Data from OPW FloodInfo.ie*

The OPW undertook an Irish Coastal Protection Strategy Study (ICPSS) which produced coastal/tidal flood extents maps for the Irish coastline for a 0.5% AEP tidal flood level. This map indicates that the site is far outside the extents of the coastal/tidal flood zone.


*Figure 3.4 Extract of ICPSS Data from OPW FloodInfo.ie*

A site-specific Flood Risk Assessment has been carried out for the proposed development site.

Although the site is not situated in a high risk (Flood Zone A) or moderate risk (Flood Zone B) flood zone, the assessment was carried out focusing on the proximity of the Griffeen River to the west and the existing 38kV ESB substation located within the site boundary. The assessment concludes that the ESB substation is not at risk to flooding from nearby watercourses or from the proposed development, proposed attenuation ponds or excess surface water runoff within the site.

The full Flood Risk Assessment can be found in report KSG3-DBFL-XX-XX-RP-C-0004 as part of this planning application.

### 3.9 Flood Exceedance

For storms greater than the 1%AEP pluvial event, the development's drainage network design may be exceeded, and run-off may flow above ground along the main roads. The development has been designed without minimal areas/depressions where possible.

The portion of the site northwest of Adamstown Avenue will generally route excess run-off to the north and west towards the attenuation pond ATN 02.

The portion of the site southeast of Adamstown Avenue will generally route excess run-off to the north and west towards the attenuation pond ATN 02. House floor levels have been set to make allowance for any possible areas of surface ponding during exceedance events.

Refer to Figure 3.5 for the overland flood exceedance routes for the proposed development.

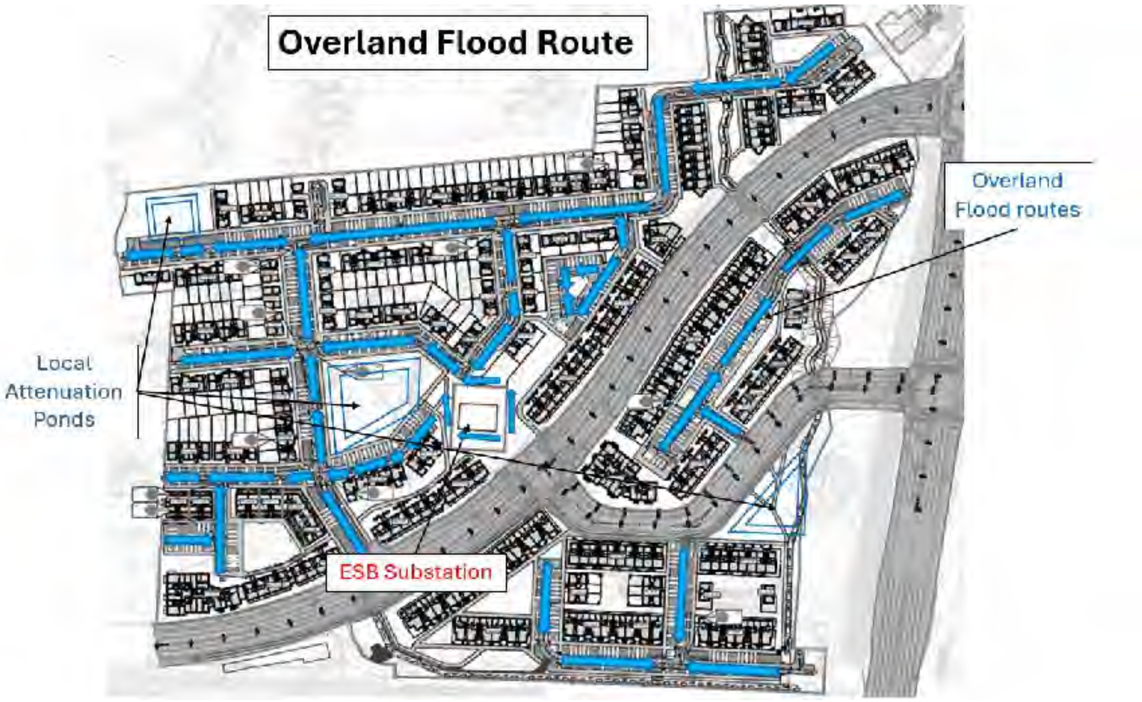



*Figure 3.5 Proposed Overland Flood Routing*

### 3.9.1 Compliance with SWMP

DBFL Consulting Engineers have separately undertaken a 'Surface Water Management Plan' (SWMP) for the overall Clonburris Strategic Development Zone (SDZ). The SWMP for the SDZ has been submitted to and agreed with SDCC. The SWMP outlines the surface water strategy for the overall SDZ lands and the requirements for each individual development site within the SDZ which includes the subject site. The SWMP includes the strategy for attenuation design, SuDS features, run off rates and trunk infrastructure layout. The subject site has been designed in accordance with the strategy agreed upon in the SWMP.

The proposed site will benefit from trunk surface water infrastructure proposed as part of the Clonburris Northern Link Steet (NLS) works for which planning was granted under reference SDZ24A/0033W. The NLS works include trunk surface water sewers and regional attenuation to serve the subject site, this strategic infrastructure aligns with the SWMP proposals and allows for a treatment train of SuDS measures within individual sites and within the regional features.

The subject site will have two main surface water catchments. Runoff generated from the western portion of the proposed development will outfall to the existing Old Bridge Road network. Runoff generated from the majority (north, south and east of site) of the proposed development will be collected in a new gravity sewer and discharged to the regional attenuation system ATN 03 constructed as part of the NLS works.

The downstream regional attenuation system ATN 03 will consist of an open attenuation pond. Outflow from the attenuation structure within the SDZ limits flow to a rate of 3.1 l/s/ha as detailed in the SWMP for the SDZ.

See Figure 3.6 and Figure 3.7 below showing the proposed development site within the overall Clonburris SDZ surface water catchment plan.

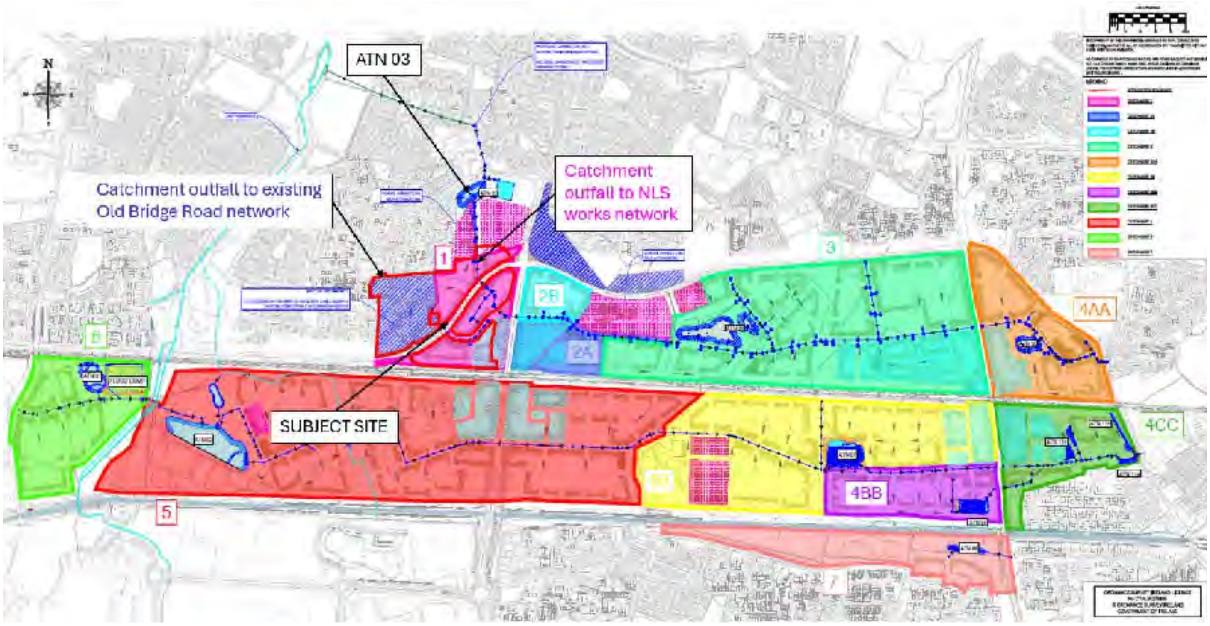



*Figure 3.6 Overall Clonburris Surface Water Catchment Map*

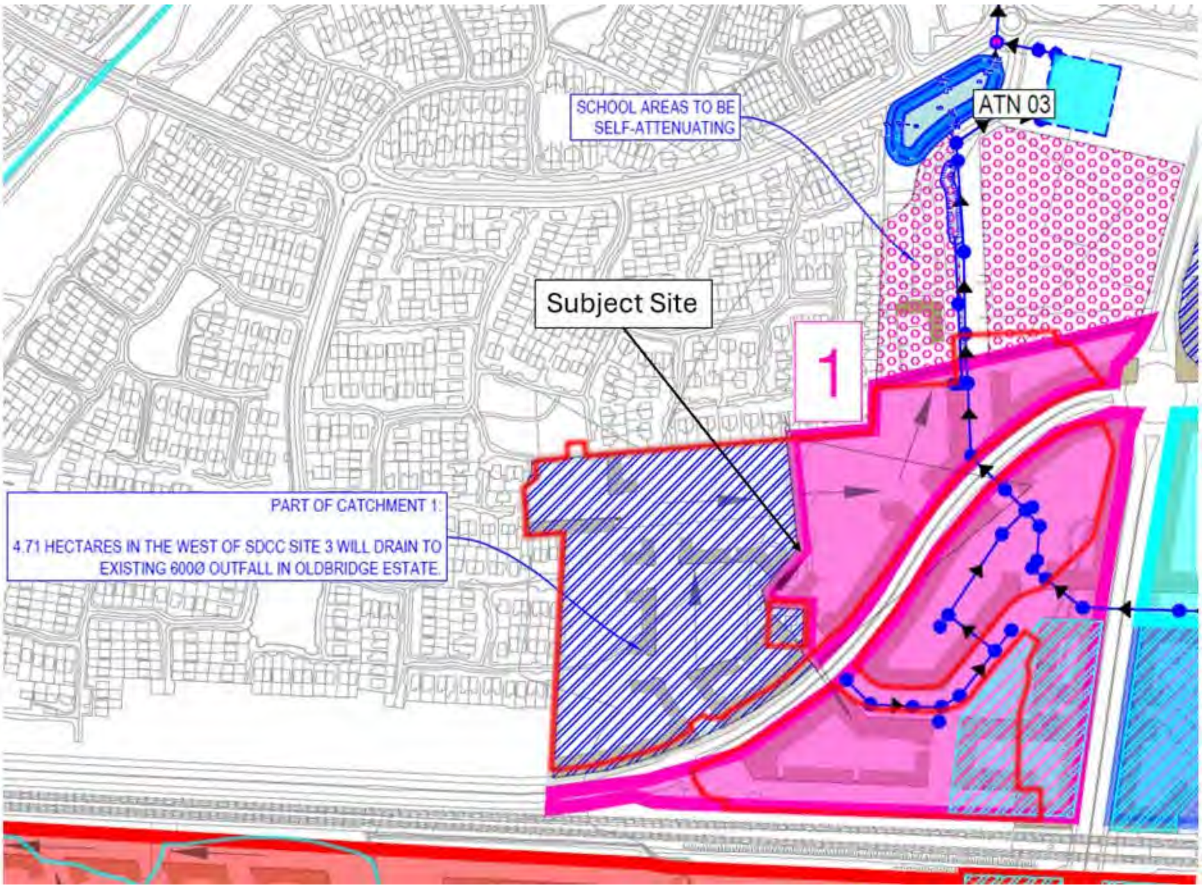



*Figure 3.7 Proposed Site within Clonburris Surface Water Catchment Plan*

The below table documents the site design compliance with the SWMP Requirements & Objectives

| SDZ Requirements/ Objectives | Proposed Development Compliance |
|---|---|
| O1. It is an objective of the Surface Water Management Plan that proposals for all development cells include provision for at least two separate SuDS features | The proposed objective is met and exceeded in the subject design. SuDS features in the site design (prior to discharge to regional SuDS features) include<br>• Permeable paving<br>• Bioretention areas<br>• SuDS tree pits<br>• Open attenuation ponds |
| O2. It is an objective of the Surface Water Management Plan that green roofs are provided to any suitable buildings with area >300m² within Urban Centre sub sectors. | A portion of the site to the southeast is within an Urban Centre sub sector. There are no buildings >300m² proposed here, therefore objective is not applicable. |

| | |
|---|---|
| Green roof coverage should be minimum of 60% of building area | |
| O3. It is an objective of the Surface Water Management Plan that runoff from roads adjacent to suitable parkland or landscape strips should be conveyed in vegetated open channel SuDS features | The proposed objective is met in the subject design.<br>Bioretention areas and tree pits are provided to collect and convey road runoff along roads adjacent to open space. |
| O4. It is an objective of the Surface Water Management Plan that new link streets incorporate drainage discharges from carriageway runoff to tree pits or similar features. | Northern Link Street design is provided separately to this development under planning reference SDZ24A/0033W. Drainage discharges to SuDS features are noted to incorporated into this separate application |
| O5. It is an objective of the Surface Water Management Plan that all private parking areas are surfaced with pervious paving. | The proposed objective is met in the subject design. All parking areas are proposed to be surfaced with pervious paving. |

### 3.9.2 Compliance with Surface Water Policy

Surface water management for the proposed development is designed to comply with the Greater Dublin Strategic Drainage Study (GDSDS) policies and guidelines and the requirements of South Dublin County Council. The guidelines require the following four main criteria to be provided by the development's surface water design:

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage using permeable paving in driveways, treatment of run-off within the SUDS features e.g. permeable paving for driveways/parking bays, swales, bioretention areas and within the attenuation storage system and oil separators on the main surface water outfalls from the development. SuDS tree pits are also proposed to intercept road runoff.
- Criterion 2: River Regime Protection – satisfied by attenuating run-off with flow control devices prior to discharge to the outfall.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the Site being outside the 1000-year coastal and fluvial flood zones, (See Flood Risk Assessment). Pluvial flood risk addressed by development designed to accommodate a 100-year storm as per GDSDS. Planned flood routing for storms greater than 100-year level, considered in design, the development has been designed to provide an overland flood route from the development towards the surface water outfall.

- Criterion 4: River flood protection – attenuation and long-term storage provided within the SUDS features e.g. permeable paving construction, swales, bioretention areas, tree pits and attenuation facilities.

# 4 FOUL DRAINAGE

## 4.1 Existing Foul Drainage

Existing foul drainage runs along the northern side of Adamstown Avenue through the subject site. The existing site is predominantly greenfield and therefore has no foul loading at present. The planning application SDZ24A/0033W includes the trunk foul sewers which the subject site will connect into. The majority of the subject site's foul layout will be designed to connect into the trunk foul sewers.

## 4.2 Design Strategy

The proposed foul water network has been split into 2no. separate catchments for the subject site.

It is proposed that the foul water generated in Kishoge Site 3 foul Catchment A will discharge into the existing OldBridge foul outfall to the northwest of the proposed site. 120no. units will connect to the existing OldBridge outfall as per connection feasibility confirmation. See Appendix C for the Uisce Éireann Confirmation of Feasibility.

Foul water from Kishoge Site 3 foul Catchment B will be collected by sewers to be constructed as part of NLS works, discharged via gravity towards pumping station 3 (to the northeast of the site) and pumped east where it eventually discharges at the existing 9B trunk sewer on R113 Fonthill Road. See Figure 4.1 below showing the proposed foul Catchments A and B.

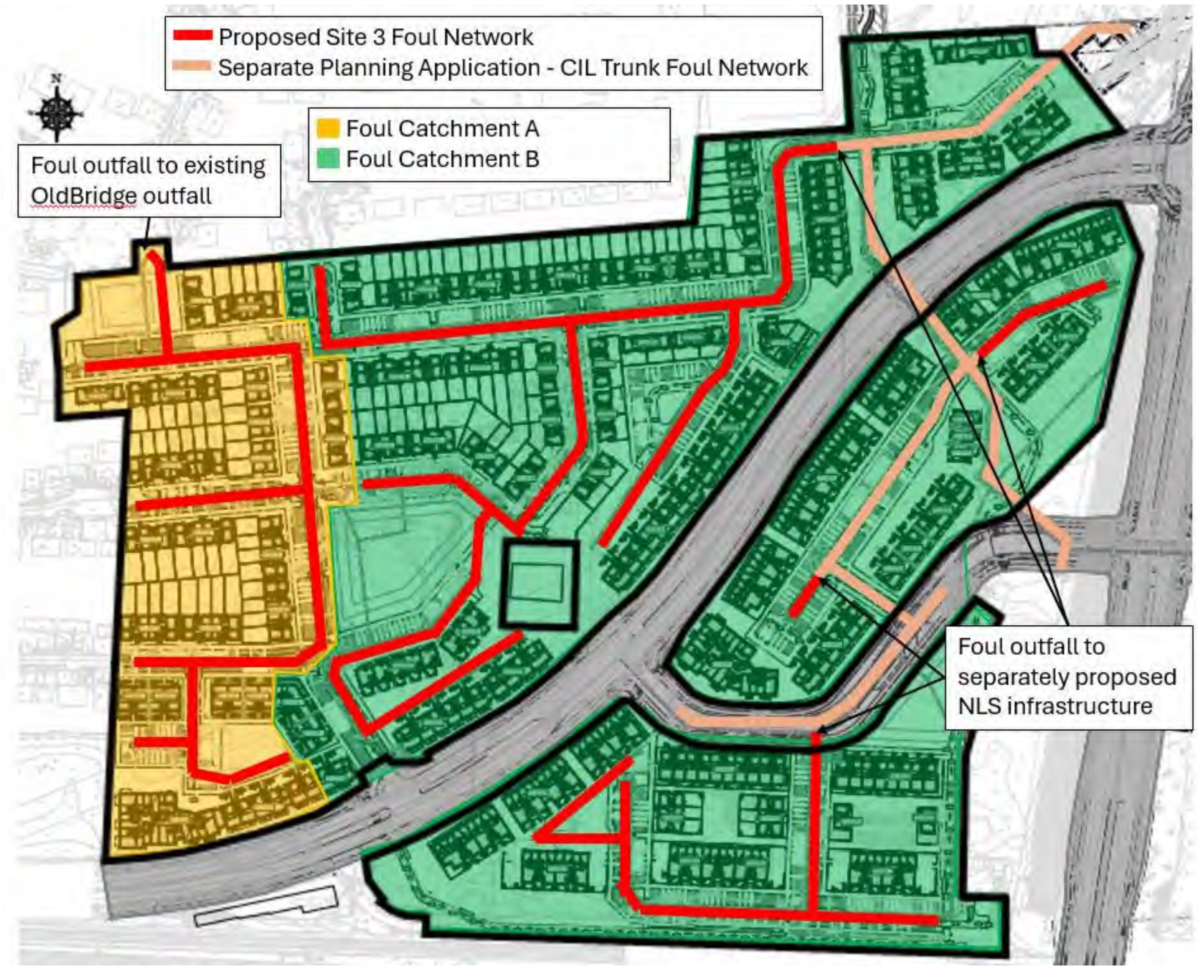



*Figure 4.1 Kishoge Site 3 Foul Water Sub-Catchments*

## 4.3 Design Criteria

Foul sewers have been designed in accordance with the Building Regulations and specifically in accordance with the principles and methods set out in the Irish Water Design and Construction Requirements for Self-Lay Developments July 2020 (Revision 2) and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The following criteria have been applied:

| | |
|---|---|
| Demand | 446l/dwelling/day (based on 2.7 persons per house, a per capita wastewater flow of 150 litres per head per day and a 10% allowance for infiltration) |
| Discharge Units | 14 units per house (as BS8301) |

| | |
|---|---|
| Pipe Friction (Ks) | 1.5 mm |
| Minimum Velocity | 0.75 m/s (self-cleansing velocity) |
| Maximum Velocity | 2.5 m/s |
| Frequency Factor | 0.5 for domestic use |
| Manhole Depths | < 5.0m |

Foul sewer design calculations from Windes are provided in Appendix B.

All foul sewers and manholes will be constructed in accordance with the Irish Water Standard Details and the Irish Water Code of Practice for Wastewater.

Longitudinal sections for the proposed foul sewers are detailed on drawings KSG3-DBFL-94-XX-DR-C-3601 to 3603.

A Statement of Design Acceptance (SoDA) was received from Uisce Éireann in March 2025 (See Appendix F).

### 4.4 Compliance with Irish Water Standards

The proposed foul sewer design and layout is in accordance with the Irish Water 'Code of Practice for Wastewater Infrastructure and the Irish Water 'Wastewater Infrastructure Standard Details'. Refer to Appendix C for the Irish Water Confirmation of Feasibility for the subject development as received form Irish Water.

### 4.5 Compliance with Clonburris Water and Wastewater Report

The proposed foul sewer design and layout complies with the Clonburris Water and Wastewater Report as agreed with SDCC and Irish Water.

The overall Clonburris SDZ has been divided into 7no. separate foul water catchments. The subject site is within foul Catchment W and Catchment S of the SDZ (refer to Table 4.1 & Figure 4.1). The proposed site will benefit from foul infrastructure proposed as part of separately approved NLS works. Trunk foul sewer network has been designed as part of the NLS works to serve the majority of the subject site based on the average net density for Catchment W, ranging from the "Low Margin" to a "High Margin". The overall SDZ lands are relatively flat, therefore, the pumping of wastewater is required.

*Table 4.1 Development Details for Clonburris SDZ Foul Catchments*

| Catchment | Residential Dwellings Low Margin | Residential Dwellings Target | Residential Dwellings High Margin | Retail GFA ($m^2$) | Employment GFA ($m^2$) | Community/Civic Building GFA ($m^2$) | Number of Schools |
|---|---|---|---|---|---|---|---|
| Catchment T | 148 | 162 | 175 | 0 | 0 | 0 | |
| Catchment U | 2035 | 2615 | 3198 | 14370 | 9215 | 3100 | 2 |
| Catchment V | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Catchment W | 1236 | 1466 | 1705 | 600 | 4800 | 0 | 2 & 1 (Existing) |
| Catchment X | 2680 | 3293 | 3896 | 6700 | 14500 | 3600 | 2 |
| Catchment Y | 1521 | 1760 | 1991 | 850 | 2600 | 600 | 1 |
| Catchment Z | 110 | 121 | 133 | 0 | 0 | 0 | |

As per the granted Clonburris NLS Stage 2 works application, a foul Catchment S has been included which will not discharge into Clonburris SDZ trunk infrastructure. Foul Catchment S will serve 120no. units and discharge to an existing network in OldBridge Estate, in agreement with SDCC and Uisce Éireann. See Figure 4.2 below.

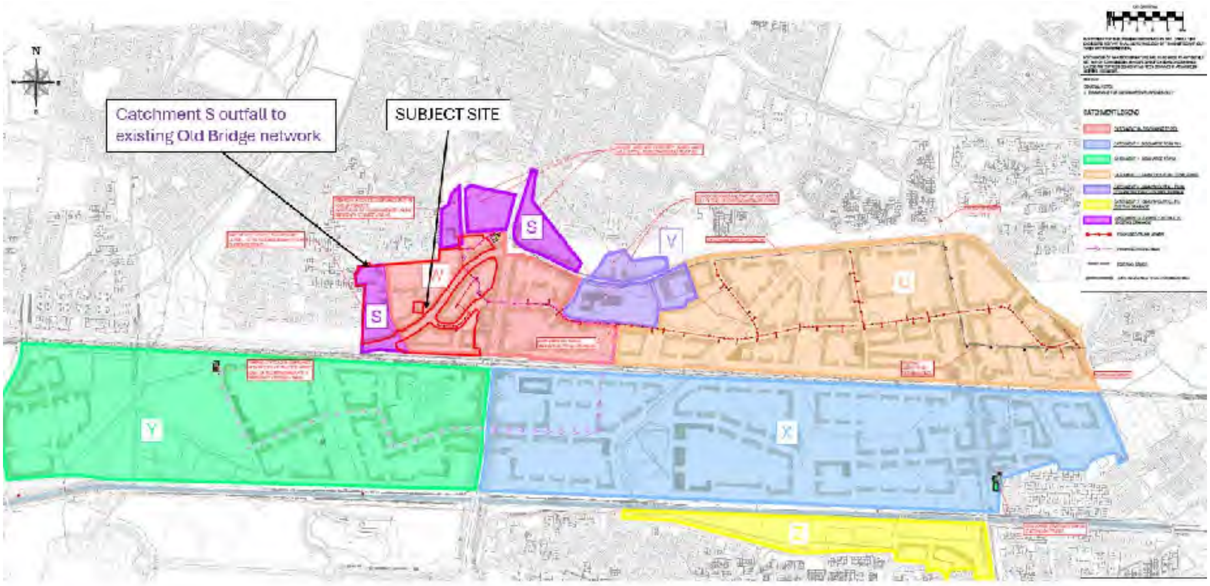



*Figure 4.2 Clonburris SDZ Foul Water Catchment Zones & Pumping Stations*

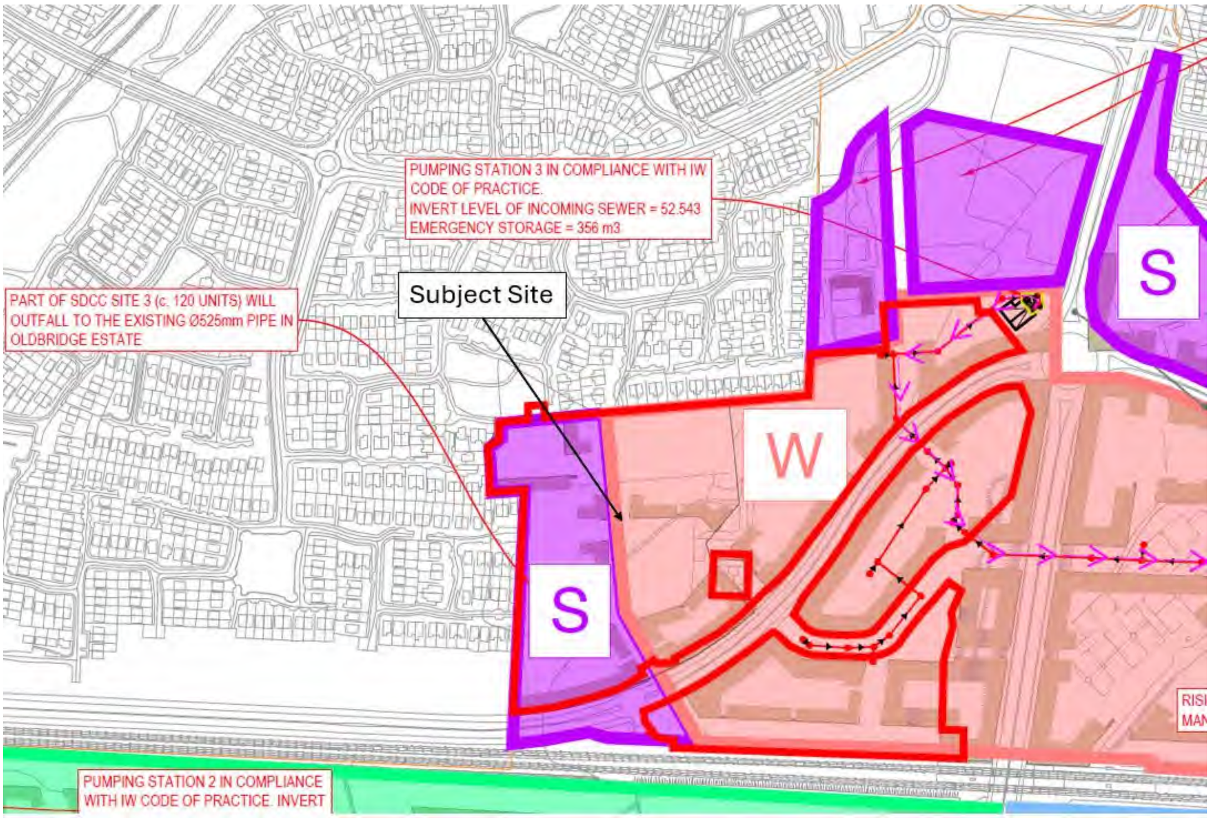



*Figure 4.3 Site within SDZ Foul Catchment Zones*

## 4.6 Design Calculations

This application comprises 580no. residential units and 553m$^2$ of creche area. The development will discharge to Pumping Station 3. The estimated loading from the proposed development is provided for both foul Catchment A in Table 4.2 and foul Catchment B in Table 4.3 below. Full network calculations are contained in Appendix B.

*Table 4.2 Predicted Kishoge Site 3 Foul Catchment A Calculations*

| **RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS** | | | | | | |
|---|---|---|---|---|---|---|
| **Unit Type** | **No.** | **Loading l/person/day** | **Occupancy person/unit** | **Occupancy** | **Daily Loading l/day** | **Daily Loading l/s** |
| Houses | 54 | 150 | 2.7 | 146 | 21,870 | 0.25 |
| Apartments | 38 | 150 | 2.7 | 103 | 15,390 | 0.18 |
| Duplexes/Triplexes | 28 | 150 | 2.7 | 76 | 11,340 | 0.13 |
| | | | | | **Residential Daily Loading** | **0.56** |
| | | | | | | |
| | | | | | Growth Factor | 1 |
| | | | | | Infiltration @ 10% (as CoP App B - 2.2.4) | 0.06 |
| | | | | | **Dry Weather Flow l/s** | **0.62** |
| | | | | | | |
| | | | | | Residential Peak Factor (as CoP App B - 2.2.5) | 6.0 |
| | | | | | **Design Foul Flow l/s** | **3.71** |
| ***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix C** | | | | | | |
| | | | | | | |
| **NON-RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS** | | | | | | |
| **Unit Type** | **Floor Area m2** | **Occupancy Load m2 /person** | **Occupancy** | **Loading l/Person/day** | **Daily Loading l/day** | **Daily Loading l/s** |
| Creche | 553 | 7 | 79 | 50 | 3,950 | 0.05 |
| | | | | | **Non - Residential Daily Loading** | **0.05** |
| | | | | | | |
| | | | | | Growth Factor | 1 |
| | | | | | Infiltration @ 10% (as CoP App B - 2.2.4) | 0.00 |
| | | | | | **Dry Weather Flow l/s** | **0.05** |
| | | | | | | |
| | | | | | Commercial Peak Factor (as CoP App B - 2.2.7) | 4.5 |
| | | | | | **Design Foul Flow l/s** | **0.23** |
| | | | | | | |
| | | | | | **TOTAL PREDICTED DEVELOPMENT AVERAGE FOUL FLOWS l/s** | **0.61** |
| | | | | | **TOTAL PREDICTED DEVELOPMENT PEAK FOUL FLOWS l/s** | **3.94** |
| ***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix D** | | | | | | |

*Table 4.3 Predicted Kishoge Site 3 Foul Catchment B Calculations*

| RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS | | | | | | |
|---|---|---|---|---|---|---|
| **Unit Type** | **No.** | **Loading l/person/day** | **Occupancy person/unit** | **Occupancy** | **Daily Loading l/day** | **Daily Loading l/s** |
| Houses | 91 | 150 | 2.7 | 246 | 36,855 | 0.43 |
| Apartments | 38 | 150 | 2.7 | 103 | 15,390 | 0.18 |
| Duplexes/Triplexes | 331 | 150 | 2.7 | 894 | 134,055 | 1.55 |
| | | | | | **Residential Daily Loading** | **2.16** |
| | | | | | | |
| | | | | | Growth Factor | 1 |
| | | | | | Infiltration @ 10% (as CoP App B - 2.2.4) | 0.22 |
| | | | | | **Dry Weather Flow l/s** | **2.37** |
| | | | | | | |
| | | | | | Residential Peak Factor (as CoP App B - 2.2.5) | 6.0 |
| | | | | | **Design Foul Flow l/s** | **14.23** |
| ***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix C** | | | | | | |
| | | | | | | |
| **NON-RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS** | | | | | | |
| **Unit Type** | **Floor Area m2** | **Occupancy Load m2 /person** | **Occupancy** | **Loading l/Person/day** | **Daily Loading l/day** | **Daily Loading l/s** |
| Creche | 553 | 7 | 79 | 50 | 3,950 | 0.05 |
| | | | | | **Non - Residential Daily Loading** | **0.05** |
| | | | | | | |
| | | | | | Growth Factor | 1 |
| | | | | | Infiltration @ 10% (as CoP App B - 2.2.4) | 0.00 |
| | | | | | **Dry Weather Flow l/s** | **0.05** |
| | | | | | | |
| | | | | | Commercial Peak Factor (as CoP App B - 2.2.7) | 4.5 |
| | | | | | **Design Foul Flow l/s** | **0.23** |
| | | | | | | |
| | | | | | **TOTAL PREDICTED DEVELOPMENT AVERAGE FOUL FLOWS l/s** | **2.20** |
| | | | | | **TOTAL PREDICTED DEVELOPMENT PEAK FOUL FLOWS l/s** | **14.46** |
| ***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix D** | | | | | | |

DBFL CONSULTING ENGINEERS

# 5 WATER SUPPLY AND DISTRIBUTION

## 5.1 Existing Water Supply

There is an existing 400mm diameter watermain running along Adamstown Avenue which will serve the proposed site. The proposed site will also benefit from trunk watermain infrastructure proposed as part of the NLS works for which was granted permission under planning reference SDZ24A/0033W. The planning application includes a 200mm diameter watermain running along the proposed NLS through the southeast of the subject site as shown in Figure 5.1.

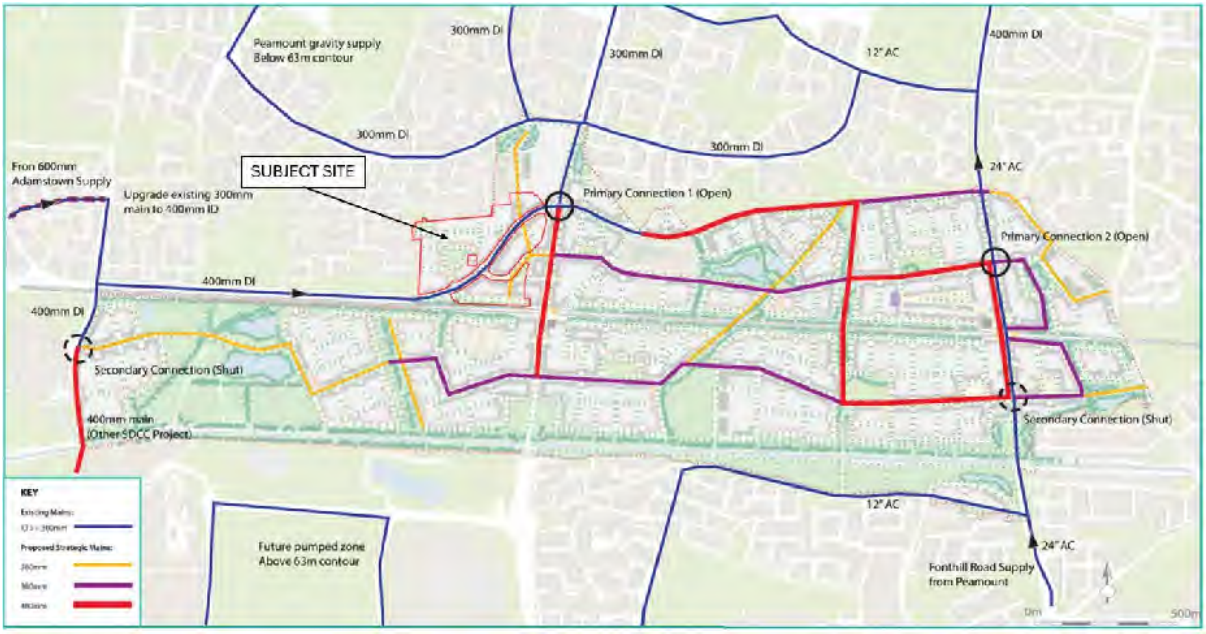



*Figure 5.1 Irish Water Strategic Watermain Plan around Clonburris SDZ*

## 5.2 Development Water Main Layout

The watermains of the subject site will connect into the NLS trunk watermain infrastructure and the existing watermain infrastructure within Adamstown Avenue, creating three separate 180mm primary watermain loops serving the proposed development site. The 180mm loops within the subject site will then feed smaller 125mm distribution watermains.

The connection to the public water main will include a metered connection with sluice valve arrangement in accordance with the requirements of Irish Water. Air valves are included at localised high points.

Individual houses will have their own connections to the distribution main via service connections and boundary boxes. Individual service boundary boxes will be of the type to suit Irish Water and to facilitate domestic meter installation.

Hydrants are provided for firefighting at locations to ensure that each dwelling is within the required Building Regulations distance of a hydrant.

The development's proposed water-main distribution system is shown on drawing KSG3-DBFL-93-XX-DR-C-1351.

A Statement of Design Acceptance (SoDA) was received from Uisce Éireann in March 2025 (See Appendix F).

## 5.3 Compliance with Irish Water Standards

The proposed watermain design and layout is in accordance with the Irish Water 'Code of Practice for Water Infrastructure' and The Irish Water 'Water Infrastructure Standard Details'.

## 5.4 Compliance with Clonburris Water and Wastewater Report

A Confirmation of Feasibility for the overall SDZ lands has been received from Uisce Éireann (ref: CDS2512559856). The proposed watermain design and layout complies with the Clonburris Water and Wastewater strategy as agreed with SDCC and Irish Water.

A further Confirmation of Feasibility application for the subject Kishoge Site 3 development (ref: CDS24003031) was completed and received in May 2024. Refer to Appendix C for further details.

The watermain systems for the NLS works have been approved under planning reference SDZ24A/0033W. Minor amendments to the plan footprints permitted under SDZ24A/0033W are proposed as part of the current application, however, the overall general arrangement is be maintained as per the permitted application.

The proposed site falls within District 8 (DMA8) of the District Metering Areas (DMA) under the Clonburris SDZ district metering strategy as shown in Figure 5.2 below.

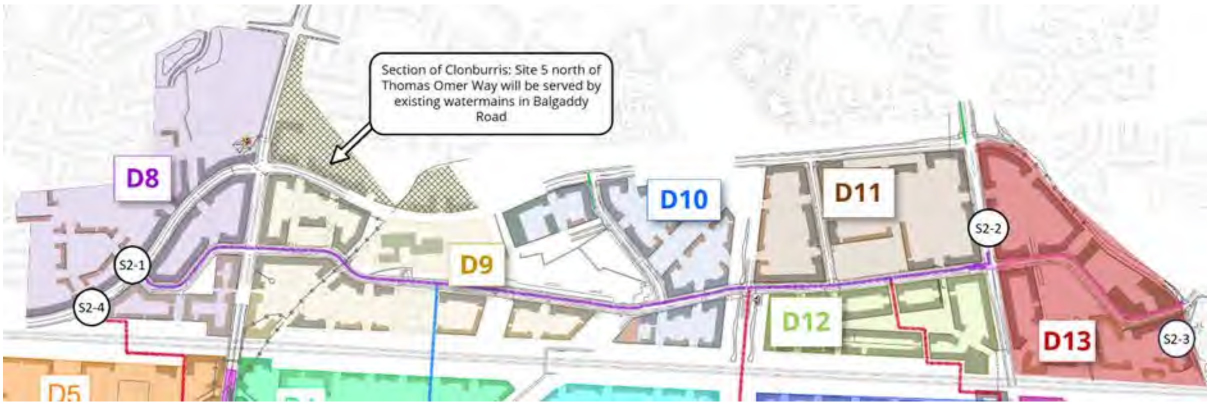



*Figure 5.2 Clonburris SDZ District Water Metering Strategy*

The water demand calculated for the proposed site is compliant with the SDZ district water demands. The proposed site has 580no. units and a creche versus 717no. units under DMA8.

The proposed site has an average day demand in peak week of 3.57l/s (308m$^3$/day) versus 503.28m$^3$/day under DMA8. Therefore, the average day demand in peak week of the proposed site is 61.2% of the DMA8 demand.

Table 5.1 below shows the water demand summary for DMA8 within the SDZ.

*Table 5.1 Clonburris SDZ Water Demand Summary*

| District Metering Area | Average Day Demand in Peak Week (m$^3$/day) | Residential Units | Domestic Population | Non Domestic Population | Total Hourly Demand (l/sec) |
|---|---|---|---|---|---|
| **DMA 8** | 503.28 | 717 | 1,936 | 533 | 17.96 |
| **DMA 9** | 605.15 | 862.00 | 2,327.40 | 615.17 | 21.58 |
| **DMA 10** | 235.57 | 364.00 | 982.80 | 164.11 | 8.27 |
| **DMA 11** | 343.87 | 558.00 | 1,506.60 | 0.00 | 11.94 |
| **DMA 12** | 656.55 | 883.00 | 2,384.10 | 1,398.38 | 23.68 |
| **DMA 13** | 502.12 | 695.00 | 1,876.50 | 539.44 | 18.01 |
| | **2846.5** | **4079** | **11013.3** | **3249.8** | **101.4** |

Table 5.2, in the next section 5.5, shows the predicted water demand for the proposed site.

## 5.5 Design Calculations

The water demand is designed in accordance with the principles and methods set out in Irish Water's 'Code of Practice for Water Infrastructure - Connections and Developer Services - Design & Construction Requirements for Self-Lay Developments - July 2020'.

Overall water demand is calculated using IW CoP for Water Infrastructure section 3.7.2, as outlined below:

- Per-capita consumption 150l/person/day
- Average day/week demand factor 1.25
- Peak demand factor 5.0
- Average daily domestic demand = Total occupancy * Per-capita consumption
- Average day/peak week demand = Average daily domestic demand * Average day/week demand factor
- Peak hour water demand = Average day/peak week demand * Peak demand factor
- Estimated water demand for the proposed development is provided in Table 5.2.

*Table 5.2 Predicted Kishoge Site 3 Water Calculations*

| RESIDENTIAL - WATER DEMAND | | | | | | |
|---|---|---|---|---|---|---|
| **Unit Type** | **No. Dwellings** | **Occupancy Rate /dwelling** | **Occupancy** | **Per Capita Consumption l/Person/day** | **Average Daily Domestic Demand l/day** | **Average Daily Domestic Demand l/s** |
| Apartments | 76 | 2.7 | 205 | 150 | 30,780 | 0.36 |
| Houses | 145 | 2.7 | 392 | 150 | 58,725 | 0.68 |
| Duplexes/Triplex | 359 | 2.7 | 969 | 150 | 145,395 | 1.68 |
| | | | | | **Total Average Daily Loading l/s** | **2.72** |
| | | | | | | |
| | | | | | **Average Day/Week Domestic Demand** | 1.25 |
| | | | | | **Average Day/Peak Week Demand l/s** | **3.40** |
| | | | | | | |
| | | | | | **Peak Demand Factor** | 5 |
| | | | | | **Peak Hour Water Demand l/s** | **16.99** |
| ***Flow rates calculated using IW CoP for Water Infrastructure** | | | | | | |
| | | | | | | |
| **NON-RESIDENTIAL WATER DEMAND** | | | | | | |
| **Unit Type** | **Floor Area $m^2$** | **Occupancy Rate $m^2$/person** | **Occupancy** | **Per Capita Consumption l/Person/day** | **Average Daily Demand l/day** | **Average Daily Demand l/s** |
| Creche | 553 | 7 | 79 | 150 | 11,850 | 0.14 |
| | | | | | **Total Average Daily Loading l/s** | **0.14** |
| | | | | | | |
| | | | | | **Average Day/Week Demand** | 1.25 |
| | | | | | **Average Day/Peak Week Demand l/s** | **0.17** |
| | | | | | | |
| | | | | | **Peak Demand Factor** | 5 |
| | | | | | **Peak Hour Water Demand l/s** | **0.86** |
| ***Flow rates calculated using IW CoP for Water Infrastructure** | | | | | | |
| | | | | | | |
| | | | | | **TOTAL AVERAGE DAILY LOADING l/s** | **2.86** |
| | | | | | **AVERAGE DAY/PEAK WEEK DEMAND l/s** | **3.57** |
| | | | | | **PEAK HOUR WATER DEMAND** | **17.85** |
| ***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix D** | | | | | | |

# Appendix A : SURFACE WATER NETWORK CALCULATIONS

# [MICRO-DRAINAGE NETWORK MODULE]

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW1

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

Total Area Contributing (ha) = 3.034 ← SW Catchment A - Impermebale Area

Total Pipe Volume (m³) = 154.059

### Network Design Table for SW1

« - Indicates pipe capacity < flow

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.541 | 0.138 | 199.6 | 0.074 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.001 | 18.446 | 0.092 | 200.5 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.002 | 12.450 | 0.062 | 200.8 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 2.000 | 19.551 | 0.098 | 199.5 | 0.074 | 4.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 50.00 | 4.41 | 54.818 | 0.074 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4 | 10.0 |
| 1.001 | 50.00 | 4.69 | 54.692 | 0.148 | 0.0 | 0.0 | 0.0 | 1.11 | 78.2 | 20.0 |
| 1.002 | 50.00 | 4.88 | 54.600 | 0.222 | 0.0 | 0.0 | 0.0 | 1.11 | 78.2 | 30.1 |
| 2.000 | 50.00 | 4.35 | 54.603 | 0.074 | 0.0 | 0.0 | 0.0 | 0.92 | 36.7 | 10.0 |

## Network Design Table for SW1

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

## Network Results Table

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

## Network Design Table for SW1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.000 | 25.107 | 0.126 | 199.3 | 0.074 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 7.000 | 12.387 | 0.039 | 317.6 | 0.074 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 7.001 | 4.924 | 0.039 | 126.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 7.002 | 21.167 | 0.118 | 179.4 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 6.001 | 20.743 | 0.104 | 199.5 | 0.074 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 6.002 | 21.048 | 0.073 | 288.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 4.008 | 12.972 | 0.143 | 90.7 | 0.074 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 4.009 | 11.152 | 0.111 | 100.5 | 0.074 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 4.010 | 13.053 | 0.065 | 200.8 | 0.074 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 8.000 | 65.603 | 0.328 | 200.0 | 0.074 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 1.008 | 66.495 | 0.332 | 200.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| 9.000 | 51.526 | 0.258 | 199.7 | 0.074 | 4.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| 9.001 | 36.034 | 0.180 | 200.2 | 0.074 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| 10.000 | 31.085 | 0.155 | 200.5 | 0.074 | 4.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6.000 | 50.00 | 4.38 | 54.497 | 0.074 | 0.0 | 0.0 | 0.0 | 1.11 | 78.5 | 10.0 |
| 7.000 | 50.00 | 4.24 | 54.566 | 0.074 | 0.0 | 0.0 | 0.0 | 0.88 | 62.0 | 10.0 |
| 7.001 | 50.00 | 4.29 | 54.528 | 0.148 | 0.0 | 0.0 | 0.0 | 1.40 | 98.8 | 20.0 |
| 7.002 | 50.00 | 4.60 | 54.489 | 0.222 | 0.0 | 0.0 | 0.0 | 1.17 | 82.8 | 30.1 |
| 6.001 | 50.00 | 4.84 | 54.371 | 0.370 | 0.0 | 0.0 | 0.0 | 1.44 | 228.4 | 50.1 |
| 6.002 | 50.00 | 5.13 | 54.267 | 0.444 | 0.0 | 0.0 | 0.0 | 1.19 | 189.6 | 60.1 |
| 4.008 | 50.00 | 6.30 | 54.305 | 1.258 | 0.0 | 0.0 | 0.0 | 2.14 | 339.6 | 170.3 |
| 4.009 | 50.00 | 6.39 | 54.162 | 1.332 | 0.0 | 0.0 | 0.0 | 2.03 | 322.6 | 180.4 |
| 4.010 | 50.00 | 6.54 | 54.051 | 1.406 | 0.0 | 0.0 | 0.0 | 1.43 | 227.6 | 190.4 |
| 8.000 | 50.00 | 4.99 | 54.314 | 0.074 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 10.0 |
| 1.008 | 50.00 | 7.67 | 53.986 | 2.294 | 0.0 | 0.0 | 0.0 | 1.72 | 485.5 | 310.6 |
| 9.000 | 50.00 | 4.93 | 54.175 | 0.074 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 10.0 |
| 9.001 | 50.00 | 5.58 | 53.917 | 0.148 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 20.0 |
| 10.000 | 50.00 | 4.56 | 53.892 | 0.074 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 10.0 |

## Network Design Table for SW1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.002 | 16.666 | 0.083 | 200.8 | 0.074 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| 1.009 | 61.773 | 0.309 | 199.9 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| 11.000 | 29.580 | 0.370 | 79.9 | 0.074 | 4.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.010 | 10.296 | 0.051 | 201.9 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| 1.011 | 15.925 | 0.080 | 199.1 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| 1.012 | 12.234 | 0.061 | 200.6 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |
| 1.013 | 8.610 | 0.043 | 200.2 | 0.074 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.002 | 50.00 | 5.89 | 53.737 | 0.296 | 0.0 | 0.0 | 0.0 | 0.92 | 36.5« | 40.1 |
| 1.009 | 50.00 | 8.27 | 53.654 | 2.664 | 0.0 | 0.0 | 0.0 | 1.72 | 486.0 | 360.7 |
| 11.000 | 50.00 | 4.22 | 53.715 | 0.074 | 0.0 | 0.0 | 0.0 | 2.28 | 361.9 | 10.0 |
| 1.010 | 50.00 | 8.37 | 53.345 | 2.812 | 0.0 | 0.0 | 0.0 | 1.71 | 483.6 | 380.8 |
| 1.011 | 50.00 | 8.52 | 53.294 | 2.886 | 0.0 | 0.0 | 0.0 | 1.72 | 487.0 | 390.8 |
| 1.012 | 50.00 | 8.64 | 53.214 | 2.960 | 0.0 | 0.0 | 0.0 | 1.72 | 485.2 | 400.8 |
| 1.013 | 50.00 | 8.72 | 53.153 | 3.034 | 0.0 | 0.0 | 0.0 | 1.72 | 485.6 | 410.8 |

## Manhole Schedules for SW1

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SA14 | 57.400 | 2.582 | Open Manhole | 1200 | 1.000 | 54.818 | 300 | | | | |
| SA13 | 57.100 | 2.420 | Open Manhole | 1200 | 1.001 | 54.692 | 300 | 1.000 | 54.680 | 300 | |
| SA12 | 56.800 | 2.200 | Open Manhole | 1200 | 1.002 | 54.600 | 300 | 1.001 | 54.600 | 300 | |
| SA11-1 | 56.965 | 2.362 | Open Manhole | 1200 | 2.000 | 54.603 | 225 | | | | |
| SA11 | 56.610 | 2.105 | Open Manhole | 1200 | 1.003 | 54.538 | 450 | 1.002 | 54.538 | 300 | |
| | | | | | | | | 2.000 | 54.505 | 225 | |
| SA10-1 | 56.308 | 1.799 | Open Manhole | 1200 | 3.000 | 54.509 | 450 | | | | |
| SA10 | 56.346 | 1.936 | Open Manhole | 1200 | 1.004 | 54.410 | 450 | 1.003 | 54.410 | 450 | |
| | | | | | | | | 3.000 | 54.410 | 450 | |
| SA9 | 56.737 | 2.440 | Open Manhole | 1500 | 1.005 | 54.297 | 600 | 1.004 | 54.297 | 450 | |
| SA8 | 56.968 | 2.741 | Open Manhole | 1500 | 1.006 | 54.227 | 600 | 1.005 | 54.227 | 600 | |
| SA7 | 57.033 | 2.819 | Open Manhole | 1500 | 1.007 | 54.214 | 600 | 1.006 | 54.214 | 600 | |
| SA6-11 | 57.300 | 1.606 | Open Manhole | 1200 | 4.000 | 55.694 | 300 | | | | |
| SA6-10 | 57.300 | 1.746 | Open Manhole | 1200 | 4.001 | 55.554 | 300 | 4.000 | 55.554 | 300 | |
| SA6-9 | 57.705 | 2.429 | Open Manhole | 1200 | 4.002 | 55.289 | 450 | 4.001 | 55.276 | 300 | |
| SA6-8 | 57.149 | 2.149 | Open Manhole | 1200 | 4.003 | 55.000 | 450 | 4.002 | 55.000 | 450 | |
| SA6-7 | 56.990 | 2.082 | Open Manhole | 1200 | 4.004 | 54.908 | 450 | 4.003 | 54.908 | 450 | |
| SA6-6 | 57.023 | 2.179 | Open Manhole | 1200 | 4.005 | 54.844 | 450 | 4.004 | 54.876 | 450 | 32 |
| SA6-5 | 57.100 | 2.338 | Open Manhole | 1200 | 4.006 | 54.762 | 450 | 4.005 | 54.762 | 450 | |
| SA6-4-2 | 57.135 | 2.172 | Open Manhole | 1200 | 5.000 | 54.963 | 300 | | | | |
| SA6-4-1 | 57.074 | 2.250 | Open Manhole | 1200 | 5.001 | 54.824 | 300 | 5.000 | 54.824 | 300 | |
| SA6-4 | 57.137 | 2.451 | Open Manhole | 1200 | 4.007 | 54.686 | 450 | 4.006 | 54.686 | 450 | |
| | | | | | | | | 5.001 | 54.686 | 300 | |
| SA6-2-2-1 | 56.794 | 2.297 | Open Manhole | 1200 | 6.000 | 54.497 | 300 | | | | |
| SA6-2-5 | 57.131 | 2.565 | Open Manhole | 1200 | 7.000 | 54.566 | 300 | | | | |
| SA6-2-4 | 57.043 | 2.516 | Open Manhole | 1200 | 7.001 | 54.528 | 300 | 7.000 | 54.527 | 300 | |
| SA6-2-3 | 56.996 | 2.507 | Open Manhole | 1200 | 7.002 | 54.489 | 300 | 7.001 | 54.489 | 300 | |
| SA6-2-2 | 56.977 | 2.606 | Open Manhole | 1200 | 6.001 | 54.371 | 450 | 6.000 | 54.371 | 300 | |
| | | | | | | | | 7.002 | 54.371 | 300 | |
| SA6-2-1 | 57.000 | 2.733 | Open Manhole | 1200 | 6.002 | 54.267 | 450 | 6.001 | 54.267 | 450 | |
| SA6-3 | 57.000 | 2.806 | Open Manhole | 1200 | 4.008 | 54.305 | 450 | 4.007 | 54.305 | 450 | |
| | | | | | | | | 6.002 | 54.194 | 450 | |
| SA6-2 | 57.000 | 2.838 | Open Manhole | 1200 | 4.009 | 54.162 | 450 | 4.008 | 54.162 | 450 | |
| SA6-1 | 56.760 | 2.709 | Open Manhole | 1200 | 4.010 | 54.051 | 450 | 4.009 | 54.051 | 450 | |
| SA6-12 | 57.167 | 2.853 | Open Manhole | 1200 | 8.000 | 54.314 | 300 | | | | |
| SA6 | 56.677 | 2.691 | Open Manhole | 1500 | 1.008 | 53.986 | 600 | 1.007 | 53.986 | 600 | |
| | | | | | | | | 4.010 | 53.986 | 450 | |
| | | | | | | | | 8.000 | 53.986 | 300 | |

Manhole Schedules for SW1

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SA5-3 | 57.103 | 2.928 | Open Manhole | 1200 | 9.000 | 54.175 | 225 | | | | |
| SA5-2 | 56.754 | 2.837 | Open Manhole | 1200 | 9.001 | 53.917 | 225 | 9.000 | 53.917 | 225 | |
| SA5-1-1 | 56.700 | 2.808 | Open Manhole | 1200 | 10.000 | 53.892 | 225 | | | | |
| SA5-1 | 56.549 | 2.812 | Open Manhole | 1200 | 9.002 | 53.737 | 225 | 9.001 | 53.737 | 225 | |
| | | | | | | | | 10.000 | 53.737 | 225 | |
| SA5 | 56.396 | 2.742 | Open Manhole | 1500 | 1.009 | 53.654 | 600 | 1.008 | 53.654 | 600 | |
| | | | | | | | | 9.002 | 53.654 | 225 | |
| SA4-1 | 55.978 | 2.263 | Open Manhole | 1200 | 11.000 | 53.715 | 450 | | | | |
| SA4 | 56.099 | 2.754 | Open Manhole | 1500 | 1.010 | 53.345 | 600 | 1.009 | 53.345 | 600 | |
| | | | | | | | | 11.000 | 53.345 | 450 | |
| SA3 | 56.300 | 3.006 | Open Manhole | 1500 | 1.011 | 53.294 | 600 | 1.010 | 53.294 | 600 | |
| SA2 | 56.300 | 3.086 | Open Manhole | 1500 | 1.012 | 53.214 | 600 | 1.011 | 53.214 | 600 | |
| SA1 | 56.300 | 3.147 | Open Manhole | 1500 | 1.013 | 53.153 | 600 | 1.012 | 53.153 | 600 | |
| SA0 | 56.000 | 2.890 | Open Manhole | 0 | | OUTFALL | | 1.013 | 53.110 | 600 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SA14 | 704165.528 | 732828.314 | 704165.528 | 732828.314 | Required |  |
| SA13 | 704139.618 | 732818.977 | 704139.618 | 732818.977 | Required |  |
| SA12 | 704121.439 | 732822.107 | 704121.439 | 732822.107 | Required |  |
| SA11-1 | 704101.887 | 732834.557 | 704101.887 | 732834.557 | Required |  |
| SA11 | 704121.439 | 732834.557 | 704121.439 | 732834.557 | Required |  |
| SA10-1 | 704101.729 | 732873.117 | 704101.729 | 732873.117 | Required |  |
| SA10 | 704121.436 | 732873.095 | 704121.436 | 732873.095 | Required |  |

## Manhole Schedules for SW1

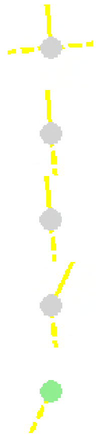
| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SA9 | 704155.340 | 732873.063 | 704155.340 | 732873.063 | Required |  |
| SA8 | 704176.185 | 732875.085 | 704176.185 | 732875.085 | Required |  |
| SA7 | 704178.145 | 732878.512 | 704178.145 | 732878.512 | Required |  |
| SA6-11 | 704267.076 | 732883.340 | 704267.076 | 732883.340 | Required |  |
| SA6-10 | 704244.364 | 732866.881 | 704244.364 | 732866.881 | Required |  |
| SA6-9 | 704196.156 | 732839.216 | 704196.156 | 732839.216 | Required |  |
| SA6-8 | 704180.338 | 732863.368 | 704180.338 | 732863.368 | Required |  |
| SA6-7 | 704179.432 | 732872.494 | 704179.432 | 732872.494 | Required |  |
| SA6-6 | 704184.857 | 732875.976 | 704184.857 | 732875.976 | Required |  |
| SA6-5 | 704192.990 | 732876.765 | 704192.990 | 732876.765 | Required |  |
| SA6-4-2 | 704244.286 | 732908.562 | 704244.286 | 732908.562 | Required |  |
| SA6-4-1 | 704226.524 | 732887.094 | 704226.524 | 732887.094 | Required |  |
| SA6-4 | 704200.238 | 732878.998 | 704200.238 | 732878.998 | Required |  |
| SA6-2-2-1 | 704188.732 | 732947.447 | 704188.732 | 732947.447 | Required |  |
| SA6-2-5 | 704248.958 | 732942.360 | 704248.958 | 732942.360 | Required |  |

Manhole Schedules for SW1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SA6-2-4 | 704239.427 | 732950.273 | 704239.427 | 732950.273 | Required | |
| SA6-2-3 | 704234.790 | 732951.927 | 704234.790 | 732951.927 | Required | |
| SA6-2-2 | 704213.725 | 732949.838 | 704213.725 | 732949.838 | Required | |
| SA6-2-1 | 704215.558 | 732929.176 | 704215.558 | 732929.176 | Required | |
| SA6-3 | 704194.886 | 732925.215 | 704194.886 | 732925.215 | Required | |
| SA6-2 | 704189.664 | 732937.089 | 704189.664 | 732937.089 | Required | |
| SA6-1 | 704184.571 | 732947.011 | 704184.571 | 732947.011 | Required | |
| SA6-12 | 704106.231 | 732940.154 | 704106.231 | 732940.154 | Required | |
| SA6 | 704171.530 | 732946.455 | 704171.530 | 732946.455 | Required | |
| SA5-3 | 704268.825 | 733022.699 | 704268.825 | 733022.699 | Required | |
| SA5-2 | 704217.539 | 733017.724 | 704217.539 | 733017.724 | Required | |
| SA5-1-1 | 704178.679 | 733045.137 | 704178.679 | 733045.137 | Required | |
| SA5-1 | 704181.678 | 733014.197 | 704181.678 | 733014.197 | Required | |
| SA5 | 704165.085 | 733012.637 | 704165.085 | 733012.637 | Required | |
| SA4-1 | 704074.160 | 733003.817 | 704074.160 | 733003.817 | Required | |

Manhole Schedules for SW1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SA4 | 704103.601 | 733006.673 | 704103.601 | 733006.673 | Required | |
| SA3 | 704102.614 | 733016.922 | 704102.614 | 733016.922 | Required | |
| SA2 | 704101.147 | 733032.779 | 704101.147 | 733032.779 | Required | |
| SA1 | 704099.862 | 733044.946 | 704099.862 | 733044.946 | Required | |
| SA0 | 704103.668 | 733052.669 | | | No Entry | |



## PIPELINE SCHEDULES for SW1

### Upstream Manhole

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

### Downstream Manhole

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

## PIPELINE SCHEDULES for SW1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 4.006 | o | 450 | SA6-5 | 57.100 | 54.762 | 1.888 | Open Manhole | 1200 |
| 5.000 | o | 300 | SA6-4-2 | 57.135 | 54.963 | 1.872 | Open Manhole | 1200 |
| 5.001 | o | 300 | SA6-4-1 | 57.074 | 54.824 | 1.950 | Open Manhole | 1200 |
| 4.007 | o | 450 | SA6-4 | 57.137 | 54.686 | 2.001 | Open Manhole | 1200 |
| 6.000 | o | 300 | SA6-2-2-1 | 56.794 | 54.497 | 1.997 | Open Manhole | 1200 |
| 7.000 | o | 300 | SA6-2-5 | 57.131 | 54.566 | 2.265 | Open Manhole | 1200 |
| 7.001 | o | 300 | SA6-2-4 | 57.043 | 54.528 | 2.215 | Open Manhole | 1200 |
| 7.002 | o | 300 | SA6-2-3 | 56.996 | 54.489 | 2.207 | Open Manhole | 1200 |
| 6.001 | o | 450 | SA6-2-2 | 56.977 | 54.371 | 2.156 | Open Manhole | 1200 |
| 6.002 | o | 450 | SA6-2-1 | 57.000 | 54.267 | 2.283 | Open Manhole | 1200 |
| 4.008 | o | 450 | SA6-3 | 57.000 | 54.305 | 2.245 | Open Manhole | 1200 |
| 4.009 | o | 450 | SA6-2 | 57.000 | 54.162 | 2.388 | Open Manhole | 1200 |
| 4.010 | o | 450 | SA6-1 | 56.760 | 54.051 | 2.259 | Open Manhole | 1200 |
| 8.000 | o | 300 | SA6-12 | 57.167 | 54.314 | 2.553 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 4.006 | 7.584 | 99.8 | SA6-4 | 57.137 | 54.686 | 2.001 | Open Manhole | 1200 |
| 5.000 | 27.864 | 200.5 | SA6-4-1 | 57.074 | 54.824 | 1.950 | Open Manhole | 1200 |
| 5.001 | 27.504 | 199.3 | SA6-4 | 57.137 | 54.686 | 2.151 | Open Manhole | 1200 |
| 4.007 | 46.526 | 122.1 | SA6-3 | 57.000 | 54.305 | 2.245 | Open Manhole | 1200 |
| 6.000 | 25.107 | 199.3 | SA6-2-2 | 56.977 | 54.371 | 2.306 | Open Manhole | 1200 |
| 7.000 | 12.387 | 317.6 | SA6-2-4 | 57.043 | 54.527 | 2.216 | Open Manhole | 1200 |
| 7.001 | 4.924 | 126.3 | SA6-2-3 | 56.996 | 54.489 | 2.207 | Open Manhole | 1200 |
| 7.002 | 21.167 | 179.4 | SA6-2-2 | 56.977 | 54.371 | 2.306 | Open Manhole | 1200 |
| 6.001 | 20.743 | 199.5 | SA6-2-1 | 57.000 | 54.267 | 2.283 | Open Manhole | 1200 |
| 6.002 | 21.048 | 288.3 | SA6-3 | 57.000 | 54.194 | 2.356 | Open Manhole | 1200 |
| 4.008 | 12.972 | 90.7 | SA6-2 | 57.000 | 54.162 | 2.388 | Open Manhole | 1200 |
| 4.009 | 11.152 | 100.5 | SA6-1 | 56.760 | 54.051 | 2.259 | Open Manhole | 1200 |
| 4.010 | 13.053 | 200.8 | SA6 | 56.677 | 53.986 | 2.241 | Open Manhole | 1500 |
| 8.000 | 65.603 | 200.0 | SA6 | 56.677 | 53.986 | 2.391 | Open Manhole | 1500 |

## PIPELINE SCHEDULES for SW1

### Upstream Manhole

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

### Downstream Manhole

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

## Area Summary for SW1

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

## Free Flowing Outfall Details for SW1

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

## Simulation Criteria for SW1

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

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

## Synthetic Rainfall Details

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

## Online Controls for SW1

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

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

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

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

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

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

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

Hydro-Brake® Optimum Manhole: SA2, DS/PN: 1.012, Volume ($m^3$): 9.5

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

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

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

## Storage Structures for SW1

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

Invert Level (m) 55.800

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1268.0 | 1.200 | 2088.0 |

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

Invert Level (m) 54.600

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 500.0 | 1.200 | 500.0 |

## Summary of Critical Results by Maximum Level (Rank 1) for SW1

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

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

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

+20% modelled for climate change

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 1.000 | SA14 | 720 minute 100 year Winter I+20% | 57.400 | 55.973 | 0.855 | 0.000 | 0.04 |
| 1.001 | SA13 | 720 minute 100 year Winter I+20% | 57.100 | 55.973 | 0.981 | 0.000 | 0.09 |
| 1.002 | SA12 | 720 minute 100 year Winter I+20% | 56.800 | 55.972 | 1.072 | 0.000 | 0.14 |
| 2.000 | SA11-1 | 720 minute 100 year Winter I+20% | 56.965 | 55.972 | 1.144 | 0.000 | 0.09 |
| 1.003 | SA11 | 720 minute 100 year Winter I+20% | 56.610 | 55.971 | 0.983 | 0.000 | 0.09 |
| 3.000 | SA10-1 | 720 minute 100 year Winter I+20% | 56.308 | 55.970 | 1.011 | 0.000 | 0.02 |
| 1.004 | SA10 | 720 minute 100 year Winter I+20% | 56.346 | 55.970 | 1.110 | 0.000 | 0.12 |
| 1.005 | SA9 | 720 minute 100 year Winter I+20% | 56.737 | 55.968 | 1.071 | 0.000 | 0.08 |
| 1.006 | SA8 | 960 minute 100 year Winter I+20% | 56.968 | 55.968 | 1.141 | 0.000 | 0.09 |
| 1.007 | SA7 | 960 minute 100 year Winter I+20% | 57.033 | 55.968 | 1.154 | 0.000 | 0.06 |
| 4.000 | SA6-11 | 30 minute 100 year Summer I+20% | 57.300 | 57.226 | 1.232 | 0.000 | 0.30 |
| 4.001 | SA6-10 | 30 minute 100 year Summer I+20% | 57.300 | 57.160 | 1.306 | 0.000 | 0.55 |
| 4.002 | SA6-9 | 30 minute 100 year Summer I+20% | 57.705 | 57.060 | 1.321 | 0.000 | 0.22 |
| 4.003 | SA6-8 | 30 minute 100 year Summer I+20% | 57.149 | 56.892 | 1.442 | 0.000 | 0.49 |
| 4.004 | SA6-7 | 30 minute 100 year Summer I+20% | 56.990 | 56.787 | 1.429 | 0.000 | 0.75 |
| 4.005 | SA6-6 | 30 minute 100 year Summer I+20% | 57.023 | 56.767 | 1.473 | 0.000 | 0.75 |
| 4.006 | SA6-5 | 30 minute 100 year Summer I+20% | 57.100 | 56.664 | 1.452 | 0.000 | 0.88 |
| 5.000 | SA6-4-2 | 15 minute 100 year Winter I+20% | 57.135 | 56.725 | 1.462 | 0.000 | 0.36 |
| 5.001 | SA6-4-1 | 30 minute 100 year Summer I+20% | 57.074 | 56.657 | 1.533 | 0.000 | 0.63 |
| 4.007 | SA6-4 | 30 minute 100 year Summer I+20% | 57.137 | 56.561 | 1.425 | 0.000 | 0.81 |

## Summary of Critical Results by Maximum Level (Rank 1) for SW1

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 1.000 | SA14 | | 1.301 | 2.9 | SURCHARGED |
| 1.001 | SA13 | | 3.319 | 5.8 | SURCHARGED |
| 1.002 | SA12 | | 2.765 | 8.7 | SURCHARGED |
| 2.000 | SA11-1 | | 1.543 | 2.9 | SURCHARGED |
| 1.003 | SA11 | | 3.177 | 14.4 | SURCHARGED |
| 3.000 | SA10-1 | | 1.647 | 2.9 | SURCHARGED |
| 1.004 | SA10 | | 10.640 | 20.1 | SURCHARGED |
| 1.005 | SA9 | | 8.122 | 23.0 | SURCHARGED |
| 1.006 | SA8 | | 8.565 | 20.8 | SURCHARGED |
| 1.007 | SA7 | | 3.782 | 23.1 | SURCHARGED |
| 4.000 | SA6-11 | | 1.726 | 21.5 | FLOOD RISK |
| 4.001 | SA6-10 | | 3.709 | 40.8 | FLOOD RISK |
| 4.002 | SA6-9 | | 5.856 | 61.5 | SURCHARGED |
| 4.003 | SA6-8 | | 6.535 | 83.2 | FLOOD RISK |
| 4.004 | SA6-7 | | 3.387 | 104.9 | FLOOD RISK |
| 4.005 | SA6-6 | | 3.004 | 126.8 | FLOOD RISK |
| 4.006 | SA6-5 | | 3.254 | 148.6 | SURCHARGED |
| 5.000 | SA6-4-2 | | 1.987 | 25.2 | SURCHARGED |
| 5.001 | SA6-4-1 | | 3.952 | 44.8 | SURCHARGED |
| 4.007 | SA6-4 | | 4.989 | 213.0 | SURCHARGED |

## Summary of Critical Results by Maximum Level (Rank 1) for SW1

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 6.000 | SA6-2-2-1 | 15 minute 100 year Winter I+20% | 56.794 | 56.585 | 1.788 | 0.000 | 0.38 |
| 7.000 | SA6-2-5 | 30 minute 100 year Summer I+20% | 57.131 | 56.725 | 1.859 | 0.000 | 0.50 |
| 7.001 | SA6-2-4 | 30 minute 100 year Summer I+20% | 57.043 | 56.705 | 1.877 | 0.000 | 0.79 |
| 7.002 | SA6-2-3 | 30 minute 100 year Summer I+20% | 56.996 | 56.626 | 1.837 | 0.000 | 1.00 |
| 6.001 | SA6-2-2 | 30 minute 100 year Summer I+20% | 56.977 | 56.510 | 1.689 | 0.000 | 0.66 |
| 6.002 | SA6-2-1 | 30 minute 100 year Summer I+20% | 57.000 | 56.401 | 1.684 | 0.000 | 0.93 |
| 4.008 | SA6-3 | 30 minute 100 year Summer I+20% | 57.000 | 56.307 | 1.552 | 0.000 | 1.77 |
| 4.009 | SA6-2 | 720 minute 100 year Winter I+20% | 57.000 | 56.236 | 1.624 | 0.000 | 0.04 |
| 4.010 | SA6-1 | 960 minute 100 year Winter I+20% | 56.760 | 55.970 | 1.469 | 0.000 | 0.05 |
| 8.000 | SA6-12 | 960 minute 100 year Winter I+20% | 57.167 | 55.968 | 1.354 | 0.000 | 0.03 |
| 1.008 | SA6 | 960 minute 100 year Winter I+20% | 56.677 | 55.968 | 1.382 | 0.000 | 0.08 |
| 9.000 | SA5-3 | 960 minute 100 year Winter I+20% | 57.103 | 55.971 | 1.571 | 0.000 | 0.07 |
| 9.001 | SA5-2 | 960 minute 100 year Winter I+20% | 56.754 | 55.970 | 1.828 | 0.000 | 0.14 |
| 10.000 | SA5-1-1 | 960 minute 100 year Winter I+20% | 56.700 | 55.969 | 1.852 | 0.000 | 0.07 |
| 9.002 | SA5-1 | 960 minute 100 year Winter I+20% | 56.549 | 55.967 | 2.005 | 0.000 | 0.29 |
| 1.009 | SA5 | 960 minute 100 year Winter I+20% | 56.396 | 55.965 | 1.711 | 0.000 | 0.11 |
| 11.000 | SA4-1 | 960 minute 100 year Winter I+20% | 55.978 | 55.960 | 1.795 | 0.000 | 0.01 |
| 1.010 | SA4 | 960 minute 100 year Winter I+20% | 56.099 | 55.961 | 2.016 | 0.000 | 0.17 |
| 1.011 | SA3 | 960 minute 100 year Winter I+20% | 56.300 | 55.959 | 2.065 | 0.000 | 0.16 |
| 1.012 | SA2 | 960 minute 100 year Winter I+20% | 56.300 | 55.957 | 2.143 | 0.000 | 0.05 |
| 1.013 | SA1 | 15 minute 100 year Summer I+20% | 56.300 | 53.309 | -0.444 | 0.000 | 0.15 |

Attenuation Pond 1 - Top Water Level

Attenuation Pond 2 - Top Water Level

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 6.000 | SA6-2-2-1 | | 2.356 | 26.7 | FLOOD RISK |
| 7.000 | SA6-2-5 | | 2.436 | 24.3 | SURCHARGED |
| 7.001 | SA6-2-4 | | 3.249 | 48.6 | SURCHARGED |
| 7.002 | SA6-2-3 | | 2.674 | 72.7 | SURCHARGED |
| 6.001 | SA6-2-2 | | 5.515 | 120.7 | SURCHARGED |
| 6.002 | SA6-2-1 | | 5.516 | 143.5 | SURCHARGED |
| 4.008 | SA6-3 | | 12.750 | 377.8 | SURCHARGED |
| 4.009 | SA6-2 | | 616.543 | 6.6 | SURCHARGED |
| 4.010 | SA6-1 | | 3.747 | 9.0 | SURCHARGED |
| 8.000 | SA6-12 | | 1.865 | 2.3 | SURCHARGED |
| 1.008 | SA6 | | 28.774 | 36.7 | SURCHARGED |
| 9.000 | SA5-3 | | 2.026 | 2.4 | SURCHARGED |
| 9.001 | SA5-2 | | 4.317 | 4.7 | SURCHARGED |
| 10.000 | SA5-1-1 | | 2.343 | 2.4 | SURCHARGED |
| 9.002 | SA5-1 | | 5.090 | 9.5 | SURCHARGED |
| 1.009 | SA5 | | 23.060 | 48.5 | SURCHARGED |
| 11.000 | SA4-1 | | 2.534 | 2.4 | FLOOD RISK |
| 1.010 | SA4 | | 26.146 | 53.1 | FLOOD RISK |
| 1.011 | SA3 | | 7.188 | 55.5 | SURCHARGED |
| 1.012 | SA2 | | 687.177 | 15.0 | SURCHARGED |
| 1.013 | SA1 | | 0.603 | 44.2 | OK |

Attenuation Pond 1 - Max Pond Volume

Attenuation Pond 2 - Max Pond Volume

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW2

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.631 | 4-8 | 0.708 |

Total Area Contributing (ha) = 1.339 ← SW Catchment B1 - Impermeable Area

Total Pipe Volume (m³) = 55.609

### Network Design Table for SW2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.506 | 0.138 | 199.3 | 0.090 | 4.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.001 | 5.939 | 0.030 | 198.0 | 0.090 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.002 | 55.854 | 0.186 | 300.3 | 0.090 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.003 | 70.969 | 0.237 | 299.4 | 0.090 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 2.000 | 54.270 | 0.362 | 149.9 | 0.089 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 2.001 | 30.810 | 0.205 | 150.3 | 0.089 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 50.00 | 4.32 | 55.618 | 0.090 | 0.0 | 0.0 | 0.0 | 1.44 | 228.5 | 12.2 |
| 1.001 | 50.00 | 4.39 | 55.480 | 0.180 | 0.0 | 0.0 | 0.0 | 1.44 | 229.2 | 24.4 |
| 1.002 | 50.00 | 5.18 | 55.450 | 0.270 | 0.0 | 0.0 | 0.0 | 1.17 | 185.8 | 36.6 |
| 1.003 | 50.00 | 6.20 | 55.264 | 0.360 | 0.0 | 0.0 | 0.0 | 1.17 | 186.0 | 48.7 |
| 2.000 | 50.00 | 4.71 | 55.886 | 0.089 | 0.0 | 0.0 | 0.0 | 1.28 | 90.6 | 12.1 |
| 2.001 | 50.00 | 5.11 | 55.524 | 0.178 | 0.0 | 0.0 | 0.0 | 1.28 | 90.5 | 24.1 |

## Network Design Table for SW2

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.002 | 9.502 | 0.063 | 150.8 | 0.089 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| 2.003 | 10.098 | 0.067 | 150.7 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 2.004 | 3.078 | 0.021 | 146.6 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 2.005 | 21.201 | 0.141 | 150.4 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.004 | 19.168 | 0.064 | 299.5 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.005 | 8.890 | 0.030 | 296.3 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.006 | 50.428 | 0.168 | 300.2 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.007 | 11.508 | 0.038 | 302.8 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| 1.008 | 22.972 | 0.077 | 298.3 | 0.089 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.002 | 50.00 | 5.23 | 55.319 | 0.267 | 0.0 | 0.0 | 0.0 | 1.28 | 90.3 | 36.2 |
| 2.003 | 50.00 | 5.33 | 55.256 | 0.356 | 0.0 | 0.0 | 0.0 | 1.65 | 263.0 | 48.2 |
| 2.004 | 50.00 | 5.36 | 55.189 | 0.445 | 0.0 | 0.0 | 0.0 | 1.68 | 266.7 | 60.3 |
| 2.005 | 50.00 | 5.58 | 55.168 | 0.534 | 0.0 | 0.0 | 0.0 | 1.66 | 263.3 | 72.3 |
| 1.004 | 50.00 | 6.47 | 55.027 | 0.983 | 0.0 | 0.0 | 0.0 | 1.17 | 186.0 | 133.1 |
| 1.005 | 50.00 | 6.60 | 54.963 | 1.072 | 0.0 | 0.0 | 0.0 | 1.18 | 187.0 | 145.2 |
| 1.006 | 50.00 | 7.31 | 54.933 | 1.161 | 0.0 | 0.0 | 0.0 | 1.17 | 185.8 | 157.2 |
| 1.007 | 50.00 | 7.48 | 54.765 | 1.250 | 0.0 | 0.0 | 0.0 | 1.16 | 185.0 | 169.3 |
| 1.008 | 50.00 | 7.81 | 54.727 | 1.339 | 0.0 | 0.0 | 0.0 | 1.17 | 186.4 | 181.3 |

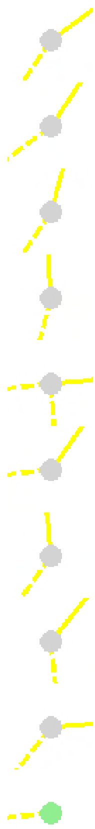
## Manhole Schedules for SW2

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SB9 | 57.109 | 1.491 | Open Manhole | 1200 | 1.000 | 55.618 | 450 | | | | |
| SB8 | 57.246 | 1.766 | Open Manhole | 1200 | 1.001 | 55.480 | 450 | 1.000 | 55.480 | 450 | |
| SB7 | 57.298 | 1.848 | Open Manhole | 1200 | 1.002 | 55.450 | 450 | 1.001 | 55.450 | 450 | |
| SB6 | 57.236 | 1.972 | Open Manhole | 1200 | 1.003 | 55.264 | 450 | 1.002 | 55.264 | 450 | |
| SB5-6 | 58.000 | 2.114 | Open Manhole | 1200 | 2.000 | 55.886 | 300 | | | | |
| SB5-5 | 58.106 | 2.582 | Open Manhole | 1200 | 2.001 | 55.524 | 300 | 2.000 | 55.524 | 300 | |
| SB5-4 | 58.108 | 2.789 | Open Manhole | 1200 | 2.002 | 55.319 | 300 | 2.001 | 55.319 | 300 | |
| SB5-3 | 58.119 | 2.863 | Open Manhole | 1200 | 2.003 | 55.256 | 450 | 2.002 | 55.256 | 300 | |
| SB5-2 | 58.080 | 2.891 | Open Manhole | 1200 | 2.004 | 55.189 | 450 | 2.003 | 55.189 | 450 | |
| SB5-1 | 58.038 | 2.870 | Open Manhole | 1200 | 2.005 | 55.168 | 450 | 2.004 | 55.168 | 450 | |
| SB5 | 57.814 | 2.787 | Open Manhole | 1200 | 1.004 | 55.027 | 450 | 1.003 | 55.027 | 450 | |
| | | | | | | | | 2.005 | 55.027 | 450 | |
| SB4 | 58.013 | 3.050 | Open Manhole | 1200 | 1.005 | 54.963 | 450 | 1.004 | 54.963 | 450 | |
| SB3 | 58.143 | 3.210 | Open Manhole | 1200 | 1.006 | 54.933 | 450 | 1.005 | 54.933 | 450 | |
| SB2 | 57.934 | 3.169 | Open Manhole | 1200 | 1.007 | 54.765 | 450 | 1.006 | 54.765 | 450 | |
| SB1 | 57.946 | 3.219 | Open Manhole | 1200 | 1.008 | 54.727 | 450 | 1.007 | 54.727 | 450 | |
| SB0 | 57.818 | 3.168 | Open Manhole | 700 | | OUTFALL | | 1.008 | 54.650 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SB9 | 704272.615 | 732941.906 | 704272.615 | 732941.906 | Required |  |
| SB8 | 704290.130 | 732963.114 | 704290.130 | 732963.114 | Required |  |
| SB7 | 704291.938 | 732968.772 | 704291.938 | 732968.772 | Required |  |
| SB6 | 704286.574 | 733024.368 | 704286.574 | 733024.368 | Required |  |
| SB5-6 | 704297.545 | 732922.176 | 704297.545 | 732922.176 | Required |  |
| SB5-5 | 704327.384 | 732967.506 | 704327.384 | 732967.506 | Required |  |

## Manhole Schedules for SW2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SB5-4 | 704344.563 | 732993.082 | 704344.563 | 732993.082 | Required | |
| SB5-3 | 704352.209 | 732998.723 | 704352.209 | 732998.723 | Required | |
| SB5-2 | 704357.856 | 733007.095 | 704357.856 | 733007.095 | Required | |
| SB5-1 | 704358.657 | 733010.067 | 704358.657 | 733010.067 | Required | |
| SB5 | 704357.212 | 733031.219 | 704357.212 | 733031.219 | Required | |
| SB4 | 704376.290 | 733033.069 | 704376.290 | 733033.069 | Required | |
| SB3 | 704381.475 | 733040.291 | 704381.475 | 733040.291 | Required | |
| SB2 | 704376.607 | 733090.483 | 704376.607 | 733090.483 | Required | |
| SB1 | 704383.817 | 733099.452 | 704383.817 | 733099.452 | Required | |
| SB0 | 704406.687 | 733101.621 | | | No Entry | |



## PIPELINE SCHEDULES for SW2

### 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 | 450 | SB9 | 57.109 | 55.618 | 1.041 | Open Manhole | 1200 |
| 1.001 | o | 450 | SB8 | 57.246 | 55.480 | 1.316 | Open Manhole | 1200 |
| 1.002 | o | 450 | SB7 | 57.298 | 55.450 | 1.398 | Open Manhole | 1200 |
| 1.003 | o | 450 | SB6 | 57.236 | 55.264 | 1.522 | Open Manhole | 1200 |
| 2.000 | o | 300 | SB5-6 | 58.000 | 55.886 | 1.814 | Open Manhole | 1200 |
| 2.001 | o | 300 | SB5-5 | 58.106 | 55.524 | 2.282 | Open Manhole | 1200 |
| 2.002 | o | 300 | SB5-4 | 58.108 | 55.319 | 2.489 | Open Manhole | 1200 |
| 2.003 | o | 450 | SB5-3 | 58.119 | 55.256 | 2.413 | Open Manhole | 1200 |
| 2.004 | o | 450 | SB5-2 | 58.080 | 55.189 | 2.441 | Open Manhole | 1200 |
| 2.005 | o | 450 | SB5-1 | 58.038 | 55.168 | 2.420 | Open Manhole | 1200 |
| 1.004 | o | 450 | SB5 | 57.814 | 55.027 | 2.337 | Open Manhole | 1200 |
| 1.005 | o | 450 | SB4 | 58.013 | 54.963 | 2.600 | Open Manhole | 1200 |
| 1.006 | o | 450 | SB3 | 58.143 | 54.933 | 2.760 | Open Manhole | 1200 |
| 1.007 | o | 450 | SB2 | 57.934 | 54.765 | 2.719 | Open Manhole | 1200 |
| 1.008 | o | 450 | SB1 | 57.946 | 54.727 | 2.769 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.506 | 199.3 | SB8 | 57.246 | 55.480 | 1.316 | Open Manhole | 1200 |
| 1.001 | 5.939 | 198.0 | SB7 | 57.298 | 55.450 | 1.398 | Open Manhole | 1200 |
| 1.002 | 55.854 | 300.3 | SB6 | 57.236 | 55.264 | 1.522 | Open Manhole | 1200 |
| 1.003 | 70.969 | 299.4 | SB5 | 57.814 | 55.027 | 2.337 | Open Manhole | 1200 |
| 2.000 | 54.270 | 149.9 | SB5-5 | 58.106 | 55.524 | 2.282 | Open Manhole | 1200 |
| 2.001 | 30.810 | 150.3 | SB5-4 | 58.108 | 55.319 | 2.489 | Open Manhole | 1200 |
| 2.002 | 9.502 | 150.8 | SB5-3 | 58.119 | 55.256 | 2.563 | Open Manhole | 1200 |
| 2.003 | 10.098 | 150.7 | SB5-2 | 58.080 | 55.189 | 2.441 | Open Manhole | 1200 |
| 2.004 | 3.078 | 146.6 | SB5-1 | 58.038 | 55.168 | 2.420 | Open Manhole | 1200 |
| 2.005 | 21.201 | 150.4 | SB5 | 57.814 | 55.027 | 2.337 | Open Manhole | 1200 |
| 1.004 | 19.168 | 299.5 | SB4 | 58.013 | 54.963 | 2.600 | Open Manhole | 1200 |
| 1.005 | 8.890 | 296.3 | SB3 | 58.143 | 54.933 | 2.760 | Open Manhole | 1200 |
| 1.006 | 50.428 | 300.2 | SB2 | 57.934 | 54.765 | 2.719 | Open Manhole | 1200 |
| 1.007 | 11.508 | 302.8 | SB1 | 57.946 | 54.727 | 2.769 | Open Manhole | 1200 |
| 1.008 | 22.972 | 298.3 | SB0 | 57.818 | 54.650 | 2.718 | Open Manhole | 700 |

## Area Summary for SW2

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.090 | 0.090 | 0.090 |
| 1.001 | - | - | 100 | 0.090 | 0.090 | 0.090 |
| 1.002 | - | - | 100 | 0.090 | 0.090 | 0.090 |
| 1.003 | - | - | 100 | 0.090 | 0.090 | 0.090 |
| 2.000 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 2.001 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 2.002 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 2.003 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 2.004 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 2.005 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 1.004 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 1.005 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 1.006 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 1.007 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| 1.008 | - | - | 100 | 0.089 | 0.089 | 0.089 |
| | | | | Total | Total | Total |
| | | | | 1.339 | 1.339 | 1.339 |

## Free Flowing Outfall Details for SW2

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.008 | SB0 | 57.818 | 54.650 | 0.000 | 700 | 0 |

## Simulation Criteria for SW2

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

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

## Synthetic Rainfall Details

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

## Summary of Critical Results by Maximum Level (Rank 1) for SW2

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

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

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

+20% modelled for climate change

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 1.000 | SB9 | 15 minute 100 year Winter I+20% | 57.109 | 56.684 | 0.616 | 0.000 | 0.18 |
| 1.001 | SB8 | 15 minute 100 year Winter I+20% | 57.246 | 56.675 | 0.745 | 0.000 | 0.38 |
| 1.002 | SB7 | 15 minute 100 year Winter I+20% | 57.298 | 56.668 | 0.768 | 0.000 | 0.47 |
| 1.003 | SB6 | 15 minute 100 year Winter I+20% | 57.236 | 56.570 | 0.856 | 0.000 | 0.45 |
| 2.000 | SB5-6 | 15 minute 100 year Winter I+20% | 58.000 | 56.921 | 0.735 | 0.000 | 0.38 |
| 2.001 | SB5-5 | 15 minute 100 year Winter I+20% | 58.106 | 56.889 | 1.065 | 0.000 | 0.56 |
| 2.002 | SB5-4 | 15 minute 100 year Winter I+20% | 58.108 | 56.786 | 1.167 | 0.000 | 1.07 |
| 2.003 | SB5-3 | 15 minute 100 year Winter I+20% | 58.119 | 56.705 | 0.999 | 0.000 | 0.54 |
| 2.004 | SB5-2 | 15 minute 100 year Winter I+20% | 58.080 | 56.607 | 0.968 | 0.000 | 0.90 |
| 2.005 | SB5-1 | 15 minute 100 year Winter I+20% | 58.038 | 56.592 | 0.974 | 0.000 | 0.65 |
| 1.004 | SB5 | 15 minute 100 year Winter I+20% | 57.814 | 56.469 | 0.992 | 0.000 | 1.54 |
| 1.005 | SB4 | 15 minute 100 year Winter I+20% | 58.013 | 56.302 | 0.889 | 0.000 | 1.99 |
| 1.006 | SB3 | 15 minute 100 year Winter I+20% | 58.143 | 56.100 | 0.717 | 0.000 | 1.59 |
| 1.007 | SB2 | 15 minute 100 year Winter I+20% | 57.934 | 55.655 | 0.440 | 0.000 | 2.15 |
| 1.008 | SB1 | 15 minute 100 year Winter I+20% | 57.946 | 55.389 | 0.212 | 0.000 | 1.97 |

## Summary of Critical Results by Maximum Level (Rank 1) for SW2

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 1.000 | SB9 | | 1.200 | 34.3 | SURCHARGED |
| 1.001 | SB8 | | 5.530 | 52.2 | SURCHARGED |
| 1.002 | SB7 | | 2.126 | 80.1 | SURCHARGED |
| 1.003 | SB6 | | 10.163 | 78.9 | SURCHARGED |
| 2.000 | SB5-6 | | 1.165 | 32.4 | SURCHARGED |
| 2.001 | SB5-5 | | 5.289 | 46.0 | SURCHARGED |
| 2.002 | SB5-4 | | 3.746 | 67.5 | SURCHARGED |
| 2.003 | SB5-3 | | 2.220 | 90.7 | SURCHARGED |
| 2.004 | SB5-2 | | 3.014 | 113.7 | SURCHARGED |
| 2.005 | SB5-1 | | 1.904 | 136.8 | SURCHARGED |
| 1.004 | SB5 | | 15.902 | 229.9 | SURCHARGED |
| 1.005 | SB4 | | 4.366 | 250.6 | SURCHARGED |
| 1.006 | SB3 | | 2.537 | 268.5 | SURCHARGED |
| 1.007 | SB2 | | 8.830 | 286.1 | SURCHARGED |
| 1.008 | SB1 | | 2.383 | 304.2 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW3

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.577 | 4-8 | 0.603 |

Total Area Contributing (ha) = 1.180 ← SW Catchment B2 - Impermeable Area

Total Pipe Volume (m³) = 40.913

### Network Design Table for SW3

| 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 | 33.815 | 0.169 | 200.1 | 0.118 | 4.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.001 | 9.484 | 0.047 | 201.8 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.002 | 2.872 | 0.014 | 205.1 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.003 | 34.190 | 0.171 | 199.9 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 2.000 | 27.387 | 0.137 | 199.9 | 0.118 | 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 | 4.39 | 57.497 | 0.118 | 0.0 | 0.0 | 0.0 | 1.43 | 228.0 | 16.0 |
| 1.001 | 50.00 | 4.50 | 57.328 | 0.236 | 0.0 | 0.0 | 0.0 | 1.43 | 227.0 | 32.0 |
| 1.002 | 50.00 | 4.54 | 57.281 | 0.354 | 0.0 | 0.0 | 0.0 | 1.42 | 225.2 | 47.9 |
| 1.003 | 50.00 | 4.93 | 57.267 | 0.472 | 0.0 | 0.0 | 0.0 | 1.43 | 228.1 | 63.9 |
| 2.000 | 50.00 | 4.50 | 57.233 | 0.118 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 16.0 |

## Network Design Table for SW3

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.004 | 20.719 | 0.104 | 199.2 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.005 | 5.239 | 0.026 | 201.5 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.006 | 7.377 | 0.037 | 199.4 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.007 | 69.672 | 0.348 | 200.2 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.008 | 67.029 | 0.335 | 200.1 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.004 | 50.00 | 5.18 | 57.096 | 0.708 | 0.0 | 0.0 | 0.0 | 1.44 | 228.5 | 95.9 |
| 1.005 | 50.00 | 5.24 | 56.992 | 0.826 | 0.0 | 0.0 | 0.0 | 1.43 | 227.2 | 111.9 |
| 1.006 | 50.00 | 5.32 | 56.966 | 0.944 | 0.0 | 0.0 | 0.0 | 1.44 | 228.4 | 127.8 |
| 1.007 | 50.00 | 6.13 | 56.929 | 1.062 | 0.0 | 0.0 | 0.0 | 1.43 | 227.9 | 143.8 |
| 1.008 | 50.00 | 6.91 | 56.581 | 1.180 | 0.0 | 0.0 | 0.0 | 1.43 | 228.0 | 159.8 |

## Manhole Schedules for SW3

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SC9 | 59.300 | 1.803 | Open Manhole | 1200 | 1.000 | 57.497 | 450 | | | | |
| SC8 | 59.300 | 1.972 | Open Manhole | 1200 | 1.001 | 57.328 | 450 | 1.000 | 57.328 | 450 | |
| SC7 | 59.400 | 2.119 | Open Manhole | 1200 | 1.002 | 57.281 | 450 | 1.001 | 57.281 | 450 | |
| SC6 | 59.500 | 2.233 | Open Manhole | 1200 | 1.003 | 57.267 | 450 | 1.002 | 57.267 | 450 | |
| SC5-1 | 59.969 | 2.736 | Open Manhole | 1200 | 2.000 | 57.233 | 225 | | | | |
| SC5 | 59.870 | 2.774 | Open Manhole | 1200 | 1.004 | 57.096 | 450 | 1.003 | 57.096 | 450 | |
| | | | | | | | | 2.000 | 57.096 | 225 | |
| SC4 | 59.665 | 2.673 | Open Manhole | 1200 | 1.005 | 56.992 | 450 | 1.004 | 56.992 | 450 | |
| SC3 | 59.614 | 2.648 | Open Manhole | 1200 | 1.006 | 56.966 | 450 | 1.005 | 56.966 | 450 | |
| SC2 | 59.520 | 2.591 | Open Manhole | 1200 | 1.007 | 56.929 | 450 | 1.006 | 56.929 | 450 | |
| SC1 | 59.472 | 2.891 | Open Manhole | 1200 | 1.008 | 56.581 | 450 | 1.007 | 56.581 | 450 | |
| SC0 | 59.594 | 3.348 | Open Manhole | 0 | | OUTFALL | | 1.008 | 56.246 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SC9 | 704312.771 | 732825.135 | 704312.771 | 732825.135 | Required | |
| SC8 | 704286.508 | 732803.835 | 704286.508 | 732803.835 | Required | |
| SC7 | 704278.760 | 732798.366 | 704278.760 | 732798.366 | Required | |
| SC6 | 704279.995 | 732795.773 | 704279.995 | 732795.773 | Required | |
| SC5-1 | 704315.283 | 732821.726 | 704315.283 | 732821.726 | Required | |
| SC5 | 704314.156 | 732794.362 | 704314.156 | 732794.362 | Required | |
| SC4 | 704313.299 | 732773.661 | 704313.299 | 732773.661 | Required | |
| SC3 | 704315.105 | 732768.743 | 704315.105 | 732768.743 | Required | |

## Manhole Schedules for SW3

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SC2 | 704321.683 | 732765.402 | 704321.683 | 732765.402 | Required | |
| SC1 | 704391.288 | 732762.348 | 704391.288 | 732762.348 | Required | |
| SC0 | 704394.352 | 732829.307 | | | No Entry | |

## PIPELINE SCHEDULES for SW3

### 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 | 450 | SC9 | 59.300 | 57.497 | 1.353 | Open Manhole | 1200 |
| 1.001 | o | 450 | SC8 | 59.300 | 57.328 | 1.522 | Open Manhole | 1200 |
| 1.002 | o | 450 | SC7 | 59.400 | 57.281 | 1.669 | Open Manhole | 1200 |
| 1.003 | o | 450 | SC6 | 59.500 | 57.267 | 1.783 | Open Manhole | 1200 |
| 2.000 | o | 225 | SC5-1 | 59.969 | 57.233 | 2.511 | Open Manhole | 1200 |
| 1.004 | o | 450 | SC5 | 59.870 | 57.096 | 2.324 | Open Manhole | 1200 |
| 1.005 | o | 450 | SC4 | 59.665 | 56.992 | 2.223 | Open Manhole | 1200 |
| 1.006 | o | 450 | SC3 | 59.614 | 56.966 | 2.198 | Open Manhole | 1200 |
| 1.007 | o | 450 | SC2 | 59.520 | 56.929 | 2.141 | Open Manhole | 1200 |
| 1.008 | o | 450 | SC1 | 59.472 | 56.581 | 2.441 | 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 | 33.815 | 200.1 | SC8 | 59.300 | 57.328 | 1.522 | Open Manhole | 1200 |
| 1.001 | 9.484 | 201.8 | SC7 | 59.400 | 57.281 | 1.669 | Open Manhole | 1200 |
| 1.002 | 2.872 | 205.1 | SC6 | 59.500 | 57.267 | 1.783 | Open Manhole | 1200 |
| 1.003 | 34.190 | 199.9 | SC5 | 59.870 | 57.096 | 2.324 | Open Manhole | 1200 |
| 2.000 | 27.387 | 199.9 | SC5 | 59.870 | 57.096 | 2.549 | Open Manhole | 1200 |
| 1.004 | 20.719 | 199.2 | SC4 | 59.665 | 56.992 | 2.223 | Open Manhole | 1200 |
| 1.005 | 5.239 | 201.5 | SC3 | 59.614 | 56.966 | 2.198 | Open Manhole | 1200 |
| 1.006 | 7.377 | 199.4 | SC2 | 59.520 | 56.929 | 2.141 | Open Manhole | 1200 |
| 1.007 | 69.672 | 200.2 | SC1 | 59.472 | 56.581 | 2.441 | Open Manhole | 1200 |
| 1.008 | 67.029 | 200.1 | SC0 | 59.594 | 56.246 | 2.898 | Open Manhole | 0 |

## Area Summary for SW3

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.001 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.002 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.003 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 2.000 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.004 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.005 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.006 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.007 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| 1.008 | - | - | 100 | 0.118 | 0.118 | 0.118 |
| | | | | Total | Total | Total |
| | | | | 1.180 | 1.180 | 1.180 |

## Free Flowing Outfall Details for SW3

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.008 | SC0 | 59.594 | 56.246 | 0.000 | 0 | 0 |

## Simulation Criteria for SW3

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

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

## Synthetic Rainfall Details

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

## Summary of Critical Results by Maximum Level (Rank 1) for SW3

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

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

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

+20% modelled for climate change

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 1.000 | SC9 | 15 minute 100 year Winter I+20% | 59.300 | 58.851 | 0.904 | 0.000 | 0.17 |
| 1.001 | SC8 | 15 minute 100 year Winter I+20% | 59.300 | 58.817 | 1.039 | 0.000 | 0.43 |
| 1.002 | SC7 | 15 minute 100 year Winter I+20% | 59.400 | 58.767 | 1.036 | 0.000 | 0.82 |
| 1.003 | SC6 | 15 minute 100 year Winter I+20% | 59.500 | 58.756 | 1.039 | 0.000 | 0.64 |
| 2.000 | SC5-1 | 15 minute 100 year Winter I+20% | 59.969 | 58.775 | 1.317 | 0.000 | 1.07 |
| 1.004 | SC5 | 15 minute 100 year Winter I+20% | 59.870 | 58.650 | 1.104 | 0.000 | 1.09 |
| 1.005 | SC4 | 15 minute 100 year Winter I+20% | 59.665 | 58.532 | 1.090 | 0.000 | 1.77 |
| 1.006 | SC3 | 15 minute 100 year Winter I+20% | 59.614 | 58.368 | 0.952 | 0.000 | 1.81 |
| 1.007 | SC2 | 15 minute 100 year Winter I+20% | 59.520 | 58.153 | 0.774 | 0.000 | 1.37 |
| 1.008 | SC1 | 15 minute 100 year Winter I+20% | 59.472 | 57.475 | 0.444 | 0.000 | 1.48 |

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 1.000 | SC9 | | 1.526 | 34.4 | SURCHARGED |
| 1.001 | SC8 | | 6.866 | 67.6 | SURCHARGED |
| 1.002 | SC7 | | 2.993 | 102.1 | SURCHARGED |
| 1.003 | SC6 | | 1.945 | 128.5 | SURCHARGED |

Summary of Critical Results by Maximum Level (Rank 1) for SW3

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 2.000 | SC5-1 | | 1.739 | 36.5 | SURCHARGED |
| 1.004 | SC5 | | 8.040 | 197.9 | SURCHARGED |
| 1.005 | SC4 | | 4.840 | 231.3 | SURCHARGED |
| 1.006 | SC3 | | 2.223 | 264.0 | SURCHARGED |
| 1.007 | SC2 | | 2.361 | 291.5 | SURCHARGED |
| 1.008 | SC1 | | 11.896 | 313.4 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW4

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.441 | 4-8 | 0.096 |

Total Area Contributing (ha) = 0.537

SW Catchment B3 - Impermeable Area

Total Pipe Volume (m³) = 4.827

### Network Design Table for SW4

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | 41.731 | 0.209 | 199.7 | 0.269 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 2.001 | 26.556 | 0.133 | 199.7 | 0.268 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

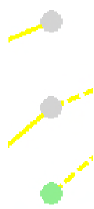
### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | 50.00 | 4.63 | 56.946 | 0.269 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4 | 36.4 |
| 2.001 | 50.00 | 5.03 | 56.737 | 0.537 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4 | 72.7 |

## Manhole Schedules for SW4

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SD2 | 59.018 | 2.072 | Open Manhole | 1200 | 2.000 | 56.946 | 300 | | | | |
| SD1 | 59.286 | 2.549 | Open Manhole | 1200 | 2.001 | 56.737 | 300 | 2.000 | 56.737 | 300 | |
| SD0 | 59.536 | 2.932 | Open Manhole | 0 | | OUTFALL | | 2.001 | 56.604 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SD2 | 704523.960 | 733040.206 | 704523.960 | 733040.206 | Required | |
| SD1 | 704485.406 | 733024.235 | 704485.406 | 733024.235 | Required | |
| SD0 | 704465.273 | 733006.918 | | | No Entry | |



## PIPELINE SCHEDULES for SW4

### 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) |
|---|---|---|---|---|---|---|---|---|
| 2.000 | o | 300 | SD2 | 59.018 | 56.946 | 1.772 | Open Manhole | 1200 |
| 2.001 | o | 300 | SD1 | 59.286 | 56.737 | 2.249 | 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) |
|---|---|---|---|---|---|---|---|---|
| 2.000 | 41.731 | 199.7 | SD1 | 59.286 | 56.737 | 2.249 | Open Manhole | 1200 |
| 2.001 | 26.556 | 199.7 | SD0 | 59.536 | 56.604 | 2.632 | Open Manhole | 0 |

## Area Summary for SW4

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 2.000 | - | - | 100 | 0.269 | 0.269 | 0.269 |
| 2.001 | - | - | 100 | 0.268 | 0.268 | 0.268 |
| | | | | Total | Total | Total |
| | | | | 0.537 | 0.537 | 0.537 |

## Free Flowing Outfall Details for SW4

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 2.001 | SD0 | 59.536 | 56.604 | 0.000 | 0 | 0 |

## Simulation Criteria for SW4

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

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

## Synthetic Rainfall Details

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

## Summary of Critical Results by Maximum Level (Rank 1) for SW4

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

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

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

+20% modelled for climate change

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 2.000 | SD2 | 15 Winter | 100 | +20% | 30/15 Summer | | | | 58.348 |
| 2.001 | SD1 | 15 Winter | 100 | +20% | 30/15 Summer | | | | 57.954 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| 2.000 | SD2 | 1.102 | 0.000 | 1.34 | | | 97.9 | SURCHARGED | |
| 2.001 | SD1 | 0.917 | 0.000 | 2.77 | | | 195.4 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW5

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW5

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.824 | 4-8 | 0.074 |

Total Area Contributing (ha) = 0.898 ← SW Catchment B4 - Impermeable Area

Total Pipe Volume (m³) = 1.553

### Network Design Table for SW5

« - 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 | 21.970 | 0.110 | 199.7 | 0.898 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 50.00 | 4.33 | 57.500 | 0.898 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4« | 121.6 |

## Manhole Schedules for SW5

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SE1 | 59.155 | 1.655 | Open Manhole | 1200 | 1.000 | 57.500 | 300 | | | | |
| SE0 | 59.124 | 1.734 | Open Manhole | 0 | | OUTFALL | | 1.000 | 57.390 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SE1 | 704382.189 | 732890.011 | 704382.189 | 732890.011 | Required |  |
| SE0 | 704394.915 | 732907.919 | | | No Entry | |

## PIPELINE SCHEDULES for SW5

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | o | 300 | SE1 | 59.155 | 57.500 | 1.355 | 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 | 21.970 | 199.7 | SE0 | 59.124 | 57.390 | 1.434 | Open Manhole | 0 |

## Area Summary for SW5

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.898 | 0.898 | 0.898 |
| | | | | Total | Total | Total |
| | | | | 0.898 | 0.898 | 0.898 |

## Free Flowing Outfall Details for SW5

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.000 | SE0 | 59.124 | 57.390 | 0.000 | 0 | 0 |

## Simulation Criteria for SW5

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

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

## Synthetic Rainfall Details

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

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW6

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.823 | 4-8 | 0.176 |

Total Area Contributing (ha) = 0.999 ← SW Catchment B5 - Impermeable Area

Total Pipe Volume (m³) = 26.326

### Network Design Table for SW6

| 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 | 50.849 | 0.246 | 206.7 | 0.200 | 4.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.001 | 76.722 | 0.383 | 200.3 | 0.200 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.002 | 13.518 | 0.183 | 73.9 | 0.200 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.003 | 18.110 | 0.181 | 100.1 | 0.200 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.004 | 6.330 | 0.063 | 100.5 | 0.199 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |

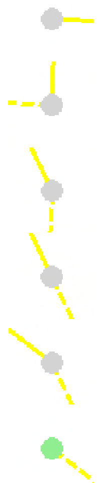
### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 50.00 | 4.60 | 57.368 | 0.200 | 0.0 | 0.0 | 0.0 | 1.41 | 224.3 | 27.1 |
| 1.001 | 50.00 | 5.49 | 57.122 | 0.400 | 0.0 | 0.0 | 0.0 | 1.43 | 227.9 | 54.2 |
| 1.002 | 50.00 | 5.59 | 56.739 | 0.600 | 0.0 | 0.0 | 0.0 | 2.37 | 376.6 | 81.2 |
| 1.003 | 50.00 | 5.74 | 56.557 | 0.800 | 0.0 | 0.0 | 0.0 | 2.03 | 323.3 | 108.3 |
| 1.004 | 50.00 | 5.79 | 56.376 | 0.999 | 0.0 | 0.0 | 0.0 | 2.03 | 322.6 | 135.3 |

## Manhole Schedules for SW6

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SF7 | 59.634 | 2.266 | Open Manhole | 1200 | 1.000 | 57.368 | 450 | | | | |
| SF6 | 59.700 | 2.578 | Open Manhole | 1200 | 1.001 | 57.122 | 450 | 1.000 | 57.122 | 450 | |
| SF5 | 60.059 | 3.320 | Open Manhole | 1200 | 1.002 | 56.739 | 450 | 1.001 | 56.739 | 450 | |
| SF2 | 59.800 | 3.244 | Open Manhole | 1200 | 1.003 | 56.557 | 450 | 1.002 | 56.556 | 450 | |
| SF1 | 59.800 | 3.424 | Open Manhole | 1200 | 1.004 | 56.376 | 450 | 1.003 | 56.376 | 450 | |
| SF0 | 60.122 | 3.809 | Open Manhole | 0 | | OUTFALL | | 1.004 | 56.313 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SF7 | 704405.174 | 732761.722 | 704405.174 | 732761.722 | Required | |
| SF6 | 704455.974 | 732759.482 | 704455.974 | 732759.482 | Required | |
| SF5 | 704458.547 | 732836.161 | 704458.547 | 732836.161 | Required | |
| SF2 | 704452.666 | 732848.333 | 704452.666 | 732848.333 | Required | |
| SF1 | 704444.888 | 732864.688 | 704444.888 | 732864.688 | Required | |
| SF0 | 704439.879 | 732868.557 | | | No Entry | |



## PIPELINE SCHEDULES for SW6

### 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 | 450 | SF7 | 59.634 | 57.368 | 1.816 | Open Manhole | 1200 |
| 1.001 | o | 450 | SF6 | 59.700 | 57.122 | 2.128 | Open Manhole | 1200 |
| 1.002 | o | 450 | SF5 | 60.059 | 56.739 | 2.870 | Open Manhole | 1200 |
| 1.003 | o | 450 | SF2 | 59.800 | 56.557 | 2.793 | Open Manhole | 1200 |
| 1.004 | o | 450 | SF1 | 59.800 | 56.376 | 2.974 | 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 | 50.849 | 206.7 | SF6 | 59.700 | 57.122 | 2.128 | Open Manhole | 1200 |
| 1.001 | 76.722 | 200.3 | SF5 | 60.059 | 56.739 | 2.870 | Open Manhole | 1200 |
| 1.002 | 13.518 | 73.9 | SF2 | 59.800 | 56.556 | 2.794 | Open Manhole | 1200 |
| 1.003 | 18.110 | 100.1 | SF1 | 59.800 | 56.376 | 2.974 | Open Manhole | 1200 |
| 1.004 | 6.330 | 100.5 | SF0 | 60.122 | 56.313 | 3.359 | Open Manhole | 0 |

## Area Summary for SW6

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.200 | 0.200 | 0.200 |
| 1.001 | - | - | 100 | 0.200 | 0.200 | 0.200 |
| 1.002 | - | - | 100 | 0.200 | 0.200 | 0.200 |
| 1.003 | - | - | 100 | 0.200 | 0.200 | 0.200 |
| 1.004 | - | - | 100 | 0.199 | 0.199 | 0.199 |
| | | | | Total | Total | Total |
| | | | | 0.999 | 0.999 | 0.999 |

## Free Flowing Outfall Details for SW6

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.004 | SF0 | 60.122 | 56.313 | 0.000 | 0 | 0 |

## Simulation Criteria for SW6

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

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

## Synthetic Rainfall Details

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

## Online Controls for SW6

### Hydro-Brake® Optimum Manhole: SF1, DS/PN: 1.004, Volume ($m^3$): 6.6

| | |
|---|---|
| Unit Reference | MD-SHE-0085-4500-2210-4500 |
| Design Head (m) | 2.210 |
| Design Flow (l/s) | 4.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 85 |
| Invert Level (m) | 56.376 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.210 | 4.5 |
| Flush-Flo™ | 0.369 | 3.4 |
| Kick-Flo® | 0.757 | 2.7 |
| Mean Flow over Head Range | - | 3.4 |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 2.5 | 1.200 | 3.4 | 3.000 | 5.2 | 7.000 | 7.7 |
| 0.200 | 3.2 | 1.400 | 3.6 | 3.500 | 5.6 | 7.500 | 8.0 |
| 0.300 | 3.4 | 1.600 | 3.9 | 4.000 | 5.9 | 8.000 | 8.2 |
| 0.400 | 3.4 | 1.800 | 4.1 | 4.500 | 6.3 | 8.500 | 8.5 |
| 0.500 | 3.4 | 2.000 | 4.3 | 5.000 | 6.6 | 9.000 | 8.7 |
| 0.600 | 3.2 | 2.200 | 4.5 | 5.500 | 6.9 | 9.500 | 8.9 |
| 0.800 | 2.8 | 2.400 | 4.7 | 6.000 | 7.2 | | |
| 1.000 | 3.1 | 2.600 | 4.8 | 6.500 | 7.5 | | |

## Storage Structures for SW6

### Tank or Pond Manhole: SF1, DS/PN: 1.004

Invert Level (m) 58.800

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 600.0 | 1.000 | 800.0 |

## Summary of Critical Results by Maximum Level (Rank 1) for SW6

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

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

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

+20% modelled for climate change

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 1.000 | SF7 | 120 minute 100 year Winter I+20% | 59.634 | 59.604 | 1.786 | 0.000 | 0.14 |
| 1.001 | SF6 | 120 minute 100 year Winter I+20% | 59.700 | 59.594 | 2.022 | 0.000 | 0.26 |
| 1.002 | SF5 | 180 minute 100 year Winter I+20% | 60.059 | 59.524 | 2.335 | 0.000 | 0.27 |
| 1.003 | SF2 | 960 minute 100 year Winter I+20% | 59.800 | 59.502 | 2.495 | 0.000 | 0.11 |
| 1.004 | SF1 | 960 minute 100 year Winter I+20% | 59.800 | 59.501 | 2.675 | 0.000 | 0.03 |

Attenuation Pond 3 - Top Water Level

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 1.000 | SF7 | | 2.523 | 28.1 | FLOOD RISK |
| 1.001 | SF6 | | 10.687 | 56.2 | FLOOD RISK |
| 1.002 | SF5 | | 15.155 | 64.7 | SURCHARGED |
| 1.003 | SF2 | | 5.286 | 26.8 | FLOOD RISK |
| 1.004 | SF1 | | 473.864 | 5.3 | FLOOD RISK |

Attenuation Pond 3 - Max Pond Volume

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for SW7

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

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

Designed with Level Soffits

### Time Area Diagram for SW7

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.424 | 4-8 | 0.116 |

Total Area Contributing (ha) = 0.540 ← SW Catchment B6 - Impermeable Area

Total Pipe Volume (m³) = 5.142

### Network Design Table for SW7

| 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 | 30.960 | 0.155 | 199.7 | 0.270 | 4.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.001 | 41.778 | 0.209 | 199.9 | 0.270 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

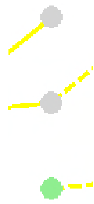
### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 50.00 | 4.47 | 55.052 | 0.270 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4 | 36.6 |
| 1.001 | 50.00 | 5.09 | 54.897 | 0.540 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 73.1 |

## Manhole Schedules for SW7

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SG2 | 58.229 | 3.177 | Open Manhole | 1200 | 1.000 | 55.052 | 300 | | | | |
| SG1 | 58.138 | 3.241 | Open Manhole | 1200 | 1.001 | 54.897 | 300 | 1.000 | 54.897 | 300 | |
| SG0 | 57.890 | 3.202 | Open Manhole | 0 | | OUTFALL | | 1.001 | 54.688 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| SG2 | 704489.893 | 733127.026 | 704489.893 | 733127.026 | Required | |
| SG1 | 704465.932 | 733107.419 | 704465.932 | 733107.419 | Required | |
| SG0 | 704424.350 | 733103.386 | | | No Entry | |



## PIPELINE SCHEDULES for SW7

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | o | 300 | SG2 | 58.229 | 55.052 | 2.877 | Open Manhole | 1200 |
| 1.001 | o | 300 | SG1 | 58.138 | 54.897 | 2.941 | 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 | 30.960 | 199.7 | SG1 | 58.138 | 54.897 | 2.941 | Open Manhole | 1200 |
| 1.001 | 41.778 | 199.9 | SG0 | 57.890 | 54.688 | 2.902 | Open Manhole | 0 |

## Area Summary for SW7

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.270 | 0.270 | 0.270 |
| 1.001 | - | - | 100 | 0.270 | 0.270 | 0.270 |
| | | | | Total | Total | Total |
| | | | | 0.540 | 0.540 | 0.540 |

## Free Flowing Outfall Details for SW7

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.001 | SG0 | 57.890 | 54.688 | 0.000 | 0 | 0 |

## Simulation Criteria for SW7

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

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

## Synthetic Rainfall Details

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

## Summary of Critical Results by Maximum Level (Rank 1) for SW7

### Simulation Criteria

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

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

### Synthetic Rainfall Details

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

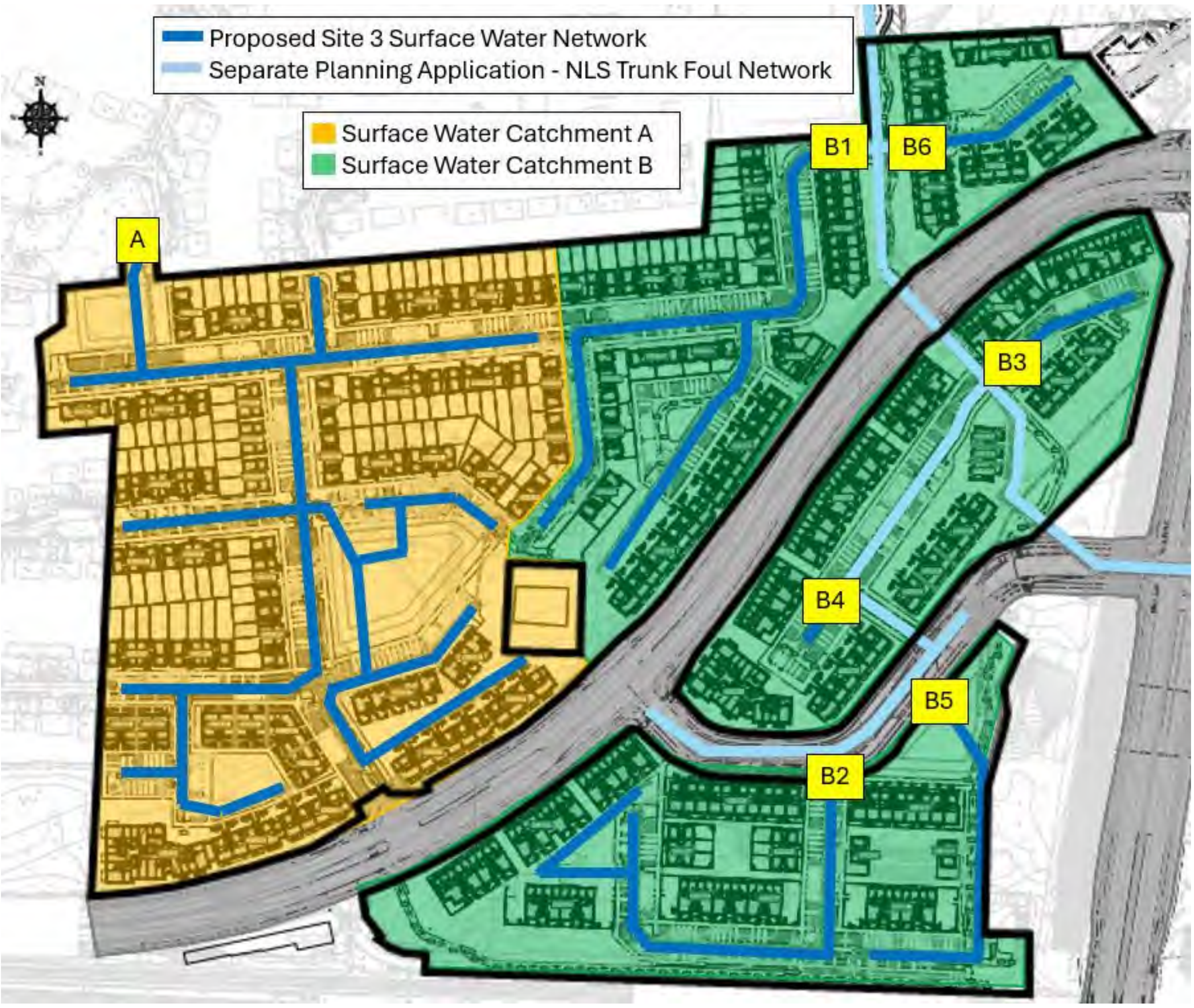
Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

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

+20% modelled for climate change

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| 1.000 | SG2 | 15 minute 100 year Winter I+20% | 58.229 | 56.867 | 1.515 | 0.000 | 1.40 |
| 1.001 | SG1 | 15 minute 100 year Winter I+20% | 58.138 | 56.556 | 1.359 | 0.000 | 2.66 |

| PN | US/MH Name | Overflow (l/s) | Maximum Vol (m³) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|
| 1.000 | SG2 | | 2.047 | 99.6 | SURCHARGED |
| 1.001 | SG1 | | 3.974 | 194.5 | SURCHARGED |




*Kishoge Site 3 – Surface Water Network Catchments & Outfalls*

# Appendix B : FOUL SEWER NETWORK CALCULATIONS [MICRO-DRAINAGE NETWORK MODULE]

## FOUL SEWERAGE DESIGN

### Design Criteria for FS1

Pipe Sizes STANDARD Manhole Sizes STANDARD

| | | | |
|---|---|---|---|
| Industrial Flow (l/s/ha) | 0.00 | Add Flow / Climate Change (%) | 0 |
| Industrial Peak Flow Factor | 0.00 | Minimum Backdrop Height (m) | 0.200 |
| Flow Per Person (l/per/day) | 150.00 | Maximum Backdrop Height (m) | 1.500 |
| Persons per House | 2.70 | Min Design Depth for Optimisation (m) | 1.200 |
| Domestic (l/s/ha) | 0.00 | Min Vel for Auto Design only (m/s) | 0.75 |
| Domestic Peak Flow Factor | 6.00 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for FS1

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.076 | 0.135 | 200.6 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.001 | 16.551 | 0.083 | 199.4 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.002 | 13.699 | 0.068 | 201.5 | 0.000 | 38 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 2.000 | 23.897 | 0.119 | 200.8 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.003 | 34.114 | 0.171 | 199.5 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 3.000 | 20.820 | 0.104 | 200.2 | 0.000 | 7 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.004 | 32.105 | 0.161 | 199.4 | 0.000 | 7 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.005 | 20.392 | 0.102 | 199.9 | 0.000 | 2 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.006 | 5.857 | 0.029 | 202.0 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.007 | 71.816 | 0.359 | 200.0 | 0.000 | 7 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

### Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 54.336 | 0.000 | 0.0 | 6 | 0.0 | 12 | 0.20 | 0.81 | 32.2 | 0.2 |
| 1.001 | 54.201 | 0.000 | 0.0 | 12 | 0.0 | 17 | 0.26 | 0.81 | 32.3 | 0.3 |
| 1.002 | 54.118 | 0.000 | 0.0 | 50 | 0.0 | 32 | 0.40 | 0.81 | 32.1 | 1.4 |
| 2.000 | 54.169 | 0.000 | 0.0 | 0 | 0.0 | 0 | 0.00 | 0.81 | 32.1 | 0.0 |
| 1.003 | 54.050 | 0.000 | 0.0 | 50 | 0.0 | 32 | 0.40 | 0.81 | 32.3 | 1.4 |
| 3.000 | 53.983 | 0.000 | 0.0 | 7 | 0.0 | 13 | 0.22 | 0.81 | 32.2 | 0.2 |
| 1.004 | 53.879 | 0.000 | 0.0 | 64 | 0.0 | 36 | 0.43 | 0.81 | 32.3 | 1.8 |
| 1.005 | 53.718 | 0.000 | 0.0 | 66 | 0.0 | 37 | 0.44 | 0.81 | 32.2 | 1.9 |
| 1.006 | 53.616 | 0.000 | 0.0 | 69 | 0.0 | 38 | 0.44 | 0.81 | 32.1 | 1.9 |
| 1.007 | 53.587 | 0.000 | 0.0 | 76 | 0.0 | 39 | 0.46 | 0.81 | 32.2 | 2.1 |

## Network Design Table for FS1

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 70.344 | 0.352 | 199.8 | 0.000 | 14 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.008 | 61.806 | 0.309 | 200.0 | 0.000 | 10 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.009 | 56.002 | 0.280 | 200.0 | 0.000 | 9 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 5.000 | 33.919 | 0.339 | 100.1 | 0.000 | 5 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.010 | 41.199 | 0.206 | 200.0 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.011 | 4.794 | 0.024 | 200.0 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

## Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 53.580 | 0.000 | 0.0 | 14 | 0.0 | 18 | 0.27 | 0.81 | 32.2 | 0.4 |
| 1.008 | 53.228 | 0.000 | 0.0 | 100 | 0.0 | 45 | 0.50 | 0.81 | 32.2 | 2.8 |
| 1.009 | 52.919 | 0.000 | 0.0 | 109 | 0.0 | 47 | 0.51 | 0.81 | 32.2 | 3.1 |
| 5.000 | 52.978 | 0.000 | 0.0 | 5 | 0.0 | 9 | 0.24 | 1.15 | 45.6 | 0.1 |
| 1.010 | 52.639 | 0.000 | 0.0 | 114 | 0.0 | 48 | 0.52 | 0.81 | 32.2 | 3.2 |
| 1.011 | 52.433 | 0.000 | 0.0 | 114 | 0.0 | 48 | 0.52 | 0.81 | 32.2 | 3.2 |

## PIPELINE SCHEDULES for FS1

### 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 | FA12 | 57.400 | 54.336 | 2.839 | Open Manhole | 1200 |
| 1.001 | o | 225 | FA11 | 57.100 | 54.201 | 2.674 | Open Manhole | 1200 |
| 1.002 | o | 225 | FA10 | 56.705 | 54.118 | 2.362 | Open Manhole | 1200 |
| 2.000 | o | 225 | FA9-1 | 56.985 | 54.169 | 2.591 | Open Manhole | 1200 |
| 1.003 | o | 225 | FA9 | 56.591 | 54.050 | 2.316 | Open Manhole | 1200 |
| 3.000 | o | 225 | FA8-1 | 56.330 | 53.983 | 2.122 | Open Manhole | 1200 |
| 1.004 | o | 225 | FA8 | 56.374 | 53.879 | 2.270 | Open Manhole | 1200 |
| 1.005 | o | 225 | FA7 | 56.742 | 53.718 | 2.799 | Open Manhole | 1200 |
| 1.006 | o | 225 | FA6 | 56.968 | 53.616 | 3.127 | Open Manhole | 1200 |
| 1.007 | o | 225 | FA5 | 57.054 | 53.587 | 3.242 | Open Manhole | 1200 |
| 4.000 | o | 225 | FA4-1 | 57.184 | 53.580 | 3.379 | Open Manhole | 1200 |
| 1.008 | o | 225 | FA4 | 56.681 | 53.228 | 3.228 | Open Manhole | 1200 |
| 1.009 | o | 225 | FA3 | 56.415 | 52.919 | 3.271 | Open Manhole | 1200 |
| 5.000 | o | 225 | FA2-1 | 56.023 | 52.978 | 2.820 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.076 | 200.6 | FA11 | 57.100 | 54.201 | 2.674 | Open Manhole | 1200 |
| 1.001 | 16.551 | 199.4 | FA10 | 56.705 | 54.118 | 2.362 | Open Manhole | 1200 |
| 1.002 | 13.699 | 201.5 | FA9 | 56.591 | 54.050 | 2.316 | Open Manhole | 1200 |
| 2.000 | 23.897 | 200.8 | FA9 | 56.591 | 54.050 | 2.316 | Open Manhole | 1200 |
| 1.003 | 34.114 | 199.5 | FA8 | 56.374 | 53.879 | 2.270 | Open Manhole | 1200 |
| 3.000 | 20.820 | 200.2 | FA8 | 56.374 | 53.879 | 2.270 | Open Manhole | 1200 |
| 1.004 | 32.105 | 199.4 | FA7 | 56.742 | 53.718 | 2.799 | Open Manhole | 1200 |
| 1.005 | 20.392 | 199.9 | FA6 | 56.968 | 53.616 | 3.127 | Open Manhole | 1200 |
| 1.006 | 5.857 | 202.0 | FA5 | 57.054 | 53.587 | 3.242 | Open Manhole | 1200 |
| 1.007 | 71.816 | 200.0 | FA4 | 56.681 | 53.228 | 3.228 | Open Manhole | 1200 |
| 4.000 | 70.344 | 199.8 | FA4 | 56.681 | 53.228 | 3.228 | Open Manhole | 1200 |
| 1.008 | 61.806 | 200.0 | FA3 | 56.415 | 52.919 | 3.271 | Open Manhole | 1200 |
| 1.009 | 56.002 | 200.0 | FA2 | 56.014 | 52.639 | 3.150 | Open Manhole | 1200 |
| 5.000 | 33.919 | 100.1 | FA2 | 56.014 | 52.639 | 3.150 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for FS1

### 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) |
|---|---|---|---|---|---|---|---|---|
| 1.010 | o | 225 | FA2 | 56.014 | 52.639 | 3.150 | Open Manhole | 1200 |
| 1.011 | o | 225 | FA1 | 55.660 | 52.433 | 3.002 | 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) |
|---|---|---|---|---|---|---|---|---|
| 1.010 | 41.199 | 200.0 | FA1 | 55.660 | 52.433 | 3.002 | Open Manhole | 1200 |
| 1.011 | 4.794 | 200.0 | FA0 | 55.630 | 52.409 | 2.996 | Open Manhole | 0 |

## Area Summary for FS1

| Pipe Number | Gross Area (ha) | Pipe Total (ha) |
|---|---|---|
| 1.000 | 0.000 | 0.000 |
| 1.001 | 0.000 | 0.000 |
| 1.002 | 0.000 | 0.000 |
| 2.000 | 0.000 | 0.000 |
| 1.003 | 0.000 | 0.000 |
| 3.000 | 0.000 | 0.000 |
| 1.004 | 0.000 | 0.000 |
| 1.005 | 0.000 | 0.000 |
| 1.006 | 0.000 | 0.000 |
| 1.007 | 0.000 | 0.000 |
| 4.000 | 0.000 | 0.000 |
| 1.008 | 0.000 | 0.000 |
| 1.009 | 0.000 | 0.000 |
| 5.000 | 0.000 | 0.000 |
| 1.010 | 0.000 | 0.000 |
| 1.011 | 0.000 | 0.000 |
| | Total | Total |
| | 0.000 | 0.000 |

## Free Flowing Outfall Details for FS1

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.011 | FA0 | 55.630 | 52.409 | 0.000 | 0 | 0 |

## Simulation Criteria for FS1

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

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

## Synthetic Rainfall Details

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

## FOUL SEWERAGE DESIGN

### Design Criteria for FS2

Pipe Sizes STANDARD Manhole Sizes STANDARD

| | | | |
|---|---|---|---|
| Industrial Flow (l/s/ha) | 0.00 | Add Flow / Climate Change (%) | 0 |
| Industrial Peak Flow Factor | 0.00 | Minimum Backdrop Height (m) | 0.200 |
| Flow Per Person (l/per/day) | 150.00 | Maximum Backdrop Height (m) | 1.500 |
| Persons per House | 2.70 | Min Design Depth for Optimisation (m) | 1.200 |
| Domestic (l/s/ha) | 0.00 | Min Vel for Auto Design only (m/s) | 0.75 |
| Domestic Peak Flow Factor | 6.00 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for FS2

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.761 | 0.139 | 199.7 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.001 | 51.254 | 0.256 | 200.2 | 0.000 | 4 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.002 | 26.716 | 0.134 | 199.4 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.003 | 5.722 | 0.029 | 197.3 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.004 | 4.118 | 0.021 | 196.1 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.005 | 9.749 | 0.049 | 199.0 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.006 | 11.536 | 0.058 | 198.9 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.007 | 24.831 | 0.124 | 200.3 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.008 | 27.247 | 0.136 | 200.3 | 0.000 | 4 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.009 | 29.849 | 0.149 | 200.3 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.010 | 7.619 | 0.038 | 200.5 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 2.000 | 32.179 | 0.161 | 199.9 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 2.001 | 6.444 | 0.032 | 201.4 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

### Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 56.337 | 0.000 | 0.0 | 3 | 0.0 | 9 | 0.16 | 0.81 | 32.2 | 0.1 |
| 1.001 | 56.198 | 0.000 | 0.0 | 7 | 0.0 | 13 | 0.22 | 0.81 | 32.2 | 0.2 |
| 1.002 | 55.942 | 0.000 | 0.0 | 10 | 0.0 | 15 | 0.24 | 0.81 | 32.3 | 0.3 |
| 1.003 | 55.808 | 0.000 | 0.0 | 13 | 0.0 | 17 | 0.26 | 0.82 | 32.4 | 0.4 |
| 1.004 | 55.779 | 0.000 | 0.0 | 16 | 0.0 | 19 | 0.28 | 0.82 | 32.5 | 0.5 |
| 1.005 | 55.758 | 0.000 | 0.0 | 16 | 0.0 | 19 | 0.28 | 0.81 | 32.3 | 0.5 |
| 1.006 | 55.709 | 0.000 | 0.0 | 19 | 0.0 | 20 | 0.30 | 0.81 | 32.3 | 0.5 |
| 1.007 | 55.651 | 0.000 | 0.0 | 25 | 0.0 | 23 | 0.32 | 0.81 | 32.2 | 0.7 |
| 1.008 | 55.527 | 0.000 | 0.0 | 29 | 0.0 | 25 | 0.34 | 0.81 | 32.2 | 0.8 |
| 1.009 | 55.391 | 0.000 | 0.0 | 32 | 0.0 | 26 | 0.35 | 0.81 | 32.2 | 0.9 |
| 1.010 | 55.242 | 0.000 | 0.0 | 32 | 0.0 | 26 | 0.35 | 0.81 | 32.2 | 0.9 |
| 2.000 | 55.492 | 0.000 | 0.0 | 3 | 0.0 | 9 | 0.16 | 0.81 | 32.2 | 0.1 |
| 2.001 | 55.331 | 0.000 | 0.0 | 6 | 0.0 | 12 | 0.20 | 0.81 | 32.1 | 0.2 |

## Network Design Table for FS2

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.002 | 19.099 | 0.095 | 201.0 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.011 | 15.413 | 0.077 | 200.2 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.012 | 40.415 | 0.202 | 200.1 | 0.000 | 4 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.013 | 7.244 | 0.036 | 201.2 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.014 | 52.483 | 0.262 | 200.3 | 0.000 | 8 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 3.000 | 31.814 | 0.159 | 200.1 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 3.001 | 51.109 | 0.256 | 199.6 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 3.002 | 58.150 | 0.291 | 199.8 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.015 | 71.565 | 0.358 | 199.9 | 0.000 | 12 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.000 | 48.841 | 0.244 | 200.2 | 0.000 | 16 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.001 | 33.637 | 0.168 | 200.2 | 0.000 | 12 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.002 | 7.528 | 0.038 | 198.1 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.003 | 10.668 | 0.053 | 201.3 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.004 | 5.073 | 0.025 | 202.9 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 4.005 | 18.823 | 0.094 | 200.2 | 0.000 | 2 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.016 | 18.118 | 0.091 | 199.1 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 1.017 | 9.684 | 0.048 | 201.8 | 0.000 | 2 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.002 | 55.299 | 0.000 | 0.0 | 9 | 0.0 | 15 | 0.23 | 0.81 | 32.1 | 0.3 |
| 1.011 | 55.204 | 0.000 | 0.0 | 44 | 0.0 | 30 | 0.39 | 0.81 | 32.2 | 1.2 |
| 1.012 | 55.127 | 0.000 | 0.0 | 48 | 0.0 | 32 | 0.40 | 0.81 | 32.2 | 1.4 |
| 1.013 | 54.925 | 0.000 | 0.0 | 51 | 0.0 | 33 | 0.40 | 0.81 | 32.1 | 1.4 |
| 1.014 | 54.889 | 0.000 | 0.0 | 59 | 0.0 | 35 | 0.42 | 0.81 | 32.2 | 1.7 |
| 3.000 | 55.333 | 0.000 | 0.0 | 3 | 0.0 | 9 | 0.16 | 0.81 | 32.2 | 0.1 |
| 3.001 | 55.174 | 0.000 | 0.0 | 6 | 0.0 | 12 | 0.20 | 0.81 | 32.2 | 0.2 |
| 3.002 | 54.918 | 0.000 | 0.0 | 9 | 0.0 | 15 | 0.23 | 0.81 | 32.2 | 0.3 |
| 1.015 | 54.627 | 0.000 | 0.0 | 80 | 0.0 | 40 | 0.46 | 0.81 | 32.2 | 2.3 |
| 4.000 | 54.889 | 0.000 | 0.0 | 16 | 0.0 | 19 | 0.28 | 0.81 | 32.2 | 0.5 |
| 4.001 | 54.645 | 0.000 | 0.0 | 28 | 0.0 | 25 | 0.34 | 0.81 | 32.2 | 0.8 |
| 4.002 | 54.477 | 0.000 | 0.0 | 28 | 0.0 | 25 | 0.34 | 0.81 | 32.4 | 0.8 |
| 4.003 | 54.439 | 0.000 | 0.0 | 28 | 0.0 | 25 | 0.33 | 0.81 | 32.1 | 0.8 |
| 4.004 | 54.386 | 0.000 | 0.0 | 31 | 0.0 | 26 | 0.34 | 0.80 | 32.0 | 0.9 |
| 4.005 | 54.361 | 0.000 | 0.0 | 33 | 0.0 | 27 | 0.35 | 0.81 | 32.2 | 0.9 |
| 1.016 | 54.269 | 0.000 | 0.0 | 113 | 0.0 | 48 | 0.52 | 0.81 | 32.3 | 3.2 |
| 1.017 | 54.178 | 0.000 | 0.0 | 115 | 0.0 | 48 | 0.52 | 0.81 | 32.1 | 3.2 |

## Network Design Table for FS2

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.018 | 52.896 | 0.264 | 200.4 | 0.000 | 17 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.019 | 7.946 | 0.040 | 198.7 | 0.000 | 1 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.020 | 20.357 | 0.102 | 199.6 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

## Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.018 | 54.130 | 0.000 | 0.0 | 132 | 0.0 | 52 | 0.54 | 0.81 | 32.2 | 3.7 |
| 1.019 | 53.866 | 0.000 | 0.0 | 133 | 0.0 | 52 | 0.54 | 0.81 | 32.3 | 3.7 |
| 1.020 | 53.826 | 0.000 | 0.0 | 133 | 0.0 | 52 | 0.54 | 0.81 | 32.2 | 3.7 |

## PIPELINE SCHEDULES for FS2

### 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 | FB21 | 57.300 | 56.337 | 0.738 | Open Manhole | 1200 |
| 1.001 | o | 225 | FB20 | 57.300 | 56.198 | 0.877 | Open Manhole | 1200 |
| 1.002 | o | 225 | FB19 | 57.694 | 55.942 | 1.527 | Open Manhole | 1200 |
| 1.003 | o | 225 | FB18 | 57.171 | 55.808 | 1.138 | Open Manhole | 1200 |
| 1.004 | o | 225 | FB17 | 57.030 | 55.779 | 1.026 | Open Manhole | 1200 |
| 1.005 | o | 225 | FB16 | 57.003 | 55.758 | 1.020 | Open Manhole | 1200 |
| 1.006 | o | 225 | FB15 | 57.100 | 55.709 | 1.166 | Open Manhole | 1200 |
| 1.007 | o | 225 | FB14 | 57.109 | 55.651 | 1.233 | Open Manhole | 1200 |
| 1.008 | o | 225 | FB13 | 57.073 | 55.527 | 1.321 | Open Manhole | 1200 |
| 1.009 | o | 225 | FB12 | 57.122 | 55.391 | 1.506 | Open Manhole | 1200 |
| 1.010 | o | 225 | FB11 | 57.100 | 55.242 | 1.633 | Open Manhole | 1200 |
| 2.000 | o | 225 | FB10-3 | 56.899 | 55.492 | 1.182 | Open Manhole | 1200 |
| 2.001 | o | 225 | FB10-2 | 56.987 | 55.331 | 1.431 | Open Manhole | 1200 |
| 2.002 | o | 225 | FB10-1 | 57.029 | 55.299 | 1.505 | Open Manhole | 1200 |
| 1.011 | o | 225 | FB10 | 57.090 | 55.204 | 1.661 | Open Manhole | 1200 |
| 1.012 | o | 225 | FB9 | 57.028 | 55.127 | 1.676 | Open Manhole | 1200 |
| 1.013 | o | 225 | FB8 | 57.254 | 54.925 | 2.104 | Open Manhole | 1200 |
| 1.014 | o | 225 | FB7 | 57.305 | 54.889 | 2.191 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.761 | 199.7 | FB20 | 57.300 | 56.198 | 0.877 | Open Manhole | 1200 |
| 1.001 | 51.254 | 200.2 | FB19 | 57.694 | 55.942 | 1.527 | Open Manhole | 1200 |
| 1.002 | 26.716 | 199.4 | FB18 | 57.171 | 55.808 | 1.138 | Open Manhole | 1200 |
| 1.003 | 5.722 | 197.3 | FB17 | 57.030 | 55.779 | 1.026 | Open Manhole | 1200 |
| 1.004 | 4.118 | 196.1 | FB16 | 57.003 | 55.758 | 1.020 | Open Manhole | 1200 |
| 1.005 | 9.749 | 199.0 | FB15 | 57.100 | 55.709 | 1.166 | Open Manhole | 1200 |
| 1.006 | 11.536 | 198.9 | FB14 | 57.109 | 55.651 | 1.233 | Open Manhole | 1200 |
| 1.007 | 24.831 | 200.3 | FB13 | 57.073 | 55.527 | 1.321 | Open Manhole | 1200 |
| 1.008 | 27.247 | 200.3 | FB12 | 57.122 | 55.391 | 1.506 | Open Manhole | 1200 |
| 1.009 | 29.849 | 200.3 | FB11 | 57.100 | 55.242 | 1.633 | Open Manhole | 1200 |
| 1.010 | 7.619 | 200.5 | FB10 | 57.090 | 55.204 | 1.661 | Open Manhole | 1200 |
| 2.000 | 32.179 | 199.9 | FB10-2 | 56.987 | 55.331 | 1.431 | Open Manhole | 1200 |
| 2.001 | 6.444 | 201.4 | FB10-1 | 57.029 | 55.299 | 1.505 | Open Manhole | 1200 |
| 2.002 | 19.099 | 201.0 | FB10 | 57.090 | 55.204 | 1.661 | Open Manhole | 1200 |
| 1.011 | 15.413 | 200.2 | FB9 | 57.028 | 55.127 | 1.676 | Open Manhole | 1200 |
| 1.012 | 40.415 | 200.1 | FB8 | 57.254 | 54.925 | 2.104 | Open Manhole | 1200 |
| 1.013 | 7.244 | 201.2 | FB7 | 57.305 | 54.889 | 2.191 | Open Manhole | 1200 |
| 1.014 | 52.483 | 200.3 | FB6 | 57.250 | 54.627 | 2.398 | Open Manhole | 1200 |

PIPELINE SCHEDULES for FS2

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) |
|---|---|---|---|---|---|---|---|---|
| 3.000 | o | 225 | FB6-3 | 56.808 | 55.333 | 1.250 | Open Manhole | 1200 |
| 3.001 | o | 225 | FB6-2 | 56.497 | 55.174 | 1.098 | Open Manhole | 1200 |
| 3.002 | o | 225 | FB6-1 | 56.843 | 54.918 | 1.700 | Open Manhole | 1200 |
| 1.015 | o | 225 | FB6 | 57.250 | 54.627 | 2.398 | Open Manhole | 1200 |
| 4.000 | o | 225 | FB5-6 | 58.000 | 54.889 | 2.886 | Open Manhole | 1200 |
| 4.001 | o | 225 | FB5-5 | 58.145 | 54.645 | 3.275 | Open Manhole | 1200 |
| 4.002 | o | 225 | FB5-4 | 58.110 | 54.477 | 3.408 | Open Manhole | 1200 |
| 4.003 | o | 225 | FB5-3 | 58.113 | 54.439 | 3.449 | Open Manhole | 1200 |
| 4.004 | o | 225 | FB5-2 | 58.086 | 54.386 | 3.475 | Open Manhole | 1200 |
| 4.005 | o | 225 | FB5-1 | 58.038 | 54.361 | 3.452 | Open Manhole | 1200 |
| 1.016 | o | 225 | FB5 | 57.842 | 54.269 | 3.348 | Open Manhole | 1200 |
| 1.017 | o | 225 | FB4 | 58.028 | 54.178 | 3.625 | Open Manhole | 1200 |
| 1.018 | o | 225 | FB3 | 58.119 | 54.130 | 3.764 | Open Manhole | 1200 |
| 1.019 | o | 225 | FB2 | 57.954 | 53.866 | 3.863 | Open Manhole | 1200 |
| 1.020 | o | 225 | FB1 | 57.968 | 53.826 | 3.917 | 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) |
|---|---|---|---|---|---|---|---|---|
| 3.000 | 31.814 | 200.1 | FB6-2 | 56.497 | 55.174 | 1.098 | Open Manhole | 1200 |
| 3.001 | 51.109 | 199.6 | FB6-1 | 56.843 | 54.918 | 1.700 | Open Manhole | 1200 |
| 3.002 | 58.150 | 199.8 | FB6 | 57.250 | 54.627 | 2.398 | Open Manhole | 1200 |
| 1.015 | 71.565 | 199.9 | FB5 | 57.842 | 54.269 | 3.348 | Open Manhole | 1200 |
| 4.000 | 48.841 | 200.2 | FB5-5 | 58.145 | 54.645 | 3.275 | Open Manhole | 1200 |
| 4.001 | 33.637 | 200.2 | FB5-4 | 58.110 | 54.477 | 3.408 | Open Manhole | 1200 |
| 4.002 | 7.528 | 198.1 | FB5-3 | 58.113 | 54.439 | 3.449 | Open Manhole | 1200 |
| 4.003 | 10.668 | 201.3 | FB5-2 | 58.086 | 54.386 | 3.475 | Open Manhole | 1200 |
| 4.004 | 5.073 | 202.9 | FB5-1 | 58.038 | 54.361 | 3.452 | Open Manhole | 1200 |
| 4.005 | 18.823 | 200.2 | FB5 | 57.842 | 54.267 | 3.350 | Open Manhole | 1200 |
| 1.016 | 18.118 | 199.1 | FB4 | 58.028 | 54.178 | 3.625 | Open Manhole | 1200 |
| 1.017 | 9.684 | 201.8 | FB3 | 58.119 | 54.130 | 3.764 | Open Manhole | 1200 |
| 1.018 | 52.896 | 200.4 | FB2 | 57.954 | 53.866 | 3.863 | Open Manhole | 1200 |
| 1.019 | 7.946 | 198.7 | FB1 | 57.968 | 53.826 | 3.917 | Open Manhole | 1200 |
| 1.020 | 20.357 | 199.6 | FB0 | 57.836 | 53.724 | 3.887 | Open Manhole | 700 |

## Area Summary for FS2

| Pipe Number | Gross Area (ha) | Pipe Total (ha) |
|---|---|---|
| 1.000 | 0.000 | 0.000 |
| 1.001 | 0.000 | 0.000 |
| 1.002 | 0.000 | 0.000 |
| 1.003 | 0.000 | 0.000 |
| 1.004 | 0.000 | 0.000 |
| 1.005 | 0.000 | 0.000 |
| 1.006 | 0.000 | 0.000 |
| 1.007 | 0.000 | 0.000 |
| 1.008 | 0.000 | 0.000 |
| 1.009 | 0.000 | 0.000 |
| 1.010 | 0.000 | 0.000 |
| 2.000 | 0.000 | 0.000 |
| 2.001 | 0.000 | 0.000 |
| 2.002 | 0.000 | 0.000 |
| 1.011 | 0.000 | 0.000 |
| 1.012 | 0.000 | 0.000 |
| 1.013 | 0.000 | 0.000 |
| 1.014 | 0.000 | 0.000 |
| 3.000 | 0.000 | 0.000 |
| 3.001 | 0.000 | 0.000 |
| 3.002 | 0.000 | 0.000 |
| 1.015 | 0.000 | 0.000 |
| 4.000 | 0.000 | 0.000 |
| 4.001 | 0.000 | 0.000 |
| 4.002 | 0.000 | 0.000 |
| 4.003 | 0.000 | 0.000 |
| 4.004 | 0.000 | 0.000 |
| 4.005 | 0.000 | 0.000 |
| 1.016 | 0.000 | 0.000 |
| 1.017 | 0.000 | 0.000 |
| 1.018 | 0.000 | 0.000 |
| 1.019 | 0.000 | 0.000 |
| 1.020 | 0.000 | 0.000 |
| | Total | Total |
| | 0.000 | 0.000 |

## Free Flowing Outfall Details for FS2

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.020 | FB0 | 57.836 | 53.724 | 0.000 | 700 | 0 |

## Simulation Criteria for FS2

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

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

## Synthetic Rainfall Details

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

## FOUL SEWERAGE DESIGN

### Design Criteria for FS3

Pipe Sizes STANDARD Manhole Sizes STANDARD

| | | | |
|---|---|---|---|
| Industrial Flow (l/s/ha) | 0.00 | Add Flow / Climate Change (%) | 0 |
| Industrial Peak Flow Factor | 0.00 | Minimum Backdrop Height (m) | 0.200 |
| Flow Per Person (l/per/day) | 150.00 | Maximum Backdrop Height (m) | 1.500 |
| Persons per House | 2.70 | Min Design Depth for Optimisation (m) | 1.200 |
| Domestic (l/s/ha) | 0.00 | Min Vel for Auto Design only (m/s) | 0.75 |
| Domestic Peak Flow Factor | 6.00 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for FS3

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 46.847 | 0.234 | 200.2 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.001 | 9.824 | 0.049 | 200.5 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.002 | 3.699 | 0.018 | 205.5 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.003 | 36.136 | 0.181 | 199.6 | 0.000 | 9 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 2.000 | 27.948 | 0.140 | 199.6 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.004 | 17.955 | 0.090 | 199.5 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.005 | 8.856 | 0.044 | 201.3 | 0.000 | 7 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.006 | 8.143 | 0.041 | 198.6 | 0.000 | 3 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 1.007 | 72.248 | 0.361 | 200.1 | 0.000 | 6 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |
| 3.000 | 53.502 | 0.268 | 199.6 | 0.000 | 5 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

### Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 58.018 | 0.000 | 0.0 | 6 | 0.0 | 12 | 0.20 | 0.81 | 32.2 | 0.2 |
| 1.001 | 57.784 | 0.000 | 0.0 | 12 | 0.0 | 17 | 0.26 | 0.81 | 32.2 | 0.3 |
| 1.002 | 57.735 | 0.000 | 0.0 | 18 | 0.0 | 20 | 0.29 | 0.80 | 31.8 | 0.5 |
| 1.003 | 57.717 | 0.000 | 0.0 | 27 | 0.0 | 24 | 0.33 | 0.81 | 32.2 | 0.8 |
| 2.000 | 58.026 | 0.000 | 0.0 | 6 | 0.0 | 12 | 0.20 | 0.81 | 32.2 | 0.2 |
| 1.004 | 57.536 | 0.000 | 0.0 | 39 | 0.0 | 29 | 0.37 | 0.81 | 32.3 | 1.1 |
| 1.005 | 57.446 | 0.000 | 0.0 | 46 | 0.0 | 31 | 0.39 | 0.81 | 32.1 | 1.3 |
| 1.006 | 57.402 | 0.000 | 0.0 | 49 | 0.0 | 32 | 0.40 | 0.81 | 32.3 | 1.4 |
| 1.007 | 57.361 | 0.000 | 0.0 | 55 | 0.0 | 34 | 0.41 | 0.81 | 32.2 | 1.5 |
| 3.000 | 57.268 | 0.000 | 0.0 | 5 | 0.0 | 11 | 0.19 | 0.81 | 32.2 | 0.1 |

## Network Design Table for FS3

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 71.900 | 0.360 | 199.7 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | |

## Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 57.000 | 0.000 | 0.0 | 60 | 0.0 | 35 | 0.43 | 0.81 | 32.2 | 1.7 |

## PIPELINE SCHEDULES for FS3

### 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 | FC9 | 59.400 | 58.018 | 1.157 | Open Manhole | 1200 |
| 1.001 | o | 225 | FC8 | 59.300 | 57.784 | 1.291 | Open Manhole | 1200 |
| 1.002 | o | 225 | FC7 | 59.400 | 57.735 | 1.440 | Open Manhole | 1200 |
| 1.003 | o | 225 | FC6 | 59.500 | 57.717 | 1.558 | Open Manhole | 1200 |
| 2.000 | o | 225 | FC5-1 | 59.980 | 58.026 | 1.729 | Open Manhole | 1200 |
| 1.004 | o | 225 | FC5 | 59.850 | 57.536 | 2.089 | Open Manhole | 1200 |
| 1.005 | o | 225 | FC4 | 59.670 | 57.446 | 1.999 | Open Manhole | 1200 |
| 1.006 | o | 225 | FC3 | 59.591 | 57.402 | 1.964 | Open Manhole | 1200 |
| 1.007 | o | 225 | FC2 | 59.515 | 57.361 | 1.929 | Open Manhole | 1200 |
| 3.000 | o | 225 | FC1-1 | 59.679 | 57.268 | 2.186 | Open Manhole | 1200 |
| 1.008 | o | 225 | FC1 | 59.520 | 57.000 | 2.295 | 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 | 46.847 | 200.2 | FC8 | 59.300 | 57.784 | 1.291 | Open Manhole | 1200 |
| 1.001 | 9.824 | 200.5 | FC7 | 59.400 | 57.735 | 1.440 | Open Manhole | 1200 |
| 1.002 | 3.699 | 205.5 | FC6 | 59.500 | 57.717 | 1.558 | Open Manhole | 1200 |
| 1.003 | 36.136 | 199.6 | FC5 | 59.850 | 57.536 | 2.089 | Open Manhole | 1200 |
| 2.000 | 27.948 | 199.6 | FC5 | 59.850 | 57.886 | 1.739 | Open Manhole | 1200 |
| 1.004 | 17.955 | 199.5 | FC4 | 59.670 | 57.446 | 1.999 | Open Manhole | 1200 |
| 1.005 | 8.856 | 201.3 | FC3 | 59.591 | 57.402 | 1.964 | Open Manhole | 1200 |
| 1.006 | 8.143 | 198.6 | FC2 | 59.515 | 57.361 | 1.929 | Open Manhole | 1200 |
| 1.007 | 72.248 | 200.1 | FC1 | 59.520 | 57.000 | 2.295 | Open Manhole | 1200 |
| 3.000 | 53.502 | 199.6 | FC1 | 59.520 | 57.000 | 2.295 | Open Manhole | 1200 |
| 1.008 | 71.900 | 199.7 | FC0 | 59.577 | 56.640 | 2.712 | Open Manhole | 0 |

## Area Summary for FS3

| Pipe Number | Gross Area (ha) | Pipe Total (ha) |
|---|---|---|
| 1.000 | 0.000 | 0.000 |
| 1.001 | 0.000 | 0.000 |
| 1.002 | 0.000 | 0.000 |
| 1.003 | 0.000 | 0.000 |
| 2.000 | 0.000 | 0.000 |
| 1.004 | 0.000 | 0.000 |
| 1.005 | 0.000 | 0.000 |
| 1.006 | 0.000 | 0.000 |
| 1.007 | 0.000 | 0.000 |
| 3.000 | 0.000 | 0.000 |
| 1.008 | 0.000 | 0.000 |
| | Total | Total |
| | 0.000 | 0.000 |

## Free Flowing Outfall Details for FS3

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.008 | FC0 | 59.577 | 56.640 | 0.000 | 0 | 0 |

## Simulation Criteria for FS3

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

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

## Synthetic Rainfall Details

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

## FOUL SEWERAGE DESIGN

### Design Criteria for FS4

Pipe Sizes STANDARD Manhole Sizes STANDARD

| | | | |
|---|---|---|---|
| Industrial Flow (l/s/ha) | 0.00 | Add Flow / Climate Change (%) | 0 |
| Industrial Peak Flow Factor | 0.00 | Minimum Backdrop Height (m) | 0.200 |
| Flow Per Person (l/per/day) | 150.00 | Maximum Backdrop Height (m) | 1.500 |
| Persons per House | 2.70 | Min Design Depth for Optimisation (m) | 1.200 |
| Domestic (l/s/ha) | 0.00 | Min Vel for Auto Design only (m/s) | 0.75 |
| Domestic Peak Flow Factor | 6.00 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for FS4

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | 39.521 | 0.124 | 318.7 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |
| 2.001 | 24.919 | 0.206 | 121.0 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | 55.375 | 0.000 | 0.0 | 0 | 0.0 | 0 | 0.00 | 0.64 | 25.5 | 0.0 |
| 2.001 | 55.251 | 0.000 | 0.0 | 0 | 0.0 | 0 | 0.00 | 1.04 | 41.5 | 0.0 |

## PIPELINE SCHEDULES for FS4

### 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) |
|---|---|---|---|---|---|---|---|---|
| 2.000 | o | 225 | FD2 | 59.000 | 55.375 | 3.400 | Open Manhole | 1200 |
| 2.001 | o | 225 | FD1 | 59.283 | 55.251 | 3.807 | 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) |
|---|---|---|---|---|---|---|---|---|
| 2.000 | 39.521 | 318.7 | FD1 | 59.283 | 55.251 | 3.807 | Open Manhole | 1200 |
| 2.001 | 24.919 | 121.0 | FD0 | 59.523 | 55.045 | 4.253 | Open Manhole | 0 |

## Area Summary for FS4

| Pipe Number | Gross Area (ha) | Pipe Total (ha) |
|---|---|---|
| 2.000 | 0.000 | 0.000 |
| 2.001 | 0.000 | 0.000 |
| | Total | Total |
| | 0.000 | 0.000 |

## Free Flowing Outfall Details for FS4

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 2.001 | FD0 | 59.523 | 55.045 | 0.000 | 0 | 0 |

## Simulation Criteria for FS4

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

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

## Synthetic Rainfall Details

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

## FOUL SEWERAGE DESIGN

## Design Criteria for FS5

Pipe Sizes STANDARD Manhole Sizes STANDARD

| | | | |
|---|---|---|---|
| Industrial Flow (l/s/ha) | 0.00 | Add Flow / Climate Change (%) | 0 |
| Industrial Peak Flow Factor | 0.00 | Minimum Backdrop Height (m) | 0.200 |
| Flow Per Person (l/per/day) | 222.00 | Maximum Backdrop Height (m) | 1.500 |
| Persons per House | 3.00 | Min Design Depth for Optimisation (m) | 1.200 |
| Domestic (l/s/ha) | 0.00 | Min Vel for Auto Design only (m/s) | 0.75 |
| Domestic Peak Flow Factor | 6.00 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for FS5

| PN | Length (m) | Fall (m) | Slope (1:X) | Area (ha) | Houses | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 19.041 | 0.087 | 218.9 | 0.000 | 0 | 0.0 | 1.500 | o | 225 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | US/IL (m) | Σ Area (ha) | Σ Base Flow (l/s) | Σ Hse | Add Flow (l/s) | P.Dep (mm) | P.Vel (m/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 56.714 | 0.000 | 0.0 | 0 | 0.0 | 0 | 0.00 | 0.77 | 30.8 | 0.0 |

PIPELINE SCHEDULES for FS5

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 | FE1 | 59.139 | 56.714 | 2.200 | 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 | 19.041 | 218.9 | FE0 | 59.111 | 56.627 | 2.259 | Open Manhole | 0 |

## Area Summary for FS5

| Pipe Number | Gross Area (ha) | Pipe Total (ha) |
|---|---|---|
| 1.000 | 0.000 | 0.000 |
| | Total | Total |
| | 0.000 | 0.000 |

## Free Flowing Outfall Details for FS5

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.000 | FE0 | 59.111 | 56.627 | 0.000 | 0 | 0 |

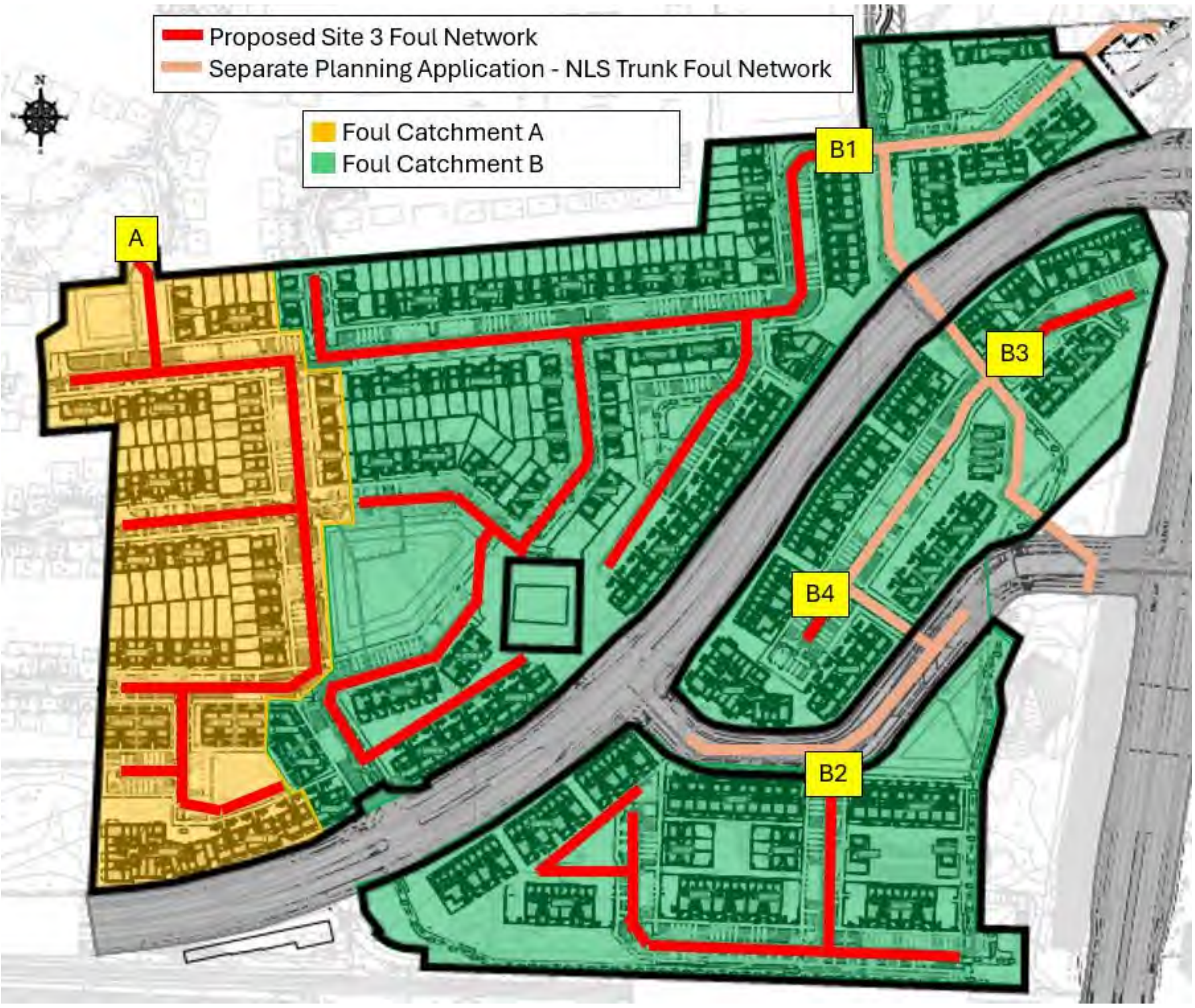
## Simulation Criteria for FS5

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

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

## Synthetic Rainfall Details

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




*Kishoge Site 3 – Foul Network Catchments & Outfalls*

# Appendix C : UISCE ÉIREANN CONFIRMATION OF FEASIBILITY

## CONFIRMATION OF FEASIBILITY

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

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Dieter Bester

DBFL
Ormond House
Ormond Quay Upper
Dublin
D07 W704

24 May 2024

**Our Ref: CDS24003031 Pre-Connection Enquiry**
**Clonburris, Dublin**

Dear Applicant/Agent,

### We have completed the review of the Pre-Connection Enquiry.

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 609 unit(s) at Clonburris, Dublin, (the **Development)**.

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection** - Feasible without infrastructure upgrade by Uisce Éireann

- The connection is feasible off the existing 400mm ID main and it should be a primary connection for the Development with a bulk meter and associated telemetry system installed on the line.
- The DMA mains must be looped to avoid dead ends and have a secondary connection via a closed valve.
- The existing valve as shown in figure below must be opened to provide the adequate supply.
- Proposed and constructed Clonburiss SDZ infrastructure within the Development must be in line with Clonburiss Water Supply Master Plan approved by Uisce Éireann.


- **Wastewater Connection** - Feasible Subject to upgrades

- 120 units of the Development may connect to the 525mm sewer as proposed by the Applicant. Clonburris Wastewater Master Plan has to be updated to reflect the above. The Developer may need to make a contribution to Esker wastewater pumping station (WWPS) upgrade. The WWPS is downstream of the 525mm sewer. At a connection application stage, the potential upgrade requirements will be reviewed, and upgrade contribution fee will be calculated.
- Proposed connections of the remaining units are to the proposed Northern Link Street (NLS) infrastructure as part of Clonburris SDZ. All relevant Clonburiss SDZ infrastructure (including PS and RM #3, NLS infrastructure), has to be in line with the approved Clonburris Master Plan, completed and connected to Uisce Éireann infrastructure prior the connection. The infrastructure will be delivered by Clonburris Infrastructure Ltd.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

## Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Uisce Éireann’s Network(s)

**This letter is issued to provide information about the current feasibility of the proposed connection(s) to Uisce Éireann's network(s). This is not a connection offer and capacity in Uisce Éireann's network(s) may only be secured by entering into a connection agreement with Uisce Éireann.**

For any further information, visit **www.water.ie/connections**, **email newconnections@water.ie** or contact 1800 278 278**.**

Yours sincerely,

**Dermot Phelan**
**Connections Delivery Manager**

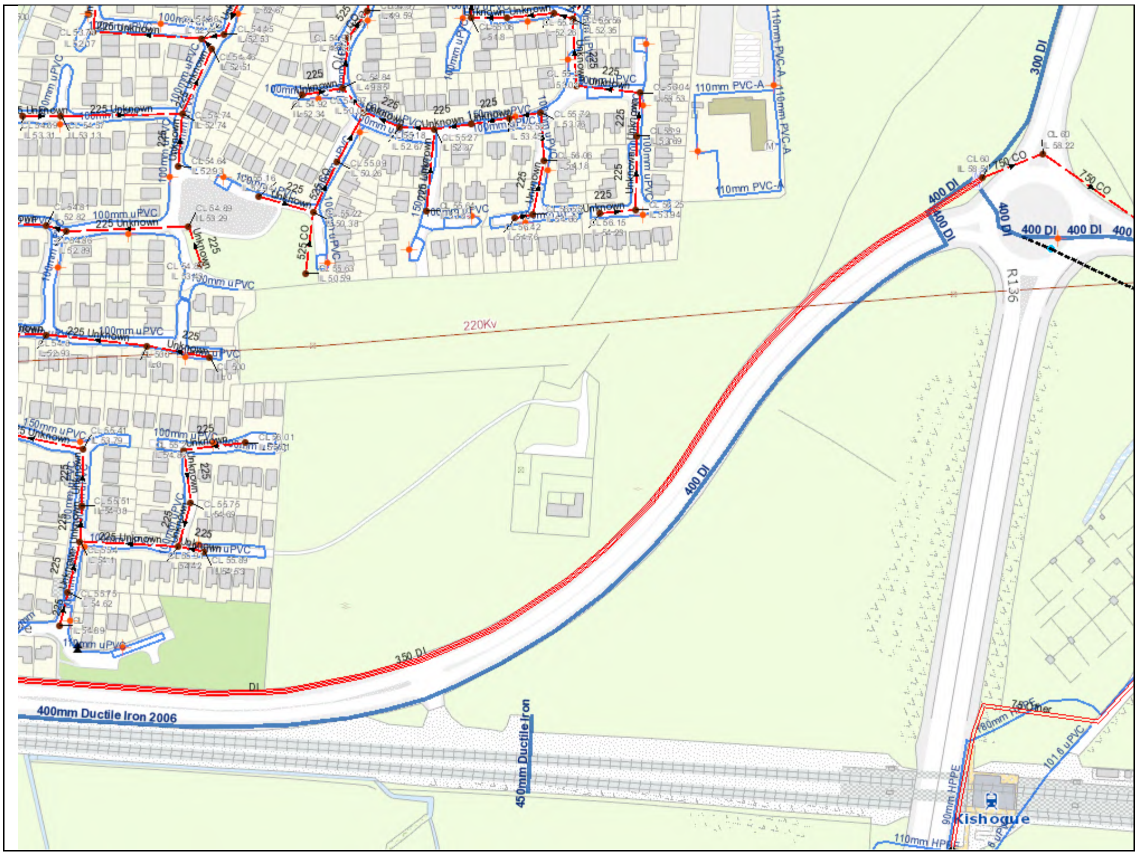
## Section A - What is important to know?

| What is important to know? | Why is this important? |
|---|---|
| **Do you need a contract to connect?** | • Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s).<br>• Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann. |
| **When should I submit a Connection Application?** | • A connection application should only be submitted after planning permission has been granted. |
| **Where can I find information on connection charges?** | • Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/ |
| **Who will carry out the connection work?** | • All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*.<br><br>*Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works |
| **Fire flow Requirements** | • The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine.<br>• **What to do?** - Contact the relevant Local Fire Authority |
| **Plan for disposal of storm water** | • The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters.<br>• **What to do?** - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges. |
| **Where do I find details of Uisce Éireann's network(s)?** | • Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie |

| | |
|---|---|
| **What are the design requirements for the connection(s)?** | • The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with ***the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice,*** available at www.water.ie/connections |
| **Trade Effluent Licensing** | • Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended).<br>• More information and an application form for a Trade Effluent License can be found at the following link:<br>https://www.water.ie/business/trade-effluent/about/<br><br>**trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended) |

## Section B – Details of Uisce Éireann's Network(s)

**The map included below outlines the current Uisce Éireann infrastructure adjacent the Development:** To access Uisce Éireann Maps email datarequests@water.ie




Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

**Note:** The information provided on the included maps as to the position of Uisce Éireann's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann's network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann's underground network(s) 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.

# Appendix D : STAGE 1 ROAD SAFETY AUDIT

24261-01-001

# PROPOSED RESIDENTIAL DEVELOPMENT, KISHOGE SITE 3, ADAMSTOWN AVENUE, KISHOGE, CO. DUBLIN

## Road Safety Audit Stage 1

for

## DBFL Consulting Engineers

JANUARY 2025

ROADPLAN CONSULTING

7, Ormonde Road
Kilkenny.
R95 N4FE

Tel: 056 7795800
info@roadplan.ie
www.roadplan.ie

**DOCUMENT CONTROL SHEET**

| | |
|---|---|
| **Project Title** | Residential Development at Adamstown Avenue, Kishoge, Co. Dublin |
| **Project No.** | 24261-01 |
| **Client** | DBFL Consulting Engineers |
| **Document Title** | Road Safety Audit Stage 1 |
| **Document No.** | 24261-01-001 |

| Status | Author(s) | Reviewed By | Approved By | Issue Date |
|---|---|---|---|---|
| Draft 1 | HC / GF | HC / GF | GF | 14/1/2025 |
| Final | HC / GF | HC / GF | GF | 20/1/2025 |

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3. AUDIT TEAM STATEMENT .......... 17
4. SAFETY AUDIT FEEDBACK FORM .......... 18
APPENDIX A .......... 20

# 1. INTRODUCTION

1.1 This report describes a Stage 1 Road Safety Audit carried out at the proposed residential development at Adamstown Avenue, Kishoge, Co. Dublin. . The audit was carried out on 13th January 2025 in the offices of Roadplan Consulting, Kilkenny.

1.2 The audit team members were as follows:

- George Frisby, BE CEng MIEI
  Auditor Number GF51255

- Harry Cullen, BE CEng MIEI
  Auditor Number HC1333178

1.3 Both audit team members visited the site on the 18th December 2024. The audit comprised of an examination of the drawings relating to the scheme supplied by DBFL Consulting Engineers and an examination of the site.

1.4 The speed limit on Adamstown Avenue is 60 km/h (see Figure 1 below), and the auditors assume that the speed limit on the new development will be 30km/h.

***Figure 1 –*** *Adamstown road speed limit at proposes development*

1.5 This Stage 1 Audit has been carried out in accordance with the relevant sections of TII GE-STY-01024. The team has examined only those issues within the design relating to the road safety implications of the scheme and has therefore not examined or verified the compliance of the design to any other criteria.

1.6 All problems described in this report are considered by the audit team to require action in order to improve the safety of the scheme and minimise accident occurrence.

1.7 Appendix A contains copies of the audited drawing.

## 2. STAGE 1 AUDIT

2.1 **Problem:** Adamstown Avenue
**Location:** At Junction A (the most westerly junction)

Adamstown Avenue is a 4-lane roadway, with a solid island in the centre. It connects the R136 on Grange Castle Road with Adamstown, over 2km to the west. All the development along this stretch of Adamstown Avenue is catered for by a service road off Adamstown Avenue. There is no direct access onto Adamstown Avenue on this 2.5km stretch of road.

This proposed development shows two main junctions off Adamstown Avenue plus a pedestrian crossing, and another junction off the R136 to service the development, highlighted in yellow boxes on Figure 2 below.

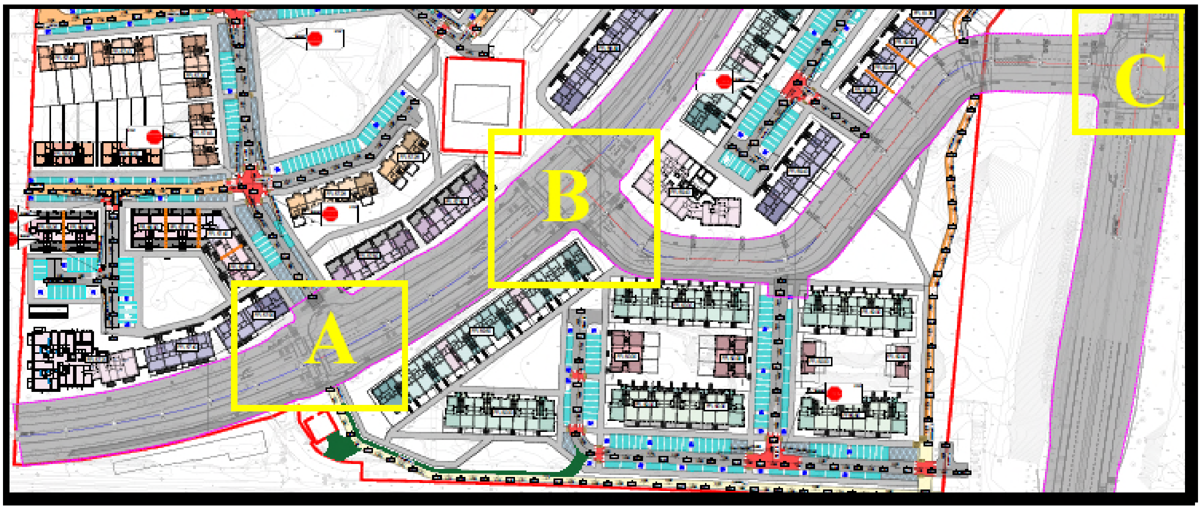



***Figure 2–** Three junctions serving the development.*

An examination of Junction A (the most westerly junction) show that the minor road (serving Street 02) is a STOP controlled junction, the other two junctions (B and C) appear to be traffic light-controlled junctions.

No traffic data has been made available to the auditors, however more than half the proposed development will be served by Junction A, and if traffic backs up exiting the development at peak times it may lead to risk taking by motorists, leading to collisions and injuries.

**Recommendation:**
Review the projected traffic flows at this junction and the need for traffic light control on entering/exiting the development at Junction A, to ensure the junction will function as proposed at peak times.

2.2 **Problem:** Adamstown Avenue
**Location:** Vulnerable Road User Movements at Junction A

Figure 3 below shows a proposal for a crossing for vulnerable road users at this junction. This is to cater for pedestrians exiting Street 02, and also for cyclists and other vulnerable road users using Greenway No. 1 to the south. This is a 4-lane highway with a solid median. Pedestrians may well have difficulty using an uncontrolled crossing given the width of the road. There are no traffic control devices shown on the drawing, but the auditors are assuming it's a controlled crossing.

Depending on the traffic flow, pedestrians could easily be 'marooned' in the central island without any control devices.

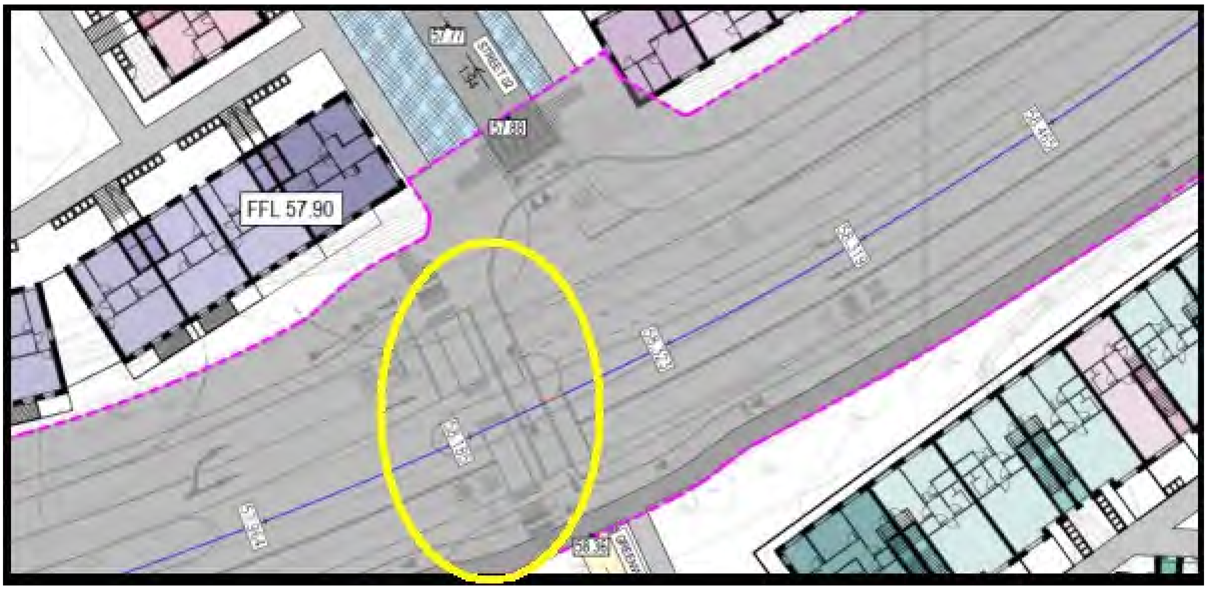



***Figure 3** – Junction A*

**Recommendation:**
Provide for a controlled crossing for vulnerable road users at this location, including push button control on the median.

2.3 **Problem:** Lack of appropriate tactile
**Location:** End of Greenways 1 at Junction A

Appropriate tactile warning does not appear to be provided at all locations where the proposed greenways running through the developments joins a shared route, see Figure 4 below. Lack of appropriate tactile could lead to collisions with injuries.

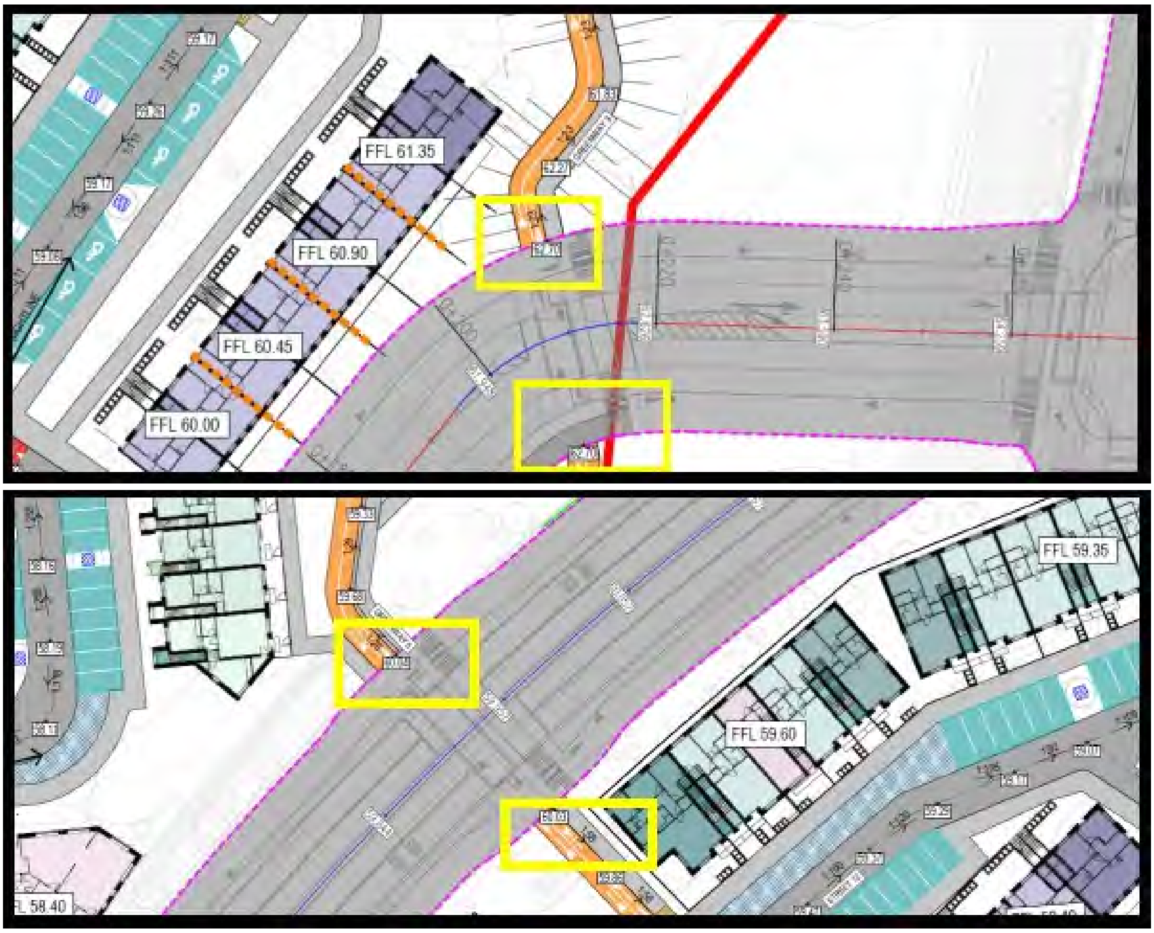



***Figure 4 –*** *Locations where Greenways joins a shared route*

**Recommendation:**
Provide appropriate tactile paving at these locations.

2.4 **Problem:** No continuation of Greenway 1 into the development
**Location:** At Junction A and onto Street No.02

Greenway 01, which is a two-way cycleway, extends along the southern boundary of the development. There is a crossing point at Junction A to the other side of the road, but there is no continuation of Greenway 01 into the development. See Figure 5 below.


**Figure 5–** *No continuation of Greenway01 and no cycleways in development*

In fact, there are very few facilities for cyclists shown in the development, except for the various Greenways along the eastern side of the development and perhaps the Home Streets.

This lack of continuity may lead to conflict between cyclists and pedestrians on the footpaths, leading to collisions and injuries.

**Recommendation:**
Provide for continuity of cycleways throughout the development.

2.5 **Problem:** Autotrack Information
**Location:** In the development

No Autotrack information for the movements of Refuse trucks and Fire Tenders has been provided on the drawings. The movements of these vehicles around the development needs to be carefully evaluated to ensure no overhangs on kerbs or green areas, to avoid interacting with pedestrians and children at play in the development, which could lead to collisions and injuries.

**Recommendation:**
Review movements of large vehicles by Autotrack through the development to ensure no overhangs onto footpaths and green areas.

2.6 **Problem: Refuse** Bin Storage areas for Apartments
**Location:** In the development

There appear to a number of apartment buildings spread throughout the development. However, no location for Refuse Bin Storage areas appears to be identified on the drawings. See an example on Figure 6 below.


***Figure 6 –*** *No Refuse Bins shown for apartments*

Refuse trucks will need easy access to bin storage areas to avoid interacting with pedestrian and children at play in the development, which could lead to collisions and injuries.

**Recommendation:**
Provide accessible locations for refuse bin storage areas

2.7 **Problem:** Number of Disabled drivers parking spaces
**Location:** In the Development

While there are a number of designated parking areas provided for wheelchair users, current guidelines would suggest that 5% of all parking spaces should be made available for disable drivers. The number provided falls short of this, and a large number of the designated disabled parking spaces as grouped together, which means that other areas have a serious shortage of disabled spaces, see Figure 7 below.

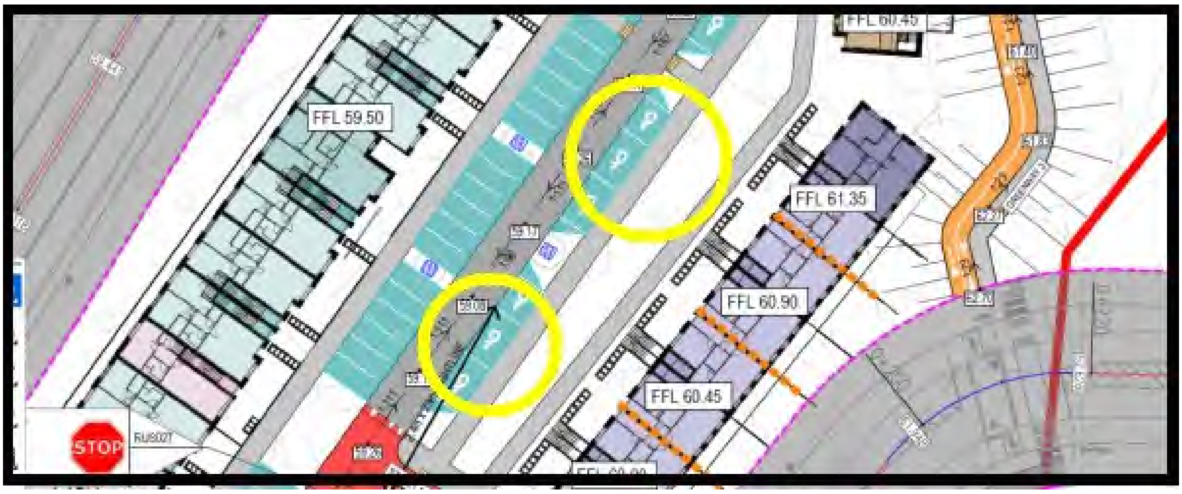



***Figure 7 –*** *Poor distribution of disabled parking spaces, and not 5% of total*

**Recommendation:**
Review the allocation of designated parking areas for wheelchair users, to meet with current guidelines. These disabled parking places should be located close to the dwellings.

2.8 **Problem:** Parking for Disabled drivers
**Location:** In the Development

There does not appear to be any dropped kerbs shown for disabled drivers parking places, see Figure 8 below. This can lead to falls and injuries for disabled drivers.


***Figure 8 –*** *No dropped kerbs shown at any disabled parking spaces in the development*

**Recommendation:**
Provide facilities to standard for disabled parking spaces.

2.9 **Problem:** Parking spaces for Electric Vehicles
**Location:** In the Development

There does not appear to be any charging points proposed for electric vehicles. The City Development Plan stipulates that all new residential developments with car parking facilities must be equipped to support EV charging. Current guidelines would suggest that all developments should provide facilities for charging battery operated cars at a rate of up to 10% of the total car parking spaces.

**Recommendation:**
Provide the allocation of designated charging points for electric vehicles, to meet with current guidelines.

2.10 **Problem:** Parking near some Apartments
**Location:** In the development

There does not appear to be any parking provided close to the apartments highlighted in Figure 9 below. This can lead to incidents, especially for disabled road users and pedestrians having to travel some distance to access their unit.

***Figure 9 –*** *No parking places close to units in the development*

**Recommendation:**
Review the provision of parking for these units close to their destination.

2.11 **Problem:** Visibility Splays at Junctions
**Location:** In the development

Visibility splays are proposed at all the junctions within the proposed development. However, the visibility splays are shown to encroach into parking bays at a number of junctions, see example in Figure 10 below. Vehicles parked in these parking spaces may restrict the proposed visibility at the adjacent junction. A lack of appropriate visibility may contribute to a collision at the junction.

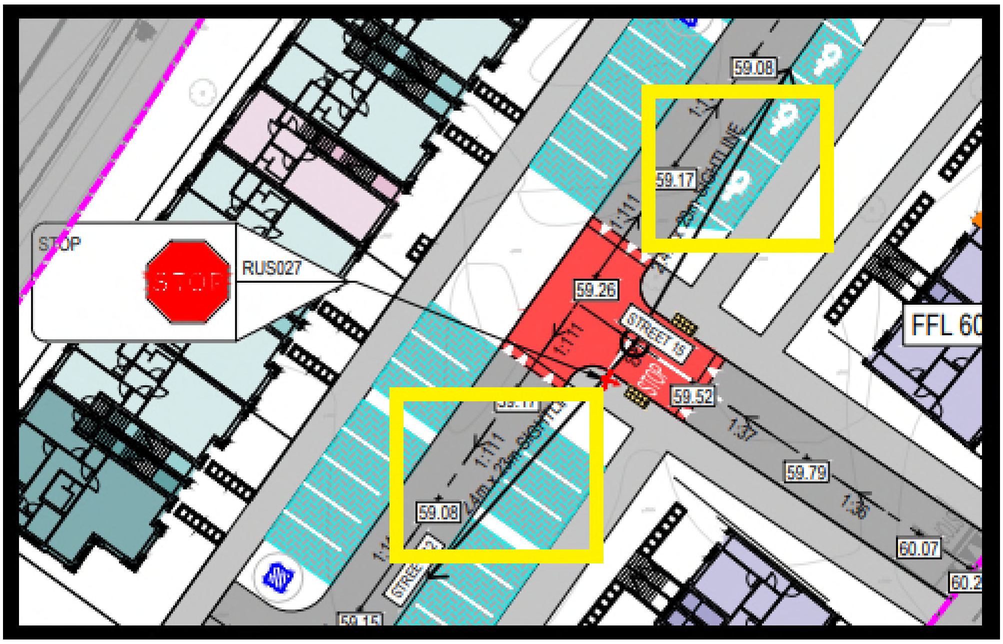



***Figure 10 –*** *Parked vehicles within visibility splays*

**Recommendation:**
Revise the layout where necessary to ensure that adequate visibility splays are provided are all junctions within the proposed development.

2.12 **Problem:** Rat Running from Junction B to Junction C
**Location:** In the development

There is a possibility of Rat Running taking place from Junction B to Junction C and vice versa, to avoid the junction at the top of Adamstown Avenue. No measures appear to be present on the drawings to ameliorate this. This can lead to traffic congestion and risk taking, resulting in collisions and injuries.

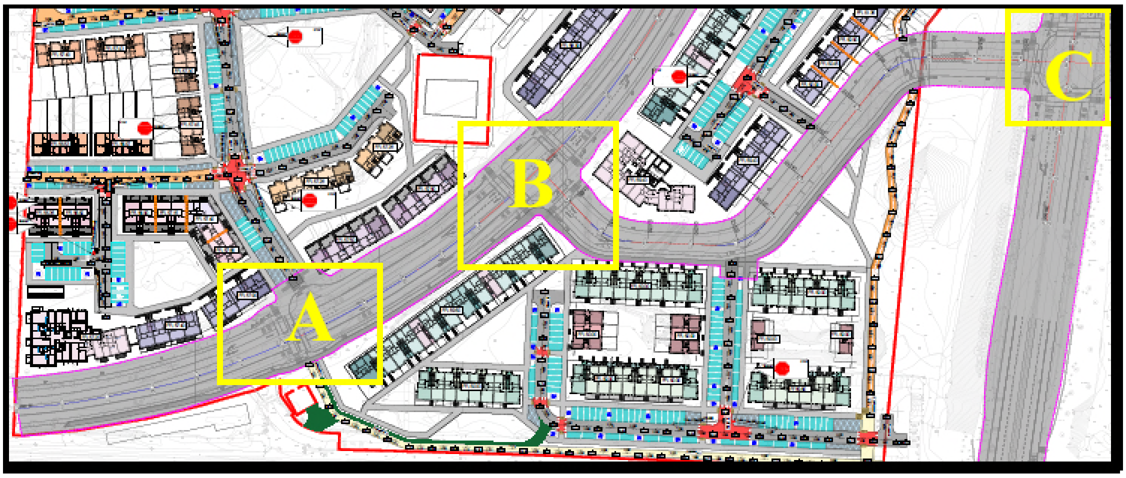



***Figure 11–*** *Potential of Rat Running from Junctions B to C*

**Recommendation:**
Review the link from Junction B to C to minimise the risk of Rat Running.

2.13 **Problem:** Visibility Splays at Pedestrian Crossings
**Location:** In the development

Intervisibility between motorist approaching pedestrian crossings and pedestrians crossing pedestrian crossings may be restricted by vehicles parked in the adjacent car parking bays, see example in Figure 12 below. A lack of appropriate intervisibility at pedestrian crossings contribute to a pedestrian collision at these locations.


***Figure 12*** *– Intervisibility at Pedestrian Crossings*

**Recommendation:**
Revise the layout where necessary to ensure that adequate intervisibility is provided between motorist approaching pedestrian crossings and pedestrians crossing pedestrian crossings.

2.14 **Problem:** Bicycle Sheds
**Location:** In the development

There appear to be quite a number of apartment units spread throughout the development. However, no bicycle sheds or shelters have been identified on the drawings.
This can lead to injuries for users and other residents as they attempt to carry their bikes into apartments.

**Recommendation:**
Review the provision of Bike Shelters for all apartment buildings

2.15 **Problem:** No pedestrian facilities at the junction off Road B to C
**Location:** In the development

There are no pedestrian crossing facilities shown at this junction. See Figure 13 below. This could lead to collisions between pedestrian and motorists, leading to injuries.

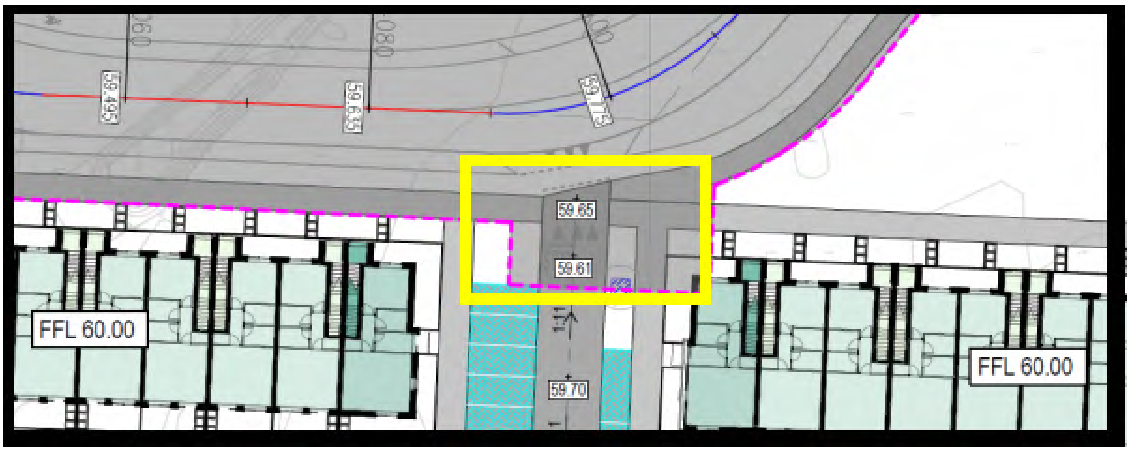



***Figure 13 –*** *No pedestrian crossing facilities at junction*

**Recommendation:**
Provide pedestrian crossing facilities at this junction.

2.16 **Problem:** No STOP sign shown at this junction
**Location:** In the development

There is no STOP sign shown on the drawing for this junction. Other more minor junctions nearby all have STOP signs shown on the drawing. See Figure 14 below.
If no STOP sign is shown at this junction it could lead to collisions with traffic on the main road, leading to injuries.


***Figure 14 –*** *No STOP sign at junction*

**Recommendation:**
Provide STOP sign at this junction.

2.17 **Problem:** No STOP sign shown at this junction
**Location:** In the development

There is no STOP sign shown on the drawing for this junction. Other more minor junctions nearby all have STOP signs shown on the drawing. See Figure 15 below.

If no STOP sign is shown at this junction it could lead to collisions with traffic on the main road, leading to injuries.


***Figure 15 –*** *No STOP sign at junction*

**Recommendation:**
Provide STOP sign at this junction.

2.18 **Problem:** Road Curvature
**Location:** In the development

The proposed horizontal curve radii at a number of locations appears to be low or non-existent, see example in Figure 16 below. A lack of appropriate curve radii within the proposed development may lead to loss of control collisions at these locations.

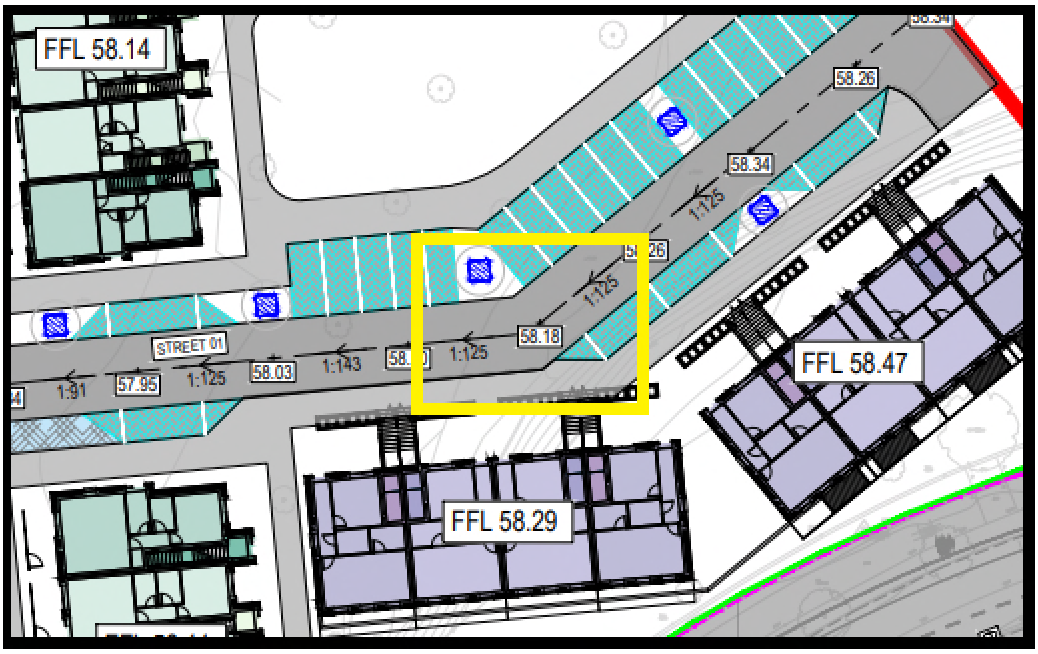



***Figure 16 –*** *Horizontal curvature.*

**Recommendation:**
Provide appropriate curve radii at all bends within the proposed development.

2.19 **Problem:** Some turning areas appear quite short
**Location:** In the development

Some of the turning areas at the end of minor roads appear quite short, considering that refuse trucks and fire tenders may need to use them to complete a turning movement, see example in Figure 17.
If these large vehicles have difficultly turning, they may mount footpath or grass verges and risk striking pedestrian or children, resulting in injuries.


**Figure 17 –** Some turning areas appear quite short

**Recommendation:**
Ensure adequate space is made available for these larger vehicles to turn in the development, without recourse to footpaths or grass areas.

2.20 **Problem:** Tactile Paving missing
**Location:** In the development

Tactile paving does not extend across the full width of the crossing in some shared spaces while tactile paving is not provided where footpaths join shared spaces in other locations, see example in Figure 18. A lack of appropriate tactile paving may contribute to a pedestrian collision in these locations.

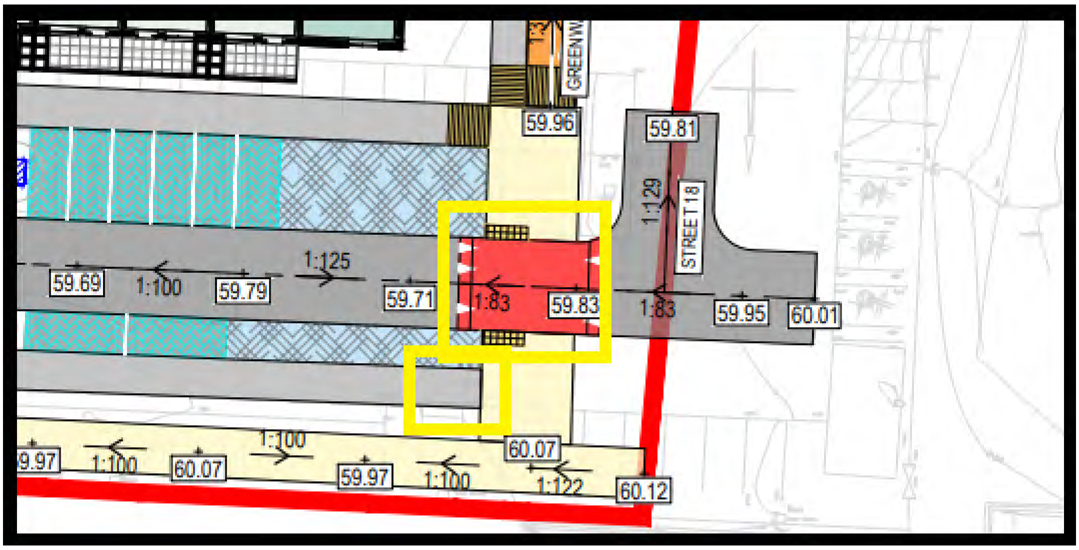



**Figure 18 –** Tactile paving missing

**Recommendation:**
Ensure adequate tactile paving is provided at all locations within the proposed development.

## 3. AUDIT TEAM STATEMENT

3.1 We certify that we have examined the drawings listed in Appendix A and have inspected the site. This examination has been carried out with the sole purpose of identifying any features of the scheme that could be removed or modified to improve the safety of the scheme.

Signed…… ………….. George Frisby

Date ...........13th January 2025………..

Signed……… …………… Harry Cullen

Date ..............13th January 2025………..

## 4. SAFETY AUDIT FEEDBACK FORM

**Scheme:** Residential Development at Adamstown Avenue, Kishoge, Dublin

**Document Number:** 24261-01-RP-001

**Audit Stage:** Stage 1 RSA

**Date Audit Completed:** 13th January 2025

| Paragraph No. in Safety Audit Report | To Be Completed By Designer | | | To Be Completed by Audit Team Leader |
|---|---|---|---|---|
| | Problem accepted (yes/no) | Recommended measure Accepted (yes/no) | Describe alternative measure(s). Give reasons for not accepting recommended measure. Only complete if recommended measure is not accepted. | Alternative measures or reasons accepted by auditors (yes/no) |
| **2.1** | Yes | Yes | --------------------------- | ------------ |
| **2.2** | Yes | Yes | --------------------------- | ------------ |
| **2.3** | Yes | Yes | --------------------------- | ------------ |
| **2.4** | No | No | The overall movement concept and road hierarchy as proposed has been developed to match the Clonburris SDZ (Figure 2.2.7) as far as feasible.<br><br>The Greenways (Shared ped/cycle routes) and cycle tracks have been provided at all locations where required in the SDZ including additional pedestrian and cycle links.<br><br>Within the development, the SDZ provides clear guidance on the allowable Local Street and Homezone cross sections for each street (Figure 2.2.6), which does not allow for cycle tracks or lanes.<br><br>Clonburris SDZ Link: Clonburris-SDZ-Planning-Scheme | Yes |
| **2.5** | Yes | Yes | --------------------------- | ------------ |
| **2.6** | Yes | Yes | --------------------------- | ------------ |
| **2.7** | Yes | Yes | --------------------------- | ------------ |
| **2.8** | Yes | Yes | --------------------------- | ------------ |

| | | | | |
|---|---|---|---|---|
| **2.9** | Yes | Yes | --------------------------- | ------------ |
| **2.10** | No | No | Sufficient accessible parking is provided north of the houses indicated and all houses have parking within 50m. Including the houses indicated.<br><br>An additional disabled parking space will be added to the parking layout as shown near the houses indicated.<br><br> | Yes |
| **2.11** | Yes | Yes | --------------------------- | ------------ |
| **2.12** | No | No | Junction A, B and C are proposed as part of a separate planning application as part of the Norther Link Street currently lodged for Planning.<br><br>A full traffic model has been developed taking the proposed surrounding Kishoge Site 3, 4 and 5 future traffic into account and showing no “rat running”.<br><br>Further, the proposed changes to Adamstown Road and the Northern Link Street (both separately planned) are proposed as dictated by the Clonburris SDZ through consultation with SDCC and the NTA. | Yes |
| **2.13** | Yes | Yes | --------------------------- | ------------ |
| **2.14** | Yes | Yes | --------------------------- | ------------ |
| **2.15** | No | No | The junction from the separately planned junction from the Northern Link Street to the Kishoge site 3 development falls within the scope of a separate project.<br><br>Further, the junction is currently proposed as a raised pedestrian priority crossing where the crossing vehicles entering and exiting the development have to stop for crossing pedestrians and cyclists. | Yes |

| | | | | |
|---|---|---|---|---|
| **2.16** | Yes | Yes | --------------------------- | ------------ |
| **2.17** | Yes | Yes | --------------------------- | ------------ |
| **2.18** | Yes | Yes | --------------------------- | ------------ |
| **2.19** | Yes | Yes | --------------------------- | ------------ |
| **2.20** | Yes | Yes | --------------------------- | ------------ |

**Safety Audit**
**Signed off** ………………………….. **Design Team Leader**

**Print Name** ……….**Dieter Bester**…….…………... **Date** …**17/01/2025**..

**Safety Audit**
**Signed off** …………….…………… **Employer**

**Print Name** …………………………. **Date** ………………

**Safety Audit**

**Signed off** ………. ……… **Audit Team Leader**

**Print Name** ……George Frisby…………… **Date** …**20/1/2025**……………

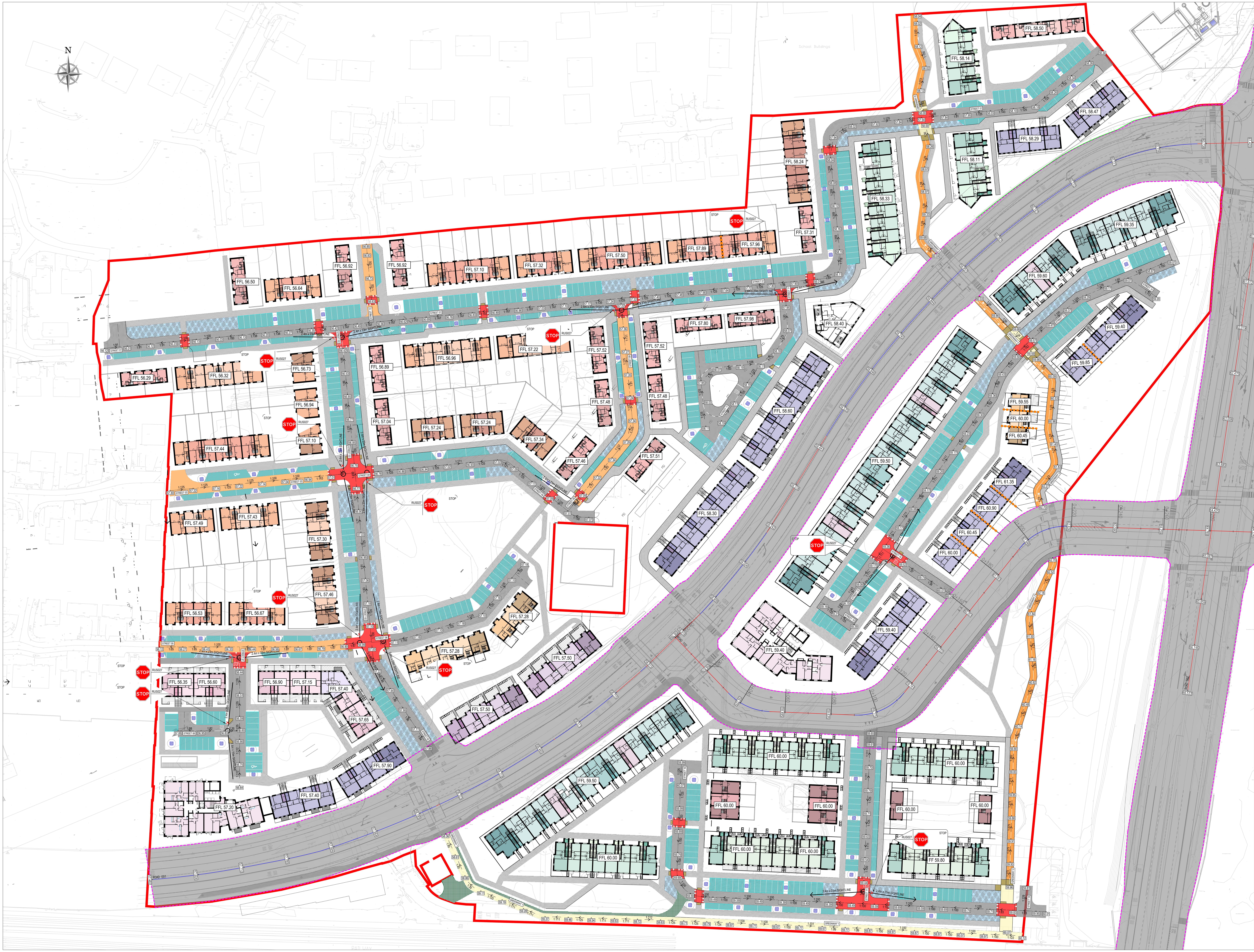
Please complete and return to: Roadplan Consulting,
7, Ormonde Road
Kilkenny
E-mail: info@roadplan.ie

# APPENDIX A

**List of Drawings Examined**

The following drawings have been provided electronically in PDF format by DBFL Consulting Engineers and are appended.

| Drawing Number | Rev | Drawing Title |
|---|---|---|
| KSG-DBFL-95 | 0 | XX-DRXC-1201 |






NO CHANGES OF WHATSOEVER NATURE ARE TO BE MADE TO ANY DETAILS

1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES.
2. ALL DIMENSIONS AND LEVELS ARE IN METERS AND ARE RELATED TO ORDINANCE DATUM. CO-ORDINATES RELATE TO IRISH TRANSVERSE MERCATOR.
3. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NRA SPECIFICATION FOR ROAD WORKS UNLESS OVERRIDDEN BY LOCAL OVERSEEING AUTHORITY'S STANDARDS
4. ALL ROAD MARKINGS & SIGNS SHALL COMPLY FULLY WITH THE TRAFFIC SIGNS MANUAL PUBLISHED BY THE DEPARTMENT OF TRANSPORT.
5. ALL SIGNS TO BE MOUNTED ON 76.1mm GALVANISED STEEL POSTS WITH COLOURED SLEEVES U.N.O. TO SPECIFICATION AND IN ACCORDANCE WITH THE TRAFFIC SIGNS MANUAL: MOUNTING HEIGHT TO BOTTOM OF SIGN = 2.3m U.N.O.
6. ALL TRAFFIC MANAGEMENT TO COMPLY FULLY WITH THE PROVISIONS OF CHAPTER 8 OF THE TRAFFIC SIGNS MANUAL
7. ALL EXISTING SIGNS (INCLUDING POLES) AND MARKINGS TO BE TAKEN UP OR COVERED AND TEMPORARY MEASURES APPLIED IN ACCORDANCE WITH CONTRACTORS TRAFFIC MANAGEMENT PLAN. THE CONTRACTOR MAY USE EXISTING SIGNAGE AS PART OF THEIR TRAFFIC MANAGEMENT PLAN.
8. ALL EXISTING CHAMBERS AND ACCESS POINTS TO REMAIN CLEAR OF OBSTRUCTION THROUGHOUT WORKS. CHAMBERS SHALL BE REBUILT/RETAINED IN POSITION IDENTIFIED ON SITE SERVICES LAYOUT DRAWING.
9. ALL PEDESTRIAN, CYCLE AND VEHICULAR ROUTES MUST BE RETAINED IN ACCORDANCE WITH APPROVED TRAFFIC MANAGEMENT PLAN.
10. ALL MATERIALS TO BE DISPOSED OFF SITE SHALL BE TAKEN TO A LICENSED FACILITY APPROVED BY THE LOCAL OVERSEEING AUTHORITY.

## LEGEND

- SITE BOUNDARY
- CHANGE IN BUILDING FLOOR LEVELS
- PROPOSED CARRIAGEWAY
- PROPOSED FOOTPATH
- PROPOSED HOMEZONE
- PROPOSED ROAD RAISED TABLE
- PROPOSED BLOCK PAVING AS PER LANDSCAPE ARCHITECT'S DRAWINGS
- PROPOSED FLAG PAVING AS PER LANDSCAPE ARCHITECT'S DRAWINGS
- PROPOSED PRIVATE PERMEABLE PAVING PARKING
- PROPOSED MANAGEMENT COMPANY PERMEABLE PAVING PARKING
- PROPOSED SHARED CYCLE PEDESTRIAN ROUTE
- PROPOSED CYCLE TRACK
- PROPOSED REINFORCED GRASS
- WORKS BEYOND THIS LINE TO BE CONSTRUCTED AS PART SEPARATE CONTRACT(S)
- PROPOSED RETAINING WALL
- PROPOSED BUFF 'DIMPLED' TACTILE PAVING
- TACTILE PAVING AT CONTROLLED CROSSINGS
- XX.XX — PROPOSED LEVELS
- XX.XX — TOP OF KERB LEVELS
- XX.XX — SPOT LEVELS
- Xm — PROPOSED ROAD WIDTH
- 1:XXX — PROPOSED ROAD GRADIENT
- FFL 99.999 — PROPOSED FINAL FLOOR LEVEL
- PROPOSED BOLLARD
- PROPOSED BIORETENTION AREA
- PROPOSED SWALE WITH GRATED MANHOLE COVER
- GAS WAYLEAVE
- SuDS TREE PIT (TYPE 1 - GULLY CONNECTION)
- SuDS TREE PIT (TYPE 2 - DIRECT DISCHARGE)

DRAFT

DBFL CONSULTING ENGINEERS LTD. ORMOND HOUSE, UPPER ORMOND QUAY, DUBLIN 7.

| rev | date | description | by | chkd. |
|---|---|---|---|---|
| 0 | 19-11-24 | DRAFT ISSUE | JVS | DCB |

STATUS CODES

| purpose | acceptance |
|---|---|
| P2 - COORDINATION | S - ISSUED |

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DUBLIN | CORK | GALWAY | WATERFORD

project ref.
KNW SITE 3 - CLONBURRIS SDZ

drawing title
PROPOSED ROADS LAYOUT

client
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# Appendix E : SITE INVESTIGATION

**IGSL Ltd**

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# Clonburris
# Phase 3

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**Ground Investigation & Geotechnical Interpretative Report**

**Project No. 25279A**

**August 2024**

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**FOREWORD**
The following conditions and notes on the geotechnical site investigation procedures should be read in conjunction with this report.

**Standards**
The ground investigation works for this project (**Clonburris Phase 3**) have been carried out by IGSL in accordance with Eurocode 7 - Part 2: Ground Investigation & Testing (EN 1997-2:2007). This has been used together with complementary documents such as Engineers Ireland Specification for Ground Investigation (2nd Ed, 2016), BS 5930 (2015+A1:2020) and BS 1377 (Parts 1 to 9) and the following European Norms:

- EN 1997-2 Eurocode 7: 2007 – Geotechnical Design – Part 2: Ground Investigation & Testing
- EN ISO 22475-1:2006 Geotechnical Investigation and Sampling – Sampling Methods & Groundwater Measurements
- EN ISO 14688-1:2017 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 1: Identification and Description
- EN ISO 14688-2:2017 Geotechnical Investigation and Testing – Identification and Classification of Soil, Part 2: Principles for a classification
- EN ISO 14689-1:2017 Geotechnical Investigation and Testing – Identification, description & classification of rock

The Eurocode 7, Part 2 – Ground Investigation and Testing GI specification shall be read in conjunction with the Specification and Related Documents for Ground Investigation in Ireland, 2nd Edition, published by Engineers Ireland in 2016.

**Reporting**
No responsibility can be held by IGSL Ltd for ground conditions between exploratory hole locations. The engineering logs provide ground profiles and configuration of strata relevant to the investigation depths achieved and caution should be taken when extrapolating between exploratory points. No liability is accepted for ground conditions extraneous to the investigation points. Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction, mining works or karstification below or close to the site.

This report has been prepared for Clonburris Infrastructure Limited and DBFL Consulting Engineers and the information should not be used without their prior written permission. IGSL Ltd accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.

**Boring Procedures**
Where required, 'shell and auger' or cable percussive boring technique is employed as defined by Section 6.3 of IS EN ISO 22475-1:2006. The boring operations, sampling and in-situ testing meet with the recommendations set out in IS EN 1997-2:2007 and BS 1377:1990 and EN ISO 22476-3:2005. The shell and auger boring technique allows for continuous sampling in clay and silt above the water table and sand and gravel below the water table (Table 2 of IS EN ISO 22475-1:2006).

It is highlighted that some disturbance and variation is unavoidable in particular ground (e.g. blowing sands, gravel / cobble dominant glacial deposits etc). Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

**In-Situ Testing**

Where required, Standard Penetration Tests (SPT's) are conducted strictly in accordance with Section 4.6 of IS EN 1997-2:2007. The SPT equipment (hammer energy test) has been calibrated in accordance with EN ISO 22476-3:2005 and the Energy Ratio ($E_r$). A calibration certificate is available upon request. The $E_r$ is defined as the ratio of the actual energy $E_{meas}$ (measured energy during calibration) delivered to the drive weight assembly into the drive rod below the anvil, to the theoretical energy ($E_{theor}$) as calculated from the drive weight assembly. The measured number of blows (N) reported on the engineering logs are uncorrected. In sands, the energy losses due to rod length and the effect of the overburden pressure should be taken into account (see IS EN ISO 22476-3:2005).

**Soil Sampling**

Three categories of sampling methods are outlined in EN ISO 22475-1:2006. The categories are referenced A, B and C for any given ground conditions and are shown in Tables 1 and 2 of EN ISO 22475-1:2006. Reference should be made to EN 1997-2:2002 for guidelines on sample class and quality for strength and compressibility testing. Samples of quality classes 1 or 2 can only be obtained by using Category A sampling methods.

Class 1 thin wall undisturbed tube samples (UT100) were obtained in fine grained soils and strictly meet the requirements of EN 1997-2:2002 and EN ISO 22475-1:2006. Soil samples for laboratory tests are divided into five classes with respect to the soil properties that are assumed to remain unchanged during sampling, handling transport and storage. The minimum sample quality required for testing purposes to Eurocode 7 compatibility (EN 1997-2:2002) is shown in Table A.

**Table A – Details of Sample Quality Requirements**

| EN 1997 Clause | Test | Minimum Sample Quality Class |
|---|---|---|
| 5.5.3 | Water Content | 3 |
| 5.5.4 | Bulk Density | 2 |
| 5.5.5 | Particle Density | N/S |
| 5.5.6 | Particle Size Analysis | N/S |
| 5.5.7 | Consistency Limits | 4 |
| 5.5.8 | Density Index | N/S |
| 5.5.9 | Soil Dispersivity | N/S |
| 5.5.10 | Frost Susceptibility | N/S |
| 5.6.2 | Organic Content | 4 |
| 5.6.3 | Carbonate Content | 3 |
| 5.6.4 | Sulphate Content | 3 |
| 5.6.5 | pH | 3 |
| 5.6.6 | Chloride Content | 3 |
| 5.7 | Strength Index | 1 |
| 5.8 | Strength Tests | 1 |
| 5.9 | Compressibility Tests | 1 |
| 5.10 | Compaction Tests | N/S |
| 5.11 | Permeability | 2 |

N/S – not stated. Presume a representative sample of appropriate size.

Samples recovered from trial pits or trenches meet the requirements of IS EN ISO 22475-1. It is highlighted that unforeseen circumstances such as variations in geological strata may lead to lower quality sample classes being obtained.

**Groundwater**
The depth of entry of any influx of groundwater is recorded during the course of boring operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible, drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level. Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc.

**Engineering Logging**
Soil and rock identification has been based on the examination of the samples recovered and conforms with IS EN ISO 14688-1:2017 and IS EN ISO 14688-2:2017. Rock weathering classification conforms to IS EN ISO 14689-1:2017 along with discontinuities (bedding planes, joints, cleavages, faults etc) as classified in Section 6.4 of IS EN ISO 14689-1:2017 and Annex C of same. Rock mechanical indices (TCR, SCR, RQD) are defined in accordance with IS EN ISO 22475-1:2006.

Where peat has been encountered, samples have been logged in accordance with the Von Post Classification (ref. Von Post, L. 1992. Sveriges Gologiska Undersoknings torvinventering och nogra av dess hittils vunna resultat (SGU peat inventory and some preliminary results) Svenska Mosskulturforeningens Tidskrift, Jonkoping, Swedden, 36, 1-37 and Hobbs N. B. Mire morphology and the properties of some British and foreign peats. QJEG, Vol. 19, 1986.

**Retention of Samples**
After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material will be discarded. Unless a period of retention of samples is agreed, it is our normal practice to discard all soil samples one month after submission of our final report.

# 1. INTRODUCTION

IGSL has undertaken a programme of site investigation works in the area of the proposed Clonburris Strategic Development Zone, specifically in the area near the Balgaddy 38kV substation, west of the R136 Grange Castle Road (also referred to as the Outer Ring Road) and north of the Kildare Rail Link (Figure 1). The lands at Clonburris Phase 3, measuring approximately 34 acres, are currently characterised by transitional agricultural landscapes and border mature housing developments to the west and north. The exploratory hole records and an interpretation of the complete 'Phase 3' tranche of site investigation works feature in this report.

**Figure 1 – Site Location Plan** – intrusive locations plotted


Retrieved from the Ordnance Survey of Ireland

The investigation comprised rotary core drilling, trial pitting and slit trenching. In situ plate bearing tests and soakaway tests (to BRE365) were also performed on site. The investigations were executed in accordance with BS 5930, Code of Practice for Site Investigations (BS 5930:2015 +A1:2020) and EN 1997-2 Eurocode 7 Part 2 Ground Investigation & Testing and supervised by an IGSL geotechnical engineer.

Geotechnical, chemical and environmental laboratory testing was scheduled on a range of soil and rock samples. The geotechnical soil testing included moisture contents, Atterberg Limits and particle size distribution [PSD] testing. Soil reusability testing included Moisture Condition Value (MCV) tests, CBR and compaction testing. Suites of both chemical testing and environmental testing were undertaken on soils. A *"Pyrite Chemical Suite"* was scheduled on near rockhead samples taken from the base of trial pits TP06, TP07, TP16 and TP21. Rock strength testing on recovered cores comprised point load strength index testing [PLSI].

This report presents an interpretation of the data and an assessment of the key geotechnical issues. The exploratory hole locations are plotted on the site plan in Appendix 12.

# 2. FIELDWORKS

## 2.1 General

The bulk of the geotechnical investigation works were carried out during March / April 2024 with the rotary drilling works following in May 2024. The site works comprised the following:

- Rotary Core Drillholes (6 No.)
- Trial Pits (29 No.)
- Slit Trenching (29 No.[1])
- Plate Bearing Tests (21 No.)
- Soakaway Tests (to BRE365) (7 No.)
- Groundwater Monitoring
- Surveying of Exploratory Hole Locations

[1] Slit trenches ST09A and ST25A were carried out to further explore the presence of buried cables locally

## 2.2 Rotary Core Drillholes

Rotary core drilling was carried out (holes denoted RC_) at six locations using a Comacchio GEO-405 rig. Symmetrex drilling was utilised within the overlying superficial deposits with coring techniques used in the underlying bedrock when encountered. Drillholes were taken to depths ranging 5.30m to 7.50m bgl. The rotary drilling in bedrock produced 78mm diameter cores. Bedrock was logged as weak to strong, medium to thinly bedded (to thinly laminated where fissile mudstone/shale), grey/dark grey/black, fine-grained, LIMESTONE. The rock was further described as predominantly argillaceous limestone with layers of calci-siltite limestone, local stylolites and with pyrite present. The rock mass was slightly weathered to moderately weathered at fissile mudstone/shale zones.

The cores were placed in 3m capacity timber boxes and logged by an IGSL engineering geologist. This included photography of the cores with a digital camera. Where rock core was recovered, a graphic fracture log is also presented alongside the mechanical indices. This illustrates the fracture state of the rock cores and allows easy identification of highly fractured / non-intact zones and discontinuity spacings. It should be noted that no correction for dip of the joints has been made and that the spacings shown are successive joint / core intersections within the core.

Standard Penetration Tests (SPT's) were performed during open hole drilling and given the nature of the soils, a solid cone was used. It is noted that the SPT N-Values reported are the number of blows for 300mm increment penetration (e.g. RC01 at 1.50m where N=23). These exclude the seating blow values, which represent the initial 150mm depth of penetration. Where partial penetration was achieved during testing, the number of blows is shown for the actual penetration depth achieved (e.g. RC06 at 4.50m where N=25/10mm). In accordance with Eurocode 7, the SPT hammer has been calibrated and the energy ratio (Er) value is incorporated on the engineering logs. It is highlighted that the SPT N-Values reported on the engineering logs are uncorrected for energy ratio.

The core log records are presented in Appendix 1 and this includes engineering geological descriptions, details of the bedding / discontinuities and mechanical indices (TCR, SCR and RQD's) for each core run. Core photographs are also presented in the aforementioned Appendix 1 and these illustrate the structure and fracture state of the bedrock. The SPT energy ratio calibration certificate features in Appendix 1.

## 2.3 Trial Pits

Trial pitting was performed at twenty-nine locations across the site. The trial pits were excavated, logged and sampled under the direction of an IGSL geotechnical engineer in accordance with BS 5930 (2015+A1:2020). Bulk samples (B) (typically 20 to 30kg) were taken as the pits progressed.

The bulk samples were placed in heavy-duty polyethylene bags. The trial pits were backfilled with the as-dug arisings and reinstated to the satisfaction of IGSL's site geotechnical engineer. The trial pit logs and photos are presented in Appendix 2 and include descriptions of the soils encountered, groundwater conditions and stability of the pit sidewalls.

**2.4 Slit Trenching**

Slit trenching was undertaken at twenty-nine locations on the site. The trenches were excavated on a mixture of both grassland and gravel-surfaced areas in lands both north and south of the L1058, Adamstown Avenue. The machine-assisted hand-dug trenches were opened to expose the track of existing buried services and were specifically set out to intercept same based on existing utility drawings. In certain areas, no services were recorded in the open trenchwork. Additional pits were undertaken at locations ST09A and ST25A where visible evidence of ground disturbance suggested services were likely at depth.

Detailed records of the pit findings including depth, diameter and type of service (where found) are presented in Appendix 3. The soil profile provided on the slit trench logs describes the majority of the soils across the transverse trench. Trench extremities (X and Y) were surveyed to ITM using GPS techniques. In addition, the locations of individual services exposed in the pits were also captured. Photographs taken during excavation are presented on the logs as well as separately in Appendix 3 of the report.

**2.5 Plate Bearing Tests**

Plate bearing tests were conducted at twenty-one locations at depths ranging 0.50m to 0.90m below ground level [bgl]. Plate testing was undertaken to evaluate the modulus of sub-grade reaction (Ks) and equivalent CBR value. A 450mm diameter plate was used for the tests with kentledge provided by a mechanical excavator. Two load cycle tests were performed and the load / settlement plots, Ks and equivalent CBR values are presented in Appendix 4.

**2.6 Soakaway Test (to BRE 365)**

Seven infiltration tests (SA01-SA07) were performed to assess the suitability of the sub-soils for dispersion of storm water through a soakaway system. The infiltration tests were performed in accordance with BRE Digest 365 'Soakaway Design'. To obtain a measure of the infiltration rate of the sub-soils, water was poured into each test pit, with records taken of the fall in water level against time. Following the first soak cycle, the procedure was repeated to ensure saturation of the sub-soils. The infiltration rate is the volume of water dispersed per unit of exposed area per unit of time, and is generally expressed as metres / minute or metres / second. Designs are based on the slowest infiltration rate, which is generally calculated from the final soak cycle. The soakaway design logs are presented in Appendix 5.

**2.7 Groundwater Monitoring**

Groundwater monitoring was undertaken following installation of standpipes in each of the rotary core drillholes. Groundwater levels were measured using an electric dipmeter. The levels recorded are shown in Appendix 6.

**2.8 Surveying of Exploratory Hole Locations**

Following completion of the exploratory works, surveying was carried out using GPS techniques. Co-ordinates (x, y) were measured to Irish Transverse Mercator and ground levels (z) established to Malin Head. The co-ordinates and ground levels are shown on the exploratory hole logs with locations shown on the exploratory hole plans in Appendix 12.

## 3. LABORATORY TESTING

Geotechnical laboratory testing was carried out at IGSL's INAB-accredited laboratory in accordance with the methods set out in BS1377; British Standard Methods of Test for Soils for Civil Engineering Purposes; British Standards Institute:1990. The laboratory applies best practice management systems as per International Standard IS EN ISO/IEC 17025. The geotechnical testing included moisture contents, Atterberg Limits, particle size distribution [PSD], MCV, CBR and dry density / moisture content relationship (compaction) testing. The results from geotechnical testing on selected trial pit soils are presented in Appendix 7.

Chemical analysis incorporating BRE SD1 Suite D was scheduled on recovered soils. The soil chemical results are presented in Chemtest report 24-16171 in Appendix 8. Eighteen soil samples were selected for Waste Acceptance Criteria (WAC) analysis as per the Rilta suite of testing. The results can be used to classify the material with regard to its potential for disposal to landfill. The results are enclosed in the aforementioned Chemtest report in Appendix 8. The same results formed the basis of a waste classification assessment which was undertaken by O'Callaghan Moran & Associates [OCM] in accordance with the Environmental Protection Agency (EPA) Guidelines on the Classification of Waste (2015). This report is presented separately in Appendix 9.

A "*Pyrite Chemical Suite*" to EN1744 'Tests for Chemical properties of Aggregates' was scheduled on four samples acquired from the base of four trial pits carried out on site. The samples were generally described as "Possible highly weathered rockhead recovered as grey brown clayey/silty GRAVEL". The chemical results are presented in Appendix 10.

Finally, rock core strength testing comprised Point Load Strength Index [PLSI] testing. The results are presented in Appendix 11.

# 4. DESK STUDY

## 4.1 Online GSI Database

The Quaternary Soils plot for the area (Figure 2 - retrieved from GSI website) reaffirms the findings of the investigation and highlights the presence of clay-dominant till (TLs) derived from the ubiquitous Carboniferous Limestone of the area. Shallow outcrop or subcrop is also flagged in the area, to the east of the Outer Ring Road.

**Figure 2 - Quaternary Soils Plot for the Clonburris Phase 3 Site**

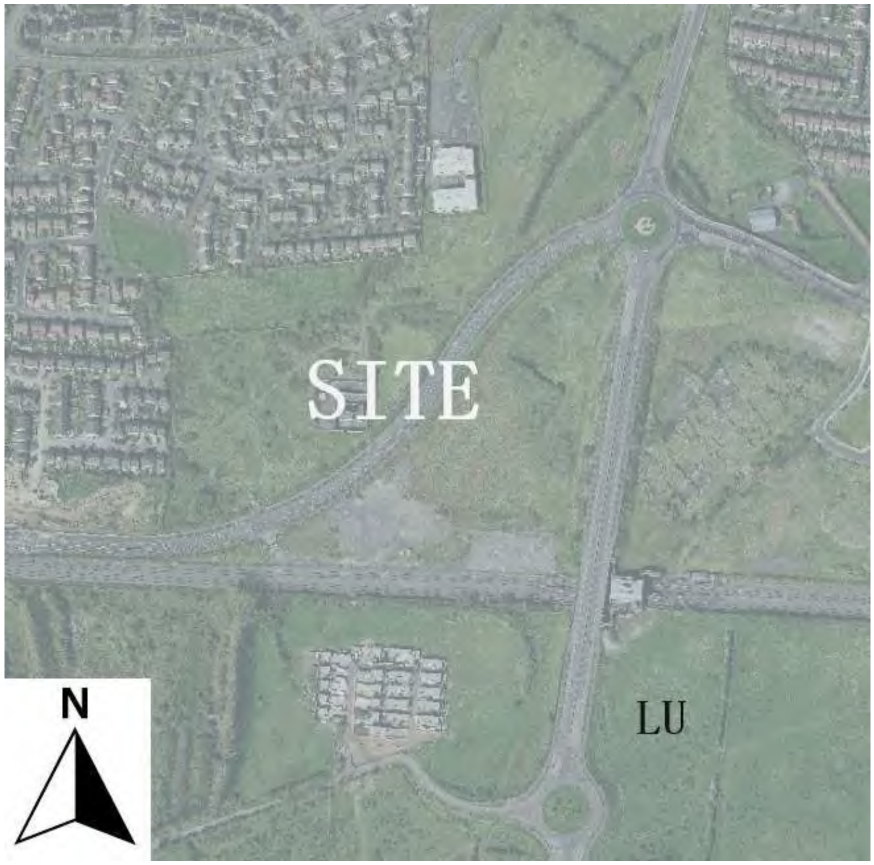

**Map Key** **TLs** - Till derived from Limestones

Reference to the GSI map for the area (Figure 3, 1:100,000 Solid Geology series) shows that the site is underlain by Lower Carboniferous, Lucan Formation. The Lucan Formation (Nolan 1986, 1989) forms the bulk of the basinal rocks throughout the geologically termed 'Dublin Basin', and is characterised by graded, intraclastic skeletal packstone/grainstone interbedded with anoxic calcareous mudstone / black shale, laminated calcisiltite and argillaceous micrite (i.e. impure limestone with clay minerals).

Its base is defined by the first appearance of thick graded beds of limestone, and a marked decrease in the proportion of interbedded shale, compared with the underlying Tober Colleen Formation. The Lucan Formation is widely known as the Calp Limestone (Marchant and

Sevastopulo, 1980) but is also referred to as the Upper Dark Limestone and has long been a source of building materials and aggregate for Dublin. The Calp is largely undifferentiated geologically.

**Figure 3 - Bedrock Geological Map for the Clonburris Phase 3 Site** (retrieved from the GSI website)




**Key:** **LU** = Lucan Formation

**4.2 Online OSI Database / Aerial Imagery**

Inspection of historic 25" drawings for the area reveals the presence of what appears to be a reservoir in the east of the site nearing the current R136 Outer Ring Road. A '*Pump*' is present in the same area in the 1897-1913 OSI drawing. This prominent feature endures and can be viewed in the 25" Cassini drawing of the 1930's (Figure 4A & 4B).

Aerial orthophotography reveals an interesting development from 1995 (See Figure 5). A trackway crosses east-west across the site which leads to an area of apparent tipping / stockpiling. The area of disturbed ground persists into the colour imagery dating from 1996-2000. The Balgaddy 38kV Substation also appears in the image as does the linear scar of trenchwork resulting from works on a 900mm diameter gas transmission main.

The drawings from 2012 show the Outer Orbital Route under construction. The R136 roundabout is in place but spurs to both Balgaddy / Neillstown to the east and Ballyowen / Lucan to the north are as yet undeveloped. Soil stockpiling is again noted, this time to the west and northwest of the newly constructed R136 roundabout. The current road network, including Adamstown Avenue can be viewed in the more recent 2013-2018 orthophotograph.

**Figure 4A, 4B & 4C – Historic OSI drawings with 'Pump' reference for the Kishoge site Fig 4A** Ordnance Survey of Ireland 25" drawing dated 1897-1913 depicting '*Pump*'. **Fig 4B** OSI 25" Cassini drawing with similar ponded feature to that of the 1897-1913 drawing. **Fig 4C** OSI 2013-2018 aerial image showing existing landscape with the R136 forming the eastern site boundary.

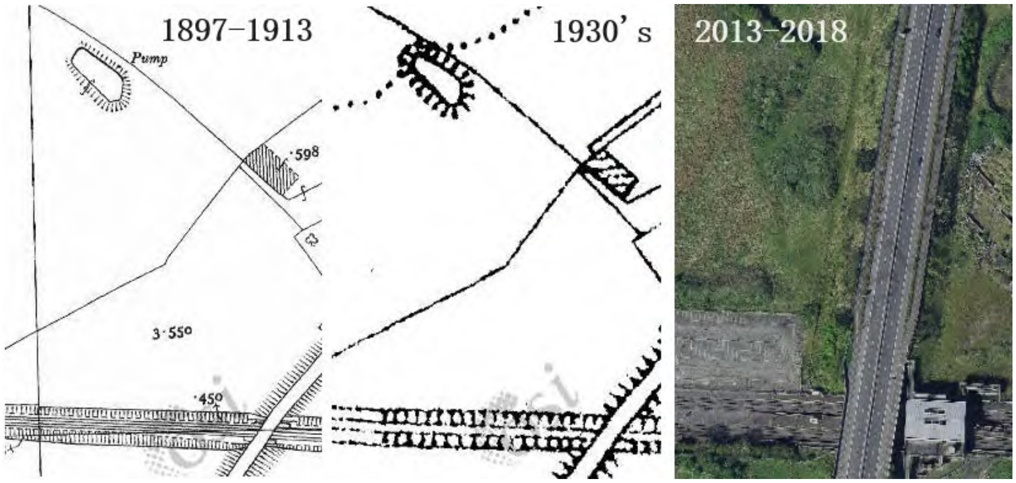



**Fig 4A** **Fig 4B** **Fig 4C**

**Figure 5 –OSI aerial orthophotographs for the Kishoge site 1995 - 2018** (Tailte Éireann)

# 5. GROUND CONDITIONS & GROUNDWATER

## 5.1 Ground Profile - Superficial Deposits

The following is a summary of the ground conditions encountered across the Phase 3, Clonburris SDZ site, west of the R136 Outer Ring Road / Grange Castle Road.

### MADE GROUND

#### North of Adamstown Avenue

- Given the recent disturbance documented in the aerial orthophotographs from 1995 (See Figure 5), the existence of Made Ground soils in the stratigraphy is not unexpected.

- Extensive CLAY fill was uncovered in TP02. TP02 lies in an area flagged as having soil disturbance dating from the period of R136 road construction (See Figure 5). Dark brown and dark grey sandy gravelly CLAY soils extended to 1.70m (56.67m OD) where a greyish brown CLAY/SILT was unearthed. This was remarked as containing organic matter. Although classed pitside as Made Ground, this may be a buried topsoil / organic subsoil deposit. This extended to 2.30m (56.07m OD) at which point natural stiff soils were logged.

- In the same field parcel as TP02, nearby TP04 to the south also revealed a thick sequence of Made Ground. Underlying the cover of topsoil, from 0.40m bgl the Made Ground was described as dark grey sandy gravelly silty CLAY with boulders (up to 700mm), cobbles, plastic and steel. A strong organic odour was remarked. The pit ended in Made Ground at 2.50m bgl (57.66m OD).

- At TP07, near the northern boundary of the site close to Oldbridge housing estate, a layer of Made Ground was logged from 0.15m to 1.10m bgl (55.15m OD). It was signaled by the inclusion of rare concrete blocks, rare rubbish / plastic and steel. However, it is thought that these anthropogenic inclusions may be localised in their distribution. A stiff Clay is logged from 1.10m (54.45m OD).

- Rare plastic / rubbish is observed in the topsoil excavated at TP12 to a depth of 0.35m bgl.

- The most extensive collection of rubbish / plastic was logged in TP13. It was measured from ground level to 1.40m bgl. Anthropogenic content was >2% in this area, being rare to occasional. The dig location is linked with the historical soil disturbance noted from 1995 coupled with being proximal to the construction of the adjacent Balgaddy substation. Stiff clay was viewed from 1.40m to the pit base at 2.50m. For the same reasons as TP13, the uppermost soils in nearby TP16 also contained Made Ground to 0.60m. With an absence of rubbish / plastic, the soil disturbance is more likely to relate to construction activity at the time of the substation construction.

#### South of Adamstown Avenue

- At TP19, to the northeast of the site, a thin cover of topsoil was found to overlie an equally thin layer of clay Made Ground containing rare plastic / rubbish, wood, red brick and concrete fragments. This extended to 0.40m bgl. Stiff indigenous soils were found immediately below this layer.

- Overall, across the southern part of the site, south of Adamstown Avenue, there were variable thicknesses of Made Ground exposed during pitting. In TP24, Made Ground descended to a total of 0.70m bgl (58.93m OD). The Clay soil contained rare plastic / rubbish, pipe fragments and cobbles and boulders. Elsewhere, the deepest accumulation of Made Ground was at TP20 where a 1.40m thick layer of Made Ground was identified. Rare plastic / rubbish was found to 1.0m (58.03m OD). Possible Made Ground extends from 1.40m to 1.90m. However, this is thought to be an indigenous layer of slightly organic subsoil, likely buried decades earlier by the overlying mixed clays.

- At only one pit south of Adamstown Avenue is there an absence of Made Ground. This occurs in TP21 where natural soils extend from ground level to 1.90m bgl (56.28m OD) ending on possible rockhead.

- Excavated into an embankment placed towards the southeastern flank of the site, up to 3.20m (to 58.69m OD) of Made Ground was found in TP28 with 2.60m (to 59.55m OD) in pit TP29.

**Figures 6A – 6C – Trial pit sidewall profiles showing Made Ground.**
**Fig 6A** TP04, positioned ca. 2m higher than nearby trial pits, found dark grey slightly sandy slightly gravelly CLAY (MADE GROUND) to 2.50m bgl (57.66m OD). Rare plastic / rubbish and steel combined with a strong organic odour were noted.

**Fig 6B** At TP13, >2% plastic / rubbish was recorded in the Clay Made Ground to a depth of 1.40m (56.02m OD).

**Fig 6C** At TP22, Topsoil overlies a dark brown to brown sandy gravelly CLAY with rare plastic and cobble-sized concrete blocks. Possible Made Ground continues to 1.50m with an organic signature. This is thought to be buried topsoil / subsoil.

**TOPSOIL**

- Where naturally occurring topsoil was unearthed, it was found to be present in layers ranging 200mm to 450mm thick. A gradational lower transition was present whereby the topsoil was underlain by a SILT/CLAY subsoil, almost devoid of gravel.

**GLACIAL DEPOSITS**

- A fine-grained light brown occasionally mottled orange brown SILT/CLAY subsoil layer, generally firm in consistency, was found underlying the topsoil. Occasionally this was noted as firm to stiff with grey brown mottling also observed.

- Where indigenous deposits were encountered, the soils increased in strength to stiff and were found to contain an increasing gravel-sized clast content with depth. Colour change to grey was observed with depth.

- A stiff dark grey layer completed many of the pits. This was increasingly gravelly, with angular cobble and boulder-sized fragments frequently noted. Towards the base of this layer, the increased volume of angular tabular and platy material caused the layer to be described as a "Possible Weathered Rockhead" horizon. This was noted in six of the twenty-nine pits namely TP05, 06, 07 and 08 as well as TP16 and TP21.

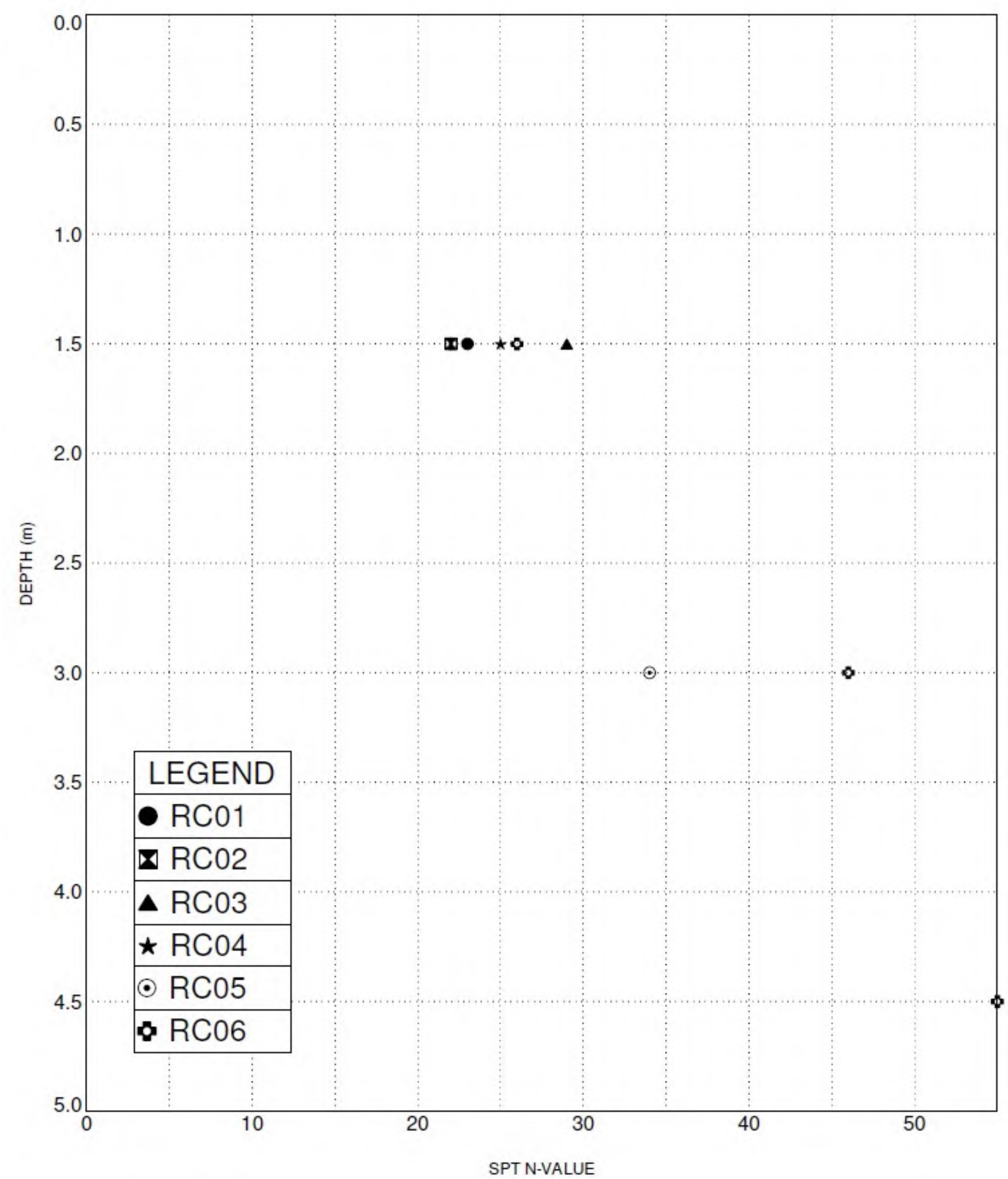
- Rotary drilling revealed bedrock at depths ranging 2.30m to 2.70m north of Adamstown Avenue with rock coring commencing at the deeper depths of 4.30m and 4.50m south of the Avenue. However, in both RC05 and RC06 south of the roadway, a layer of "clayey COBBLES" was intercepted shy of rock. This may well be a layer of weathered rock.

**Figures 7A – 7B – Natural ground sidewall profiles photographed during trial pitting. Fig 7A** TP05 with topsoil overlying firm to stiff and stiff brown mottled grey & light brown sandy gravelly CLAY with cobbles to 1.30m. Stiff grey blue sandy gravelly silty CLAY to 1.70m. A possible highly weathered rockhead recovered as clayey/silty GRAVEL from 1.70m to the pit base at 2.0m. Slow water entry at 1.70m.

**Fig 7B** At TP07, topsoil was found overlying a firm brown slightly sandy slightly gravelly SILT/CLAY with rare anthropogenic content. Stiff grey sandy gravelly silty CLAY persisted from 1.10m to 1.80m. From 1.80m to the pit base at 2.50m, possible highly weathered rock was recovered as clayey/silty GRAVEL. Again, as with TP05, a moderate water strike was recorded towards the base of the pit at 2.30m.

In-situ testing was undertaken during the construction of drillholes RC01-RC06. The standard penetration test [SPT] allows for an appraisal of the ground stiffness. A plot showing the blowcounts generated from testing at each hole is presented in Figure 8. It illustrates the occurrence of stiff soils from 1.50m. The depths of rock proven in holes RC01-RC04 allowed only one SPT test to be performed ahead of coring, ie., at 1.50m bgl. Two of the three deeper tests were carried out in RC05 and RC06 in a stratum comprising “clayey COBBLES” at a depth of 3m.

**Figure 8 – SPT Plot versus Depth for Rotary Drillholes** (uncorrected for energy ratio)



### 5.2 Bedrock

As referenced earlier in Section 4, the GSI rock map for the area (Figure 3, 1:100,000 Solid Geology series) shows that the Lucan Formation underlies the site. The formation is comprised of argillaceous bioclastic limestones and interbedded shales.

Rotary drilling was conducted at six locations. At each location, drilling penetrated a thin cover of glacial till with core recovery in the underlying bedrock commencing at depths ranging from 2.30m to 4.50m. Figure 9 shows the core recovery in RC02.

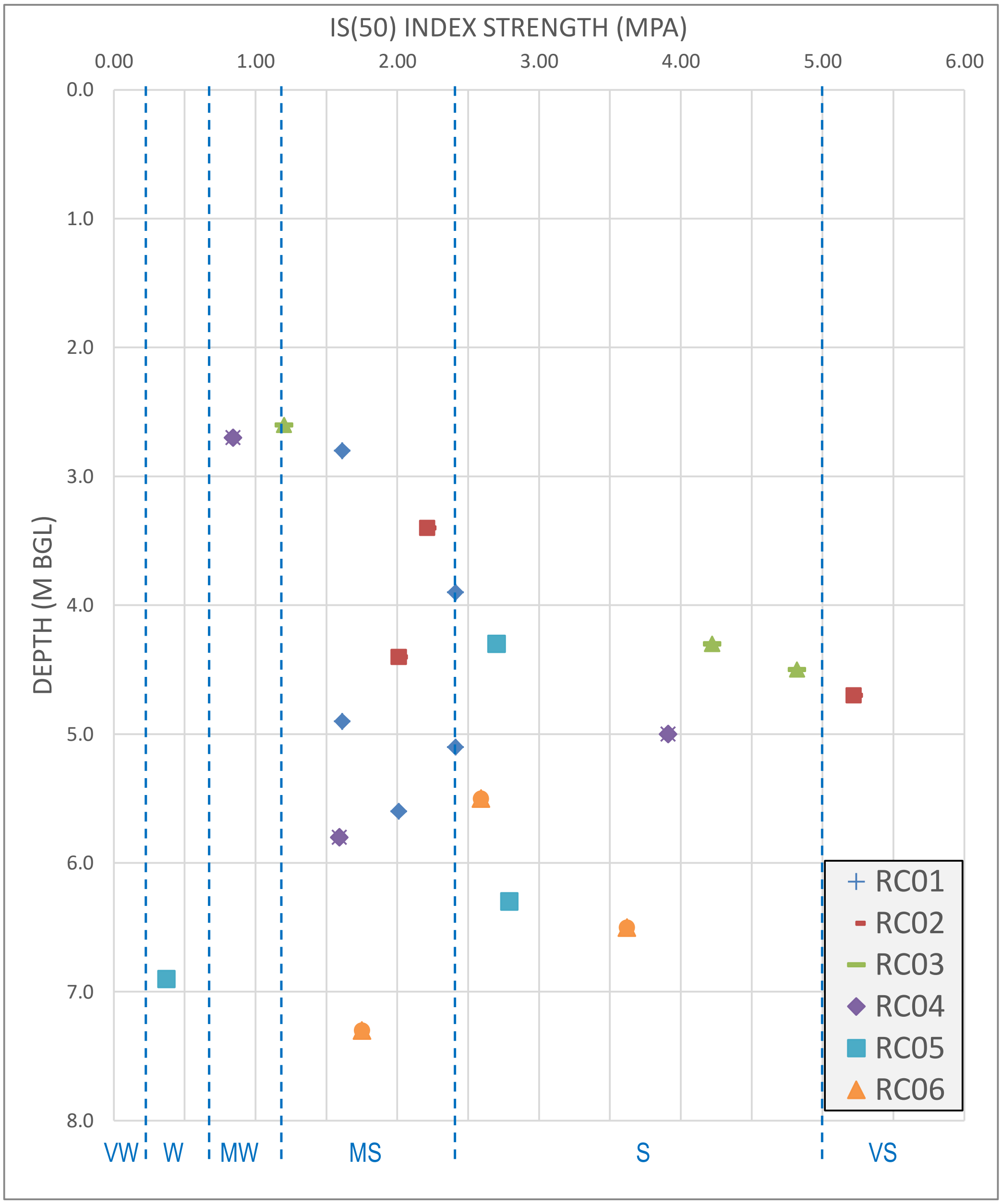
The recovered cores were logged as weak to strong, medium to thinly bedded (to thinly laminated where fissile mudstone/shale), grey/dark grey/black, fine-grained, LIMESTONE. The rock was further described as predominantly argillaceous limestone with layers of calci-siltite limestone, local stylolites and with pyrite present. The rock mass was slightly weathered to moderately weathered at fissile mudstone/shale zones.

**Figure 9 - Cores in RC02 from 2.60m bgl to 5.60m**


Discontinuity spacings in the rotary cores generally ranged from medium (200 to 600mm) to closely spaced (60 to 200mm), rarely widely (600 to 2000mm) spaced. The discontinuity surfaces were typically smooth to locally rough, planar to locally curviplanar. Apertures were tight to locally partly open with local clay smearing. Discontinuities host calcite veinfill (from 1-20mm thick). Dips are subhorizontal, 10° to 15°, rarely 40° to 45° and very locally 70°.

The point load strength index (PLSI) test data produced $I_s(50)$ values ranging from 0.37 to 5.22 MPa with a mean value of 2.49 MPa. The PLSI strengths plotted in Figure 10 form a broad scatter but are predominantly located to the right of the plot. This implies the cores are generally medium strong to strong. Points to the left of the plot are suggestive of weak rock. They are likely to have resulted from tests undertaken on cores sampled from weaker interbedded shale / mudrock as opposed to the more prominent strong calcisiltite limestone.

**Figure 10 – $I_s(50)$ strengths obtained from diametrial Point Load Strength Index testing**




VW = Very Weak, W = Weak, MW = Moderately Weak, MS = Medium Strong, S = Strong, VS = Very Strong (ISO 14689:2017 (E))

Using a correlation factor (K) of 20 to assess compressive strength, this suggests a characteristic strength envelope in the order of 7.4 to 104.4 MPa and categorizes the bedrock as weak (5 to 12.5MPa) to lower bound very strong (100 to 250MPa). The visual strength descriptors determined during engineering geological logging marry well with the overall plot scatter in Figure 10.

ISO 14689:2017 (E) rock strength parameters are drawn on Figure 10 to allow correlation between UCS and Point Load Strength tests. A correlation factor (K) of 20 was used to plot the ISO 14689:2017 (E) MPa strength divisions on the Point Load strength ($I_s(50)$) plot.

### 5.3 Groundwater

Groundwater strikes were intercepted during a number of the excavations on site. Table 1 lists the strike level as well as the intensity of water ingress, the type of stratum in which the ingress was observed, and at what depth (if any) the water equilibrated at upon completion of drilling. The potential exists for seasonal changes in groundwater level. The works were carried out during March, April and May 2024. It is likely that groundwater will be subject to seasonal variations.

**Table 1 – Water measurements in on-site exploratory holes**

| Location | Exploratory Hole No. | Water Struck m bgl | Stratum Description | Rate of Flow | Remarks / Stratum of water ingress (m OD) |
|---|---|---|---|---|---|
| North of Adamstown Avenue | TP02 | **1.20** | Interface of dark brown and underlying dark grey CLAY (**MADE GROUND**) | Seepage | |
| | | **1.70** | Interface of dark grey CLAY and underlying organic SILT/CLAY (Probable **MADE GROUND**) | Slow | |
| | TP05 | **1.70** | Possible Highly Weathered Rockhead | Slow | Water entry shy of possible rock |
| | TP06 | **1.70** | Possible Highly Weathered Rockhead | Moderate | Water entry shy of possible rock |
| | TP07 | **2.30** | Possible Highly Weathered Rockhead | Slow | Water entry shy of possible rock |
| | TP08 | **1.0** | CLAY overburden | Seepage | Slow water entry shy of possible rock |
| | | **2.0** | Possible Highly Weathered Rockhead | Slow | |
| | TP09 | **2.0** | Possible Rockhead | Slow | Water entry shy of possible rock |
| | TP11 | **0.90** | Firm brown mottled grey yellow sandy gravelly silty CLAY | Seepage | Water entry shy of possible rock |
| | | **1.90** | Possible Rockhead | Slow | |
| | TP12 | **1.50** | Stiff CLAY | Slow | |
| | TP13 | **1.0** | Dark brown sl sandy sl gravelly CLAY with rare to occasional rubbish / plastic **(MADE GROUND)** | Seepage | |
| | | **1.60** | Stiff CLAY | Seepage | |
| | | **2.40** | Stiff to very stiff CLAY | Slow | |

| Location | Exploratory Hole No. | Water Struck m bgl | Stratum Description | Rate of Flow | Remarks / Stratum of water ingress (m OD) |
|---|---|---|---|---|---|
| North of Adamstown Avenue | TP15 | **1.60** | Stiff dark blue to black cobbly CLAY / Possible Highly Weathered Rockhead | Slow | Water entry shy of possible rock |
| | TP16 | **1.90** | Interface of Stiff CLAY and underlying Possible Highly Weathered Rockhead | Seepage | Water entry shy of possible rock |
| | TP17 | **2.30** | Stiff dark blue to black cobbly CLAY / Possible Highly Weathered Rockhead | Seepage | Water entry shy of possible rock |
| | TP18 | **1.60** | Stiff dark blue to black cobbly SILT / Possible Highly Weathered Rockhead | Seepage | Water entry shy of possible rock |
| | SA04 | **0.60** | Base MADE GROUND / Uppermost firm/stiff CLAY | Seepage | No soakage reported in pit during course of test |
| | SA05 | **1.40** | Base Test Pit in stiff CLAY | Seepage | No soakage reported in pit during course of test |
| | ST01 | **0.80** | CLAY (MADE GROUND) | Seepage | - |
| | ST03 | **2.30** | CLAY (MADE GROUND) | Seepage | - |
| | ST10 | **1.50** | Clayey GRAVEL and cobbles (MADE GROUND) | RAPID | - |
| | ST12 | **1.60** | Possible Rock | Slow | Water entry shy of possible rock |
| | RC01 | - | Water resting in Upper Bedrock | - | Depth to water post drilling **3.10** / 54.72m OD (End depth 5.70m) Dips taken in range 1.94-2.15m bgl |
| | RC02 | - | Water resting in Upper Bedrock | - | Depth to water post drilling **3.70** / 52.79m OD (End depth 5.60m) Dips taken in range 2.17-2.42m bgl |
| | RC03 | - | Water resting in Upper Bedrock | - | Depth to water post drilling **2.90** / 53.59m OD (End depth 5.50m) Dips taken in range 1.93-2.22m bgl |
| | RC04 | **1.90** (54.57) | Lower Superficial deposits / Nearing Rockhead | Slow | Depth to water post drilling **1.40** / 55.07m OD (End depth 5.30m) Dips taken in range 1.27-1.38m bgl |

| Location | Exploratory Hole No. | Water Struck m bgl | Stratum Description | Rate of Flow | Remarks / Stratum of water ingress (m OD) |
|---|---|---|---|---|---|
| South of Adamstown Avenue | TP19 | **1.40** | Possible Highly Weathered Rockhead | Slow | Water entry shy of possible rock |
| | TP20 | **2.50** | Stiff to very stiff CLAY | Seepage | |
| | TP21 | **1.90** | Possible Highly Weathered Rockhead | Slow | Water entry shy of possible rock |
| | TP23 | **0.50** | SAND / SILT/CLAY (MADE GROUND) | Seepage | |
| | | **1.50** | Stiff to very stiff CLAY | Seepage | |
| | TP26 | **1.30** | Possible organic MADE GROUND overlying stiff to very stiff CLAY | Seepage | |
| | SA06 | **1.40** | Clay at base of pit | Moderate | $10^{-5}$ m/s permeability |
| | ST15 | **1.10** | Water along ESB Trenchwork | RAPID | Water flowing along service |
| | ST17 | **1.90** | Water along GNI Trenchwork | RAPID | Water flowing along service |
| | ST21 | **0.40** | SAND & GRAVEL (MADE GROUND) | Moderate | |
| | ST22 | **1.0** | SILT/CLAY (MADE GROUND) | Seepage | |
| | ST24 | **1.30** | CLAY/SILT w/cobbles & boulders (Possible MADE GROUND) | Moderate | |
| | ST25 | **1.0** | Firm / stiff Silty CLAY | Slow | |
| | RC05 | **3.90** (55.42) | COBBLES / Possible Highly Weathered Rockhead | Slow | Depth to water post drilling **4.0** (End depth 7.30m)<br><br>Dips taken in range 3.34-3.76m bgl |
| | RC06 | **4.70** (55.05) | Upper Bedrock | Slow | Depth to water post drilling **3.20** / 56.55m OD (End depth 7.50m)<br><br>Dips taken in range 3.19-3.44m bgl |

Aside from some deep-seated water strikes in bedrock to the south of Adamstown Avenue - where the rock descends to greater depth - for the most part water strikes were evidenced at the interface of the clayey overburden and underlying bedrock. The proliferation of Made Ground mantling much of the area saw the frequent occurrence of perched water seepages and slow water entries. There was a transitional zone logged at some locations where a fractured angular Gravel and Cobble layer were noted. Water entry was often associated with this 'rockhead' layer / upper weathered rock horizon.

Water entry was observed on a 'Rapid' scale where services were present and where a pathway was formed by the trenchwork. This was very evident in slit trenches ST10, ST15 and ST17.

The water levels recorded by the driller immediately after boring and coring were sited either within the rock or near rockhead.

### 5.4 Geotechnical Parameters

The ground conditions and associated properties of the superficial deposits and bedrock have been discussed in the previous sections. On foot of the field and laboratory test results, recommended geotechnical parameters are presented in Table 2. It is highlighted that the parameters shown are derived values (not characteristic values) in line with EN1997-1 CL 3.4.3. Characteristic design parameters should be carefully selected by contractors and their designers taking into consideration the ground conditions and engineering properties at particular areas within the Clonburris site.

**Table 2 – Recommended Geotechnical Parameters**

| Parameter | Fine Grained or Cohesive Glacial Till | Coarse Grained or Granular Soils | Bedrock |
|---|---|---|---|
| **Bulk Unit Weight (kN/m³)** | 22 | 20 | 25 |
| **Angle of Friction (∅)** | 34° | Varies 30 to 38° | 28° Mudstone /Shale 36° Limestone |
| **Undrained Shear Strength** | 40 kPa (soft / firm) 80 kPa (firm / stiff till) | NA | UCS Varies 60 to 100 MPa intact strong bedrock |
| **Stiffness (Eu)** | 30 MPa (soft / firm till) 60 MPa (firm / stiff till) | 70 to 100 MPa | 10 GPa (intact strong bedrock) |

# 5. GROUND ASSESSMENT & ENGINEERING RECOMMENDATIONS

## 6.1 General

In light of the investigation findings, the following ground engineering items are discussed:

- Bearing Capacity & Foundations
- Ground Bearing Slab
- Groundwater / Infiltration
- Slopes / Batters
- Pavement Construction
- Buried Concrete
- Earthworks Testing
- Waste Acceptance Criteria [WAC] & Environmental Testing – *Soils destined for Landfill*

## 6.2 Bearing Capacity & Foundations

Firm to stiff and stiff brown and grey brown glacial till soils were frequently logged towards the base of trial pits. These were exposed either under natural firm colour-mottled subsoil or underlying placed Made Ground soils. The Made Ground soil composition varied spatially throughout the site dependent on the historical use and the placement of soil stockpiles / formation of banked soil mounds (TP04, TP28 & TP29). There was a frequent occurrence of rubbish / plastic in many of the pits to depths of 1.70m / 56.67m OD (TP02) and 1.40m / 56.02m OD (TP13). Elsewhere, at former hardstanding areas, there was found a surficial layer of placed hardcore gravel (TP23-TP26).

In a number of pits, a thin layer of clayey SILT, often remarked as having an organic signature, was found underlying the Made Ground. This is thought to be a buried topsoil or organic subsoil.

During trial pitting, the soils were remarked as increasing in stiffness nearing rockhead. The firm to stiff and stiff over-consolidated glacial deposits should provide an allowable bearing capacity of 150 kN/m$^2$. Should higher bearing pressures be required, the alternative is to position the foundations on the shallow upper bedrock located at ca. 2.30 – 2.75 bgl (corresponding to 55m OD to 53.50m OD). The depth to rockhead falls to the south of the site where a layer of clayey COBBLES was first encountered from 3.0m (RC05 & RC06). South of Adamstown Avenue, the rock was cored between 4.30m and 4.50m depth bgl (ca. 55m OD). Extending foundations to this depth would likely require excavate and replace with low grade concrete from deep rockhead depths to base of foundation.

Stiff to very stiff dark grey black, bluish black, occasionally dark brown sandy gravelly CLAY was documented towards the base of a number of trial pits. Where this was intercepted, shy of rockhead, allowable bearing capacities in the over-consolidated glacial till would rise to 200kPa. Given this layer's proximity to eventual rockhead, there is a possibility for water ingress which may promote water-softening in the clay.

If foundations are placed on the medium strong and strong argillaceous limestone this should be capable of safely supporting bearing pressures of 1250 to 1500 kN/m$^2$. However, given the inherent variability in rock mass strength and the potential for some localised variations in weathering grades, the poorer quality calcareous mudstone or shale (weak) must be carefully considered in terms of potential for differential settlement and long-term performance (the mudstone can be locally weathered to a very weak rock or stiff clay). For structural design purposes, it would be prudent to size foundation pads using a safe or allowable bearing pressure of 750 kN/m$^2$. The proviso with the above is that horizons or zones of weak mudstone or muddy limestone be removed and replaced with low grade concrete.

Foundations constructed on such variably weathered bedrock require careful examination by a suitably experienced (competent) geotechnical engineer or engineering geologist. Plate load tests (minimum of 600mm diameter), if practical given dig depths, are particularly useful in evaluating performance under loading and deciding on a suitable formation depth. Foundation excavations are anticipated to reveal an irregular or saw-tooth profile with beds of strong limestone adjacent to very weak mudstone. This is not unusual in this area of north-west Dublin, hence the input and advice of a geotechnical engineer / engineering geologist during the foundation construction works.

**6.3 Ground Bearing Slab**

In order to support conventionally loaded ground bearing slabs, it is recommended that a firm (medium strength) formation is reached. It will therefore be necessary to remove any soft / low strength upper soils / Made Ground before placement of the hardcore layers. With reference to the pit findings, it is anticipated that stripping to depths of between 0.6 and ca. 1.40m bgl should be sufficient in most instances to reach firm soils. This is likely to fluctuate depending on localised thicknesses of Made Ground.

It is recommended that T0 Struc hardcore be used in conjunction with T1 hardcore and these should meet the requirements of Annex E SR21:2014+A1:2016. Proof rolling the formation (static rolling with roller having a mass per metre width of roll of not less 5400 kg) is advised to counteract disturbance or loosening due to the bulk excavation works. Under no circumstance should vibratory or dynamic rolling be used on the formation soils as this may lead to dilation where silt-dominant soils are present, producing characteristic 'cow-bellying'.

Imported granular fill 'hardcore' used in any foundation application or under concrete floor slabs should meet the requirements of Annex E of SR 21:2014+A1:2016. Both T0 and T1 hardcore fills should be rigorously tested (independent of the quarry source) to ensure that they meet the physical, durability, chemical and mineralogical characteristics as set out in the aforementioned Annex E of SR 21:2014+A1:2016. Independent testing on samples of the proposed source hardcore is strongly recommended in advance of the material being used on the site. As a minimum, particle size gradings, chemical tests (total sulphur and acid soluble sulphate) and simplified petrology are advised to screen the material and independently assess compliance with Annex E, SR21;2014+A1;2016.

Should the existing hardcore found on site (TP23-TP27) be assessed as being mudrock-containing (potentially pyritiferous mudrock), it would be recommended to remove the stone and stockpile separately for either disposal from site or for use under flexible pavements / berms. It would be important that the stone not be left lying in areas where is would ultimately be overlain by concrete floors or concrete footpaths.

**6.4 Groundwater / Infiltration**

As noted in Section 5.3 and listed in Table 1, shallow groundwater strikes between 1.0m and 2.0m depth were frequently observed in open excavations as seepages or as 'slow' ingress. Water intercepted in Made Ground was regarded as isolated, or localised perched seepages rather than representing actual water bodies. Intense water strikes were observed in slit trenches along existing service corridors. The 'rapid' water entry in three of the twenty-nine slit trenches serves to highlight the impermeability of the surrounding natural stratigraphy relative to the disturbed soils / permeable pipe surround. Shallow pits were not left open for a long duration to allow for natural water ingress / groundwater re-equilibration.

Water entry was observed in the drillholes during their construction, from 1.90m (54.57m OD) to 4.70m bgl (55.05m OD), generally associated with rockhead. Where strikes were not recorded, the levels of water dipped in the drillholes upon completion often mirrored that of the upper rockhead level. It should be noted that water levels measured in drillholes immediately upon completion can often be artificially heightened given the introduction of an air/mist flush during coring.

However, water monitoring in June and August 2024 at each of the six drillholes revealed the water levels settled just above the core commencement depths / rockhead.

Overall, based on the ground investigation findings, groundwater is likely to be found in or just above the uppermost bedrock. Groundwater flows here will be governed by fracture state and flows or ingress would be expected to occur along the more open joints or discontinuities. There is a strong likelihood that prominent or copious inflows will be uncovered at localised zones within the upper bedrock / weathered rockhead horizon. This is a well-known feature of the Calp Limestone bedrock in Dublin, where groundwater inflows occur or tend to concentrate along the more fractured beds or weathered zones.

Provision should be made for de-watering during excavation works and groundworks, especially where trenches or open cut areas are required below the glacial soil / bedrock interface. A combination of perimeter drains (open drains) connected to strategic sumps is expected to be used to control groundwater. As mentioned in Section 5.3, the potential does exist for there to be seasonal changes in groundwater level. The works were carried out during spring / early summer 2024. It may be the case that the various waterbodies at depth are subject to seasonal variations.

Soakaway tests were conducted on the site at seven locations. The tests were carried out in what were deemed to be both Made Ground CLAY soils (TP01, 04 & 07) and the natural firm and stiff overburden soils. The impermeable nature of the soils may account for the low infiltration rates obtained.

It is likely that such CLAY soils would not be suitable for conventional soakaways being classified as offering only low natural infiltration (Table 3).

**Table 3 – Measured infiltration rates (f) expressed as exposed area (metre) per unit time (minute)**

| Soakaway Test No. | Depth of Test (m bgl) | *f* (m/min) | *f* (m/sec) |
|---|---|---|---|
| **SA01 (Cycle 1)** | 1.20 | 0.00461 m/min | 7.68E -05 m/sec |
| **SA01 (Cycle 2)** | 1.20 | 0.00074 m/min | 1.24E -05 m/sec |
| **SA02** | 1.50 | 0.00025 m/min | 4.21E -06 m/sec |
| **SA03** | 1.50 | 0.000077 m/min | 1.28E -06 m/sec |
| **SA04** | 1.50 | 0 m/min | 0 m/sec |
| **SA05** | 1.40 | 0 m/min | 0 m/sec |
| **SA06** | 1.40 | 0.00125 m/min | 2.079E -05 m/sec |
| **SA07** | 1.80 | 0.00112 m/min | 1.866E -05 m/sec |

### 6.5 Slopes / Batters

A maximum slope angle of 1V to 1.5H (33º) should be possible for temporary batters constructed within the upper medium strength indigneous fine grained soils. A slope angle of 1V to 2H (26°) should be appropriate for long term batters in the same soils. Where deep excavation works are required in the superficial deposits, the use of trench box support is advised. In addition, the uppermost fine subsoils will be susceptible to softening and degradation and surface water or groundwater ingress can lead to a significant reduction in shear strength. Perched water can exist locally and this should be considered in risk assessments for excavations. This is especially true in layers of Made Ground. By the nature of their unconsolidated, unengineered placement, anthropogenic soils such as those observed on site are expected to be highly unstable.

If anticipated, excavations into uppermost rock should be assessed by a suitably qualified engineering geologist. The angle which freestanding faces in limestone bedrock can be cut to will be influenced by, among other factors, bed thickness and angle of bedding, discontinuty spacing, clay infill and groundwater entry / seepage. Man-entry into any deep excavation should be appropriately assessed and an AF3 form completed. The AF3 form details the thorough examination of an open excavation as well as documenting daily worksite inspections.

Site operatives or personnel should not enter unsupported excavations and should be informed of potential risks. Where site operatives or engineering staff work in close proximity to temporary slopes or batters, these should be inspected and approved by a suitably experienced civil engineer, preferably with geotechnical experience. Where there is a risk of spalling of battered slopes, the use of a geogrid is recommended. The geogrid should be anchored at the top and bottom of the ridge face to contain particles such as gravel, cobbles and / or boulders that may become dislodged.

### 6.6 Pavement Construction

Twenty-one plate load tests were conducted at depths ranging 0.50m bgl to 0.90m bgl. The plate load test permits an assessment of the in-situ stiffness of the upper soil. The test results are reported in Appendix 4 and summarised in Table 4. The range of equivalent CBR values measured was 0.40% and 13.7% on the initial loading cycle (Cycle 1) and 0.6% - 18.8% on the reload cycle (Cycle 2). The reload cycle demonstrates modest improvement in performance of the subgrade following initial loading. It is likely that following excavation of the formation, that use of a smooth drum roller ahead of hardcore placement will deliver a similar improvement in subgrade performance.

**Table 4 – Equivalent CBR % Values obtained in Plate Bearing Testing**

| Test No. (%) | Depth | CBR at Load Cycle (%) | CBR at Re-Load Cycle |
|---|---|---|---|
| CBR 01 | 0.50 | 2.6 | 18.8 |
| CBR 02 | 0.50 | 2.3 | 4.7 |
| CBR 03 | 0.50 | 2.4 | 3.4 |
| CBR 04 | 0.50 | 3.0 | 4.3 |
| CBR 05 | 0.50 | 1.6 | 4.2 |
| CBR 06 | 0.50 | 0.4 | 0.6 |
| CBR 07 | 0.70 | 2.3 | 4.9 |
| CBR 08 | 0.50 | 1.5 | 6.3 |
| CBR 09 | 0.50 | 1.3 | 1.5 |
| CBR 10 | 0.90 | 2.7 | 4.6 |
| CBR 11 | 0.50 | 13.7 | 18.7 |
| CBR 12 | 0.50 | 2.3 | 5.0 |
| CBR 13 | 0.50 | 1.9 | 4.4 |
| CBR 14 | 0.50 | 2.1 | 4.2 |
| CBR 15 | 0.50 | 4.9 | 6.5 |
| CBR 16 | 0.50 | 2.6 | 5.8 |
| CBR 17 | 0.60 | 1.3 | 2.2 |
| CBR 18 | 0.50 | 3.3 | 10.0 |
| CBR 19 | 0.50 | 3.6 | 9.7 |
| CBR 20 | 0.50 | 1.7 | 12.5 |
| CBR 21 | 0.50 | 8.5 | 11.9 |

In accordance with the Design Guidance for Road Pavement (HD 25-26/10:2010), the lower-end equilibrium CBR values should be used to determine capping layer thickness. Disregarding some plate test results where subgrade disturbance or the presence of Made Ground may have derived uncharacteristically lower results, a CBR design value of 2.5% should be adopted for these buried firm clay soils.

In the case of the test undertaken at CBR06, a CBR design value of <2% should be applied to the near surface soils (0.50m bgl) in their current state. It is possible that Made Ground exists at this location and so extraction and removal of same is recommended prior to road construction.

Ahead of road construction, and following compaction of the soils, a further set of plate testing (450 or 600mm diameter) should be undertaken to assess the improvement in stiffness of the formation. An improvement should see a reduction in the build-up of capping stone required. Alternatively, slightly deeper excavation may be necessary to locate a more resilient subgrade.

Assuming a design CBR value of 2.5% for the upper soils then a minimum 6F capping thickness of 400mm and a sub-base thickness (UGM) of 150mm is recommended to support the road pavements / car park. If or where very low strength subgrade occurs (CBR <1%) either geogrid reinforcement or the use of starter material (Class 6A / 6B) could be considered to provide a suitable foundation layer especially for access or haul / spine roads if they traverse low strength subgrades. Such a mechanically stabilized layer could consist of a layer of geogrid with 500 to 600mm of granular fill (well graded aggregate with maximum particle size of 75mm). Where geogrid is not utilized then approximately 500mm build-up of Class 6A / 6B starter layer material could be considered in conjunction with a capping layer (Class 6F capping in line with Series 600 of TII SRW). This should provide a satisfactory foundation layer to adequately support the pavement (150mm of unbound granular material (UGM) in accordance with Table 2.1 of CC-SPW-00800, TII August 2022). The aforementioned Class 6A / 6B material could be used in conjunction with ca. 300mm of 6F capping material. This should provide a robust foundation layer.

The time of year will play a role in sub-grade strength especially during winter or early Spring where heavy rainfall would cause degradation / wash-out of the formation. If there are particular concerns regarding the condition of the formation soils, then additional plate bearing tests should be considered during construction to verify or validate the stiffness / density of the formation soils and adequate capping thickness.

The durability of the capping material should be confirmed as capping will be exposed to the elements (especially if the works are undertaken during the winter / spring period). It is important that argillaceous sedimentary rocks (i.e. muddy limestone, calcareous mudstone, shale, etc.) are not used as capping or as a starter layer. These have high potential to give rise to degradation (i.e. poor durability and soundness) and slaking and therefore would not be suitable.

All granular fills / unbound granular mixtures (UGM) used in pavement construction should be tested and approved in advance of being used in pavement construction. They should meet the compositional, chemical and soundness requirements as prescribed in the TII publication entitled *Road Pavements – Unbound and Hydraulically Bound Mixtures* (CC-SPW-00800 – dated August 2022).

Compaction / Placement of imported granular fill or hardcore will need to achieve low air voids (<5%) and ensure that settlement is not an issue. The number of roller passes and mass per metre and width of roll should meet the guidelines in I.S. 888:2016 *Annex B: Compaction requirements for unbound mixtures Table B.1*. It is recommended to use a smooth drum roller (without vibration) with a mass per metre of roll of not less than 5400kg. Unbound mixtures should not be laid in layers greater than 150mm if using this compaction method.

### 6.7 Buried Concrete

The chemical analysis tests on natural soil samples (BRE SD1 analysis suite) show pH (2.5:1) values ranging from 8.3 to 9.6. The sulphate aqueous extract ($SO_4$) results from trial pit samples determined values of <10mg/l to 380mg/l. This would suggest the 'as-received' soil samples tested could be categorised as BRE Class DS-1.

Table C1 ACEC for greenfield sites in BRE SD 1 (2005) can be used in the selection and design of concrete. If mobile groundwater conditions prevail at the site and given the pH values obtained from the testing, then ACEC class AC-1[d] would be expected to be appropriate for buried concrete in the soils. In line with I.S. EN 206-1:2013, concrete could be manufactured to Class XA1 where founded or positioned in the upper soils (Class XA1 being ≥ 2000 and ≤ 3000 $SO_4^{2-}$ mg/kg).

In the absence of sulphate analysis conducted on the bedrock, should footings be extended to rock, the guidance given in IS EN 206;2013 (Concrete: Specification, Performance Production and Conformity) states that the most onerous value for a single chemical characteristic determines the concrete class. In terms of concrete manufacture to IS EN 206-1:2002, it would be prudent to have concrete manufactured to Class XA2 if founding in bedrock. This is advised on the knowledge of the argillaceous limestone and calcareous mudstone bedrock present in the Dublin Calp Limestone and potential for oxidation and sulphate attack.

### 6.8 Earthworks Testing

To evaluate the re-use properties of the upper soils, a programme of earthworks laboratory testing was conducted. This comprised CBR, Moisture Condition Value (MCV) and Dry Density / Moisture Content relationship. Bulk samples were acquired from trial pits excavated across the site with testing conducted on the material at their natural or 'as-received' moisture contents. Earthworks testing was undertaken on those samples listed in Table 5. Their respective depth intervals and soil descriptions are shown in the aforementioned table.

**Table 5 – Sample description of soils used in Earthworks testing**

| Exploratory Hole No. | Sample Depth | Sample Description |
|---|---|---|
| **TP01** | 0.80 | Brown slightly sandy, slightly gravelly, CLAY |
| **TP03** | 0.80 | Brown sandy, gravelly, CLAY |
| **TP06** | 0.80 | Brown slightly sandy, slightly gravelly, CLAY |
| **TP08** | 0.80 | Brown sandy, gravelly, CLAY |
| **TP10** | 0.80 | Brown slightly sandy, slightly gravelly, CLAY |
| **TP14** | 0.80 | Brown slightly sandy, gravelly, CLAY |
| **TP16** | 0.80 | Brown sandy, gravelly, CLAY |
| **TP17** | 0.80 | Brown slightly sandy, slightly gravelly, CLAY |
| **TP19** | 0.60 | Brown sandy gravelly SILT/CLAY |
| **TP24** | 1.20 | Brown slightly sandy, slightly gravelly, CLAY |

The samples, ahead of being subject to reusability testing, each have their >20mm fraction removed. The resultant earthworks testing (on natural 'as-received' samples) produced laboratory CBR results in the range 0.4 to 17.8% with MCV's of 1.2 to 11.8. Moisture contents ranged from 11 - 26%. Maximum dry densities were proven to range between 1.56 and 2.05mg/m³ at moisture contents of 14% to 17% (refer to Table 6).

The moisture contents in the 'native' CLAY/SILT are elevated (11-26%) when compared to the moistures at which the soils achieve their maximum dry density. Compaction tests revealed optimum moisture contents of 14-17%. This explains the occasionally low CBR % values, as well as the low MCV values, some of which demonstrate the soils to be wet of optimum. Overall, the testing suggests the bulk of the soils, if handled carefully, would be classed as acceptable for re-use as Class 2 materials (2C1 Stony Cohesive material – high fines content) in line with Series 600 TII SRW.

**Table 6 - Summary Details of Laboratory Testing samples**

| Hole No. | Depth | Lab CBR Value % (Moisture Content %) | MCV at Natural Moisture Content (Moisture Content %) | Dry Density / Moisture Content Relationship |
|---|---|---|---|---|
| TP01 | 0.80 | 4.0 (24) | **8.3 (25)** | Max Dry Density = 1.63mg/m³ at 15.2% OMC |
| TP03 | 0.80 | 0.4 (19.7) | 1.2 (20.3) | - |
| TP06 | 0.80 | 4.5 (14.7) | 3.7 (18.5) | Max Dry Density = 1.90mg/m³ at 12.7% OMC |
| TP08 | 0.80 | 3.7 (15.5) | 7.3 (16.7) | - |
| TP10 | 0.80 | 13.1 (26.8) | 5.9 (29.5) | Max Dry Density = 1.60mg/m³ at 17.2% OMC |
| TP14 | 0.80 | 17.8 (11.6) | 6.0 (14.8) | Max Dry Density = 2.05mg/m³ at 6.2% OMC |
| TP16 | 0.80 | 12.6 (20.2) | **11.8 (24.4)** | - |
| TP17 | 0.80 | 1.0 (14.5) | **8.7 (14.3)** | Max Dry Density = 1.99mg/m³ at 9.1% OMC |
| TP19 | 0.60 | 11.1 (22.8) | **10.4 (22.7)** | Max Dry Density = 1.68mg/m³ at 14.2% OMC |
| TP24 | 1.20 | 11.5 (24.4) | **10.6 (25.1)** | Max Dry Density = 1.56mg/m³ at 14% OMC |

*Bold font = optimum and dry of optimum (8-14)*

Given the occasionally very low and low MCV results (minimum MCV of 8 normally required for Class 2 soils) some of the soils could be modified and strengthened by the addition of lime / cement binders. Treatment with lime or lime / cement (soil stabilization) would increase MCV (limits of 8 to 12 advised) and CBR (15% recommended by plate load test method).

If the design makes provision for ground improvement or soil stabilization methods, then trial mix laboratory testing and a field demonstration trial (footprint of c. 10 x 10m) are advised. The key objective of a field trial would be to assess the performance of the modified soils with lime or lime / cement binders using earthwork plant. This would allow for in-situ testing (plate load, nuclear gauge, sand replacement and CBR mould samples) to measure CBR / stiffness, relative compaction (percentage degree of compaction) and air voids.

It is vital that if soil stabilisation process is chosen, that any soil stockpiles are graded and shaped so that surface water cannot collect or pond. Similarly, careful control of excavation, transporting, stockpiling, placing and compaction is advised to ensure that degradation of the shallow soil deposits does not occur. This is extremely important as poor earthworks management would render the fine silty soils as unsuitable for re-use.

In summary, according to laboratory testing, without reworking / drying or modification with lime (calcium oxide), the natural, uppermost, surficial fine-grained clay/silt would be suitable for re-use. However, it is possible the addition of binders would be required to produce a consistently acceptable sub-formation layer (high strength Class 2 engineered fill with an MCV 8 to 14).

### 6.9 Waste Acceptance Criteria [WAC] & Environmental Testing

Soil samples were taken across a range of depths from trial pits. Samples were analysed for their compliance to the criteria set out in the 2002 European Council Decision (2003/33/EC). O'Callaghan Moran & Associates conducted a waste characterisation assessment of the samples in accordance with the Environmental Protection Agency (EPA) Guidelines on the Classification of Waste (2015). This report, together with conclusions and recommendations, is presented in Appendix 9.

## REFERENCES


**1.0** BS 5930 (2015+A1:2020) Code of Practice for Site Investigation, British Standards Institution (BSI).

**2.0** BS 1377 (1990) Methods of Testing of Soils for Civil Engineering Purposes, BSI.

**3.0** Eurocode 7, Part 2: Ground Investigation & Testing (EN 1997-2:2007)

**4.0** International Society of Rock Mechanics (ISRM) (1981). Rock Characterisation, Testing and Monitoring; ISRM Suggested Method. Oxford, UK: Pergamon Press.

**5.0** Peck, R.B., Hanson, W.E., & Thornburn, T.H. (1974). Foundation Engineering, 2nd Edition. Wiley, New York.

**6.0** Site Investigation Practice: Assessing BS 5930 (1986), Geological Society Special Publication, No. 2.

**7.0** Stroud, M.A & Butler, F.G (1975) "The SPT and the Engineering properties of Glacial Materials". Proceedings of the Symposium on Engineering Behaviour of Glacial Materials, Birmingham

**8.0** Terzaghi, K., Peck, R.B., & Mesri, G. (1996). Soil Mechanics in Engineering, 3rd Edition. New York, Wiley.

**9.0** Tomlinson, M.J., & Boorman, R. (1986). Foundations – Design and Construction. 5th edition

# Appendix F : UISCE ÉIREANN STATEMENT of DESIGN ACCEPTANCE

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26 March 2025

**Re: Design Submission for Clonburris, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS24003031**

Dear Dieter Bester,

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, Uisce Éireann has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before you can connect to our network you must sign a connection agreement with Uisce Éireann. This can be applied for by completing the connection application form at www.water.ie/connections. Uisce Éireann'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 Uisce Éireann's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Uisce Éireann does not, in any way, render Uisce Éireann liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Uisce Éireann representative:
Name: Alicia Ros Bernal
Email: ailciarosbernal.bernal@water.ie

Yours sincerely,

**Dermot Phelan**
**Connections Delivery Manager**

ENVIRONMENT ISO 14001:2015 NSAI Certified

HEALTH & SAFETY ISO 45001:2018 NSAI Certified

QUALITY I.S. EN ISO 9001:2015 NSAI Certified

**Engineering Sustainable** Futures


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