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Project: Proposed Housing Development at Árd an Ghleanna, Mallow, Co. Cork.

Project No: 22054

Document Title: Civil Engineering Report

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Contents

1.0 Introduction

Walsh design group (WDG) were appointed by Cork County Council to produce a Civil Engineering Report as part of a planning application for the proposed residential development of 138 dwellings at Árd an Ghleanna, Mallow, Co. Cork.

This report is particularly concerned with the following engineering services:

- Flood Risk Assessment,
- Road design,
- Wastewater Drainage,
- Surface Water Drainage & Drainage Impact Assessment,
- Water Supply.

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

- 22054-XX-XX-XX-XX-DR-WDG-CE-001 Site Layout – Roads & Levels,
- 22054-XX-XX-XX-XX-DR-WDG-CE-002 Site Layout - Drainage,
- 22054-XX-XX-XX-XX-DR-WDG-CE-003 Site Layout – Water Supply,
- 22054-XX-XX-XX-XX-DR-WDG-CE-004 Site Layout – Proposed SuDS Features,
- 22054-XX-XX-XX-XX-DR-WDG-CE-005 Site Layout – Vehicle Tracking Analysis,
- 22054-XX-XX-XX-XX-DR-WDG-CE-301 Road Longitudinal Sections,
- 22054-XX-XX-XX-XX-DR-WDG-CE-302 Wastewater Longitudinal Sections Sheet 1 of 4,
- 22054-XX-XX-XX-XX-DR-WDG-CE-303 Wastewater Longitudinal Sections Sheet 2 of 4,
- 22054-XX-XX-XX-XX-DR-WDG-CE-304 Wastewater Longitudinal Sections Sheet 3 of 4,
- 22054-XX-XX-XX-XX-DR-WDG-CE-305 Wastewater Longitudinal Sections Sheet 4 of 4,
- 22054-XX-XX-XX-XX-DR-WDG-CE-500 Surface Water Drainage Typical Details,
- 22054-XX-XX-XX-XX-DR-WDG-CE-501 Irish Water Standard Details – Wastewater,
- 22054-XX-XX-XX-XX-DR-WDG-CE-502 Irish Water Standard Details – Water Supply (Sheet 1 of 2),
- 22054-XX-XX-XX-XX-DR-WDG-CE-503 Irish Water Standard Details – Water Supply (Sheet 2 of 2),
- 22054-XX-XX-XX-XX-DR-WDG-CE-504 Construction Details,
- 22054-XX-XX-XX-XX-DR-WDG-CE-903 Site Layout – Areas to be Taken in Charge.

1.1. Site Description

This site proposed for development is located just northeast of Mallow town centre, directly north of the existing Aldworth Heights estate and the access to the site is via the Aldworth heights road off St. Josephs Road. The ITM grid coordinates at the approximate centre of the site are E556636, N599227, see Figure 1. The red line application boundary encloses an area of 4.52ha.

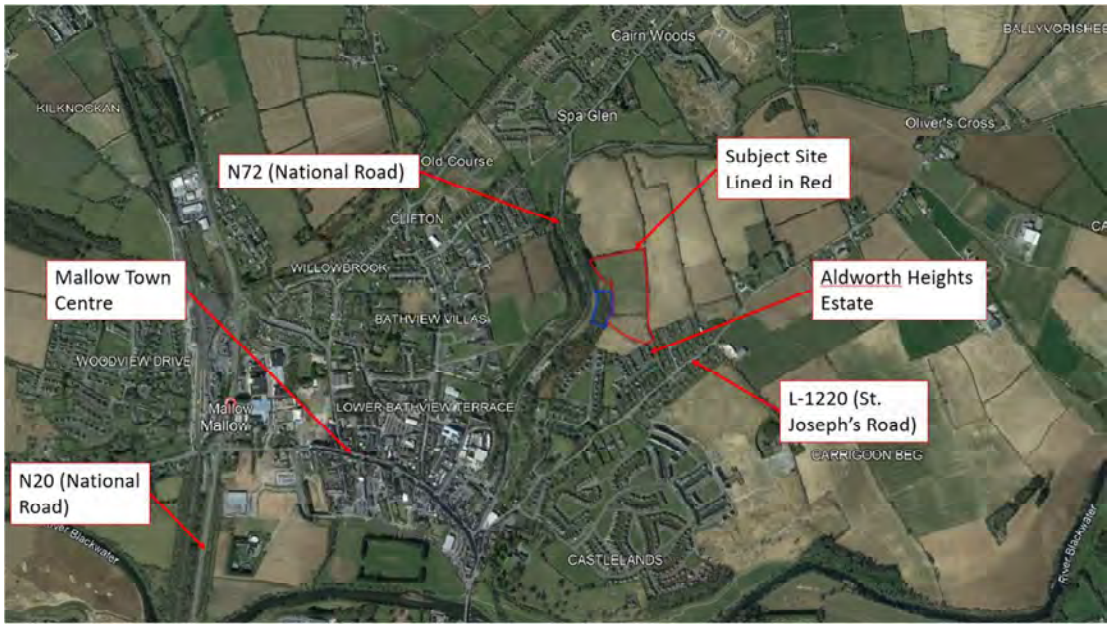


Figure 1: Google Earth Satellite Photo of the Mallow Area

Figure 2: Google Earth Satellite Photo of the proposed development site.

This is a greenfield site, currently used as agricultural land as can be seen from the satellite image in Figure 2, but some stripping of topsoil is evident in the higher parts of the site. The site generally slopes downwards from the southeast corner to the northwest. The high point of approximately 86.2m is near the entrance in the southeast and the low point of approximately 63.0m is at the northwest boundary.

The western boundary of the site is formed by the top of a steep embankment which falls towards the edge of the N72 roadway. The only current access to the site is via the double gates in the paladin fencing at the end of the Aldworth Heights cul-de-sac. The northern and eastern boundaries are shared with agricultural land and the southern boundary is shared with the Aldworth Estate.

1.2. Proposed Development

The proposed development would consist of a total of 138no. dwellings comprising 4no. 4 bed semi-detached houses, 14no. 3 bed semi-detached houses, 20no. 3 bed townhouses, 36no. 2 bed townhouses, 32no. 2 bed apartments and 32no. 1 bed apartments. A new vehicular access to the site is proposed which would connect to the end of the Aldworth Heights Road that is currently a cul-de-sac. The Aldworth Heights road connects to St. Josephs Road (L-1220). The proposed development will also include new internal estate roads, drainage, water supply, landscaping, boundary treatments, public lighting, electrical and telecommunications infrastructure and all other site development works entailed in a residential development.

Architectural, Engineering and Landscaping drawings and report together with Appropriate Assessment Screening report, Ecological Impact Assessment report, Natura Impact Statement, Archaeological Assessment reports, Traffic and Transport Assessment reports, Travel Plans Environment Impact Assessment are included in the planning documentation. An outline of the development is shown in the Architect's site layout in Figure 3.

Figure 3: Architect's Site Layout

2.0 Flood Risk

A desktop study of the history of flooding and the probability of flooding at the site was carried out with the intention of assessing the flood risk in accordance with *The Planning System and Flood Risk Management Guideline*s as published by the Department of the Environment, Heritage and Local Government give guidelines on flood risk and development planning.

The guidelines recommend a precautionary, sequential approach to assessing and managing flood risk and, where possible, to avoid development of sites that are at risk.

The sequential approach to flood risk assessment relies on the identification of Flood Zones. These are geographical areas within which the likelihood of flooding is in a particular range. There are three types of flood zones, defined in the guidelines as follows:

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

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

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

When the flood zone applicable to the site has been identified the guidelines describe the developments that would be appropriate within that zone, considering the level of flood risk involved.

2.1. Flood Maps

The OPW's online resource, Floodmaps.ie, was reviewed to assess the history and probability of all types of flooding at the proposed development site. Figure 4 shows an extract from the online flood map of the area north of Mallow Town Centre with the proposed site outlined in red.

Figure 4: Floodmaps.ie extract map of development site and surrounding area.

The interactive flood map allows the following layers to be switched on to illustrate whether any type of flooding impacts an area:

- CFRAM River Flood Extents with AEP of 10%, 1% and 0.1%,
- CFRAM Coastal Flood Extents with AEP of 10%, 1% and 0.1%,
- NIFM National Indicative Fluvial Mapping – Present day with low and medium probability,
- GSI Groundwater flooding probability Maps with low, medium and high probability,
- Past flood events – indicated with hazard signs on the map and the extent of the recorded flood events shown with a blue outline and dotted hatch pattern.

All of these layers are switched on in the extract shown in Figure 4. The CFRAM fluvial flood extents map (Mallow Tile 11) for all probabilities is also included in Appendix E to this report.

The hazard symbols to the south of the development site, shown in Figure 4, indicate past flooding events caused by the River Blackwater flooding its banks in Mallow town. The hazard symbols to the southeast of the site mark past flooding events in Ballyellis and Ballygarrett also caused by the Blackwater overtopping its banks. The recurring flood events indicated the north occur at the N72 Parkadallane Junction and the N72 at Keatley's Close.

The Cork County Development Plan 2022-2028 includes digital flood mapping where projected Flood zones A & B can be turned on as layers to assess a site's potential vulnerability to flooding, see Figure 5. As with the OPW maps, projected flood extents near the site are limited to the banks of the Spa Stream and along the N72.

Figure 5: Cork County Development Plan 2022-2028 - Flood Zones A & B

These vulnerable locations and watercourses are at significantly lower elevations than the development site, however, and it is clear from all maps available that the site lies outside any areas that have a probability of flooding in any event, whether fluvial, coastal or groundwater, up to and including a 1 in 1000-year storm. This places the site in flood zone C where residential development is appropriate without requiring a justification test.

3.0 Road Design

The layout of the proposed new roads and how they connect with St. Joseph's Road (L-1220) is shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-001.

3.1. Design Guidelines

The proposed roads within the estate have been designed in substantial compliance with the following:

- Design Manual for Urban Roads and Streets (DMURS) - Dept. of Environment and Dept. of Transport Tourism and Sport-2019,
- Cork County Council Making Places 2011
- NTA Cycle Design Manual 2023
- Recommendations for Site Development Works for housing areas – DOE 1998,

3.2. Road Hierarchy

There are no *Link* roads or 'through roads' proposed in the development. The proposed roads would be considered local roads in the DMURS hierarchy shown in Table 1. Local roads are described as roads that provide access within communities and to *Arterial* and *Link* roads. The local roads in the development will connect, via the Aldworth Heights estate road, with the L-1220 (St. Josephs Road) which is considered a link road that will connect the development with Mallow Town Centre and the arterial N20 and N72 national roads.

DMURS Description	Roads Act/NRA DMRB	Traffic Management Guidelines	National Cycle Manual
Arterial	National	Primary Distributor Roads	Distributor
Link	Regional (see note 1)	District Distributor Local Collector (see Notes 1 and 2)	Local Collector
Local	Local	Access	Access

Notes

Note 1: Larger Regional/District Distributors may fall into the category of *Arterial* where they are the main links between major centres (i.e. towns) or have an orbital function.

Note 2: Local Distributors may fall into the category of *Local* street where they are relatively short in length and simply link a neighbourhood to the broader street network.

Table 1: DMURS Table 3.1 - Terminology used in DMURS compared with other publications.

It is proposed to use road widths of 5.5m and 6.0m throughout the development as most parking spaces/driveways are perpendicular to the carriageway. All roads shall be served by at least one footpath with a minimum width of 2.0m and the estate shall have a sign posted,

slow zone speed limit of 20km/h as shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-001.

3.3. Shared surfaces and Surface Materials

DMURS encourages the use of raised and shared surfaces which promote integration between pedestrians, cyclists, and drivers. This has been shown to be effective where pedestrian activities are high and vehicle movements are mainly due to lower-level access requirements and circulatory purposes.

DMURS recommends that, where design speeds of 30km/h are desired, periodic changes in the colour and/or texture of the street surfaces should be employed. In this development, a design Speed of 20Km/hr is proposed. Shared surfaces are introduced through raised tables and the use of material changes in the street surface treatments.

Shared surfaces in the form of raised junctions and raised tables will be finished in bituminous surfacing with beige or re coloured chippings to differentiate these features from the normal street surfaces finished in standard black bituminous surfacing, see WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504 for construction details.

The proposed locations and extent of these features are shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-001.

3.4. Traffic Calming

It is proposed to limit the vehicle speeds within the development to 20km/h using standard signage and traffic calming measures as recommended by DMURS and the Traffic Management Guidelines (DoELG 2003) to help improve driver behaviour and reduce vehicle speeds.

The more visible traffic calming measures proposed are horizontal realignment, raised junctions and tables with the proposed locations shown in WDG drawing No. 22054-XX-XX-XX-XX-DR-WDG-CE-001. These are positioned to reduce the lengths of straight and level roads that would allow a build-up of vehicle speed while also providing designated non-signalised, crossing points for pedestrians.

Ramps to raised sections of roadway shall be constructed in accordance with Diagram 6.34 of The Traffic Management Guidelines. The street level is raised 75mm and finished using bituminous surfacing with beige or red coloured chippings with 1:15 ramps at each side painted with white triangles (M112) to warn drivers of the elevation change (see Figure 6).

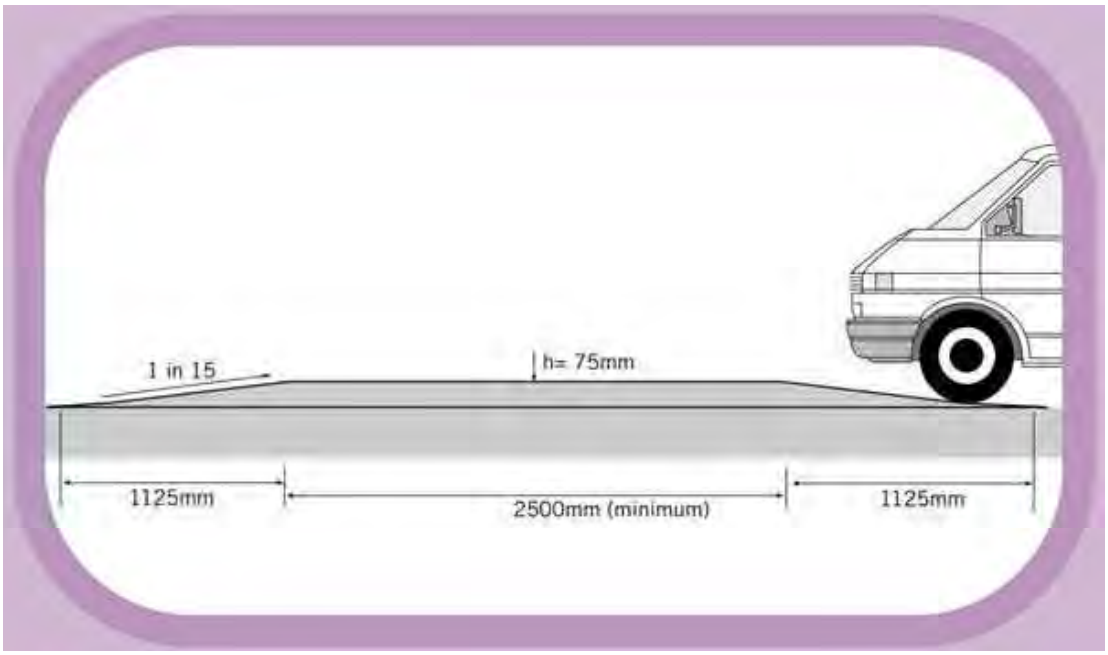


Figure 6: Traffic Management Guidelines, Diagram 6.34 - Raised Tables

Further measures to aid in traffic calming include keeping carriageway widths to a minimum and reducing corner radii as described in Sections 3.2 and 3.6.

3.5. Street Gradients

In accordance with DMURS guidelines, roads have been limited as far as possible, to gradients of 5% or less. For short sections of roadway design gradient are increased to a maximum of 8.33% following agreement with the Local Authority Estates engineer. Roads approaching junctions will have a maximum gradient of 2% for 7.0m in accordance with section 2.7 of the *Recommendations for Site Development Works for housing areas – DOE 1998.*

All proposed roads shall have a cross fall of 2.5%. Vertical alignment has been carefully considered to minimise the amount of cut and fill on site.

3.6. Corner Radii

According to DMURS section 4.3.3, reducing corner radii will significantly improve pedestrian and cyclist safety at junctions by lowering the speed at which vehicles can pass through corners and increasing the inter-visibility between users. At tighter corner radii vehicle and cyclist speeds are more compatible.

The junctions between local streets and the horizontal realignment on roads 1 and 2 within the proposed development have corner radii of 3.0m. This is considered to be acceptable in residential developments where design speeds are low, and movements of larger vehicles are infrequent. It is proposed to construct the entrance and exit roads from the creche with 2.0m kerb radii at their junctions with the estate road.

3.7. Pedestrian Crossings

Pedestrian crossings will be placed throughout the development in locations where there are footpaths on both sides and at junctions, see WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-001. The proposed pedestrian crossings are uncontrolled crossing points. Each crossing point shall be constructed using dished kerbs in accordance with Diagram 13.1 of the Traffic Management Guidelines 2013, see Figure 7.

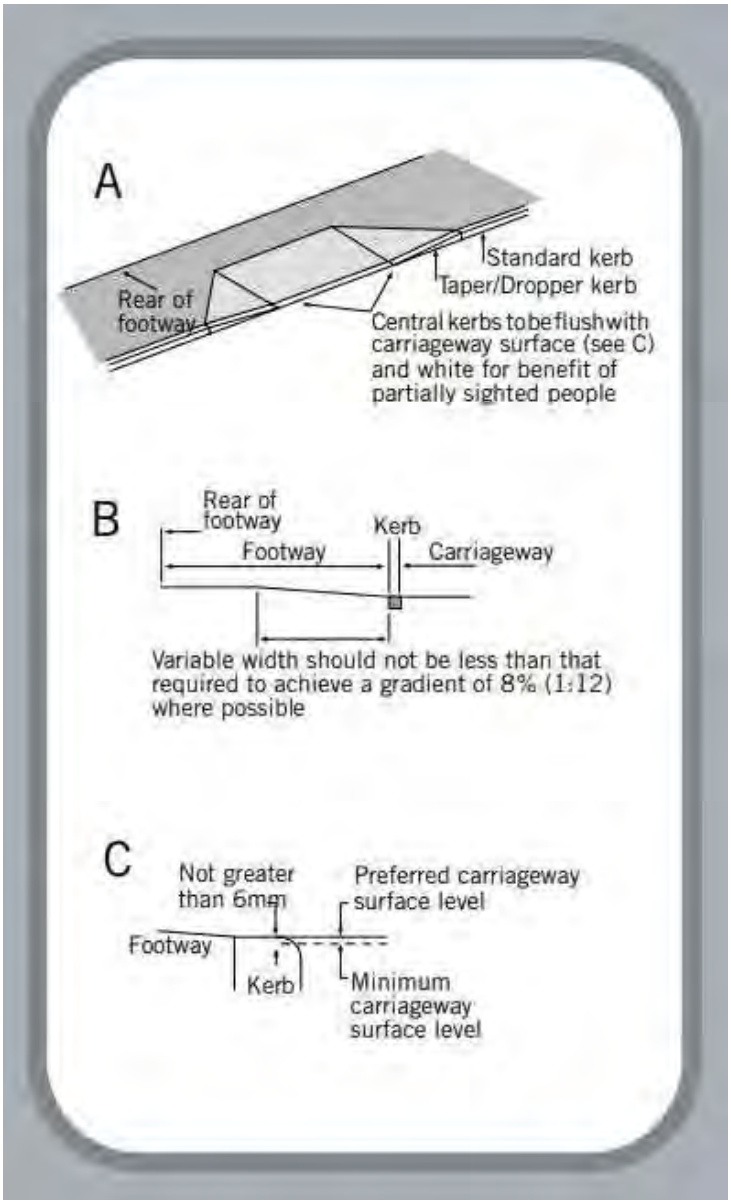


Figure 7: Diagram 13.1 Dished Crossing - Traffic Management Guidelines; DOT, 2013

Buff coloured tactile paving in accordance with Table 13.1 of the Traffic Management Guidelines shall be set in the footpath at each crossing point. Paving slabs measure 400mm x 400mm and shall be laid in patterns in accordance with the guidance in the UK DETR document; *Guidance on the use of Tactile Paving Surfaces,* at each crossing point, as illustrated on drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-001.

3.8. Pavement Construction

Street pavement and footpath construction shall be carried out in accordance with the recognised standard; 'Recommendations for Site Development Works for Housing Areas; DoELG 1998'. Roads will be finished in bituminous surfacing and footpaths will be constructed in concrete. See WDG construction details drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504 for road, footpath, and kerb details.

Road construction assumes a minimum design CBR for the existing ground. The appointed main contractor will be obliged to carry out testing to establish the actual CBR prior to final road design and commencement of road construction.

3.9. Private Driveways & Paving

Each private dwelling plot with car parking included shall have access in compliance with Technical Guidance Document M of the Building Regulations. Footpaths across all driveway entrances will be dished and incorporate dropped kerbs. All private parking bays shall be constructed with permeable paving, see WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504 for details. The permeable paving will allow for some of the surface water to soak into the subsoil and ground water rather than leaving the site via the sewer network which is preferable in terms of SuDS.

3.10. Site Cut and Fill

Prior to any construction works on site the topsoil (approx. 200mm deep) will be stripped from the surface in all areas apart from the large green areas. This topsoil will be stockpiled, according to best practice, on site to be reused in private gardens and landscaped areas.

Stockpiles are to be located, formed and maintained according to best practice. Vegetation and any waste materials are to be removed from storage areas prior to stockpiling. Soils shall be stockpiled in the driest condition possible. Soil will be banked with a maximum side slope of 1 in 2 and grass seeded with a grass/clover mix to minimise soil erosion and help reduce infestation by nuisance weeds. Stockpiles are to be fenced off and have their contents identified using clear signage. No vehicles shall be allowed to pass over stockpiles.

Fill imported onto the site to be placed under buildings shall comply with Technical Guidance Document D of the Building Regulations and NSAI Standard Recommendation 21 (S.R.21). Any fill imported for use under roadways shall comply with the Tii Specification for Roadworks Series 600 documents.

4.0 Surface Water Drainage

The proposed storm sewer collection system consists of a 100mm diameter pipe collection network around each house in accordance with TGD part H discharging to 225mm diameter uPVC sewer or larger in the public areas of the development. The surface water network layout is shown in drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-002 and the typical details for the surface water infrastructure are shown on drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-500.

The surface water sewers have been designed using the Causeway Flow design software and the Wallingford procedure for the design and analysis of urban drainage. The surface water system for the development is a single network including extensive SuDS measures falling generally from south to north and exiting the site in the northwest. It is intended to discharge the attenuated stormwater into the Spa Stream that flows in a southward direction, beside the N72, adjacent to the site.

4.1. Surface Water Design and Simulation Criteria

The storm network's design criteria included:

- maximum rainfall of 50 mm/hr,
- maximum time of concentration of 30 minutes,
- minimum cover of 1.2m to pipes under roads,
- M5-60 of 18.1mm (Met Eireann),
- SPR of 0.3 (UKSUDS).

The storm networks were tested by simulating both summer and winter storms with durations of between 15 minutes and 24 hours and return periods of 1, 30 and 100 years with the following criteria:

- Summer volumetric runoff coefficient of 0.75,
- Winter volumetric runoff coefficient of 0.84,
- Areal runoff factor of 1.0,
- Additional flow for climate change of 20%.

The surface water sewer networks have been modelled and each individual pipe run has been designed such that no flooding will occur to individual elements during any storm up to and including 24-hour 100-year return period, summer, and winter storms. In all storm simulations an additional flow of 20% was added to account for future climate change.

(See detailed design in Appendix A to this document).

4.1.1. Allowable Discharge

The allowable stormwater discharge from the surface water network was calculated by means of the QBAR equation for small rural catchments (< 25 km^2) as indicated in the institute of Hydrology, UK Report No. 124. QBAR is calculated using the following formula:

$QBAR = (0.00108\ [AREA]^{0.89}\ [SAAR]^{1.17}\ [SOIL]^{2.17})$

Where,

QBAR (m^3/sec)	=	Annual peak flow
AREA (km^2)	=	Catchment area
SAAR (mm)	=	Standard annual average rainfall (mm/yr)
SOIL	=	Index with values between 0.15 and 0.50

The variables for the sewer network are as follows:

AREA The catchment area of the estate that will have its runoff attenuated is 4.4689ha = 0.044689km^2,

SAAR The standard average rainfall for the site for the period from 1941 to 1970 was obtained from the UKSUDS website and is approximately 1126 mm/year,

SOIL This index was obtained from the UKSuDS website: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation.

For developments smaller than 50ha, the allowable discharge is linearly interpolated from the QBAR value obtained for a 50ha site. Inputting the above data into the QBAR equation, QBAR Actual is calculated as follows:

QBAR = $(0.00108\ [0.5]^{0.89}\ [1126]^{1.17}\ [0.3]^{2.17})$
= 0.1589 m3/sec
= 158.91 l/sec

By linear interpolation => Adjusted QBAR = 14.2 l/sec.

4.1.2. Network Design

This single network is designed to fall generally from south to north and exit the development in the northwest. The surface water sewer will drop down the steep embankment along the western boundary of the site and proceed to its proposed outfall into the Spa Stream.

To reduce the forward flow from the developed site to a maximum of the QBAR greenfield runoff rate of 14.2 l/s a hydrobrake shall be constructed in a manhole prior to the sewer exiting the site. Choking the flow to this rate results in the requirement for temporary attenuation storage to prevent overtopping in upstream manholes and flooding in the development. A certain amount of attenuation storage shall be provided in the under-drained roadside swales, but the primary storage elements shall be a series of shallow detention basins in the green areas to the north of the site and 1 attenuation tank under the northeast amenity area.

These features are described in more detail in the drainage impact assessment below.

Soakaway Tests (BRE Digest 365)			
Location	Test Depth (m bgl)	Infiltration Coefficient (ms^{-1})	Infiltration Coefficient (m/hr) Average
SA TP02	2.3	5.48 E-05 2.15 E-05 4.18 E-05	0.142
SA TP04	2.5	1.02 E-04 7.39 E-05 1.03 E-04	0.334
SA TP05	2.4	2.08 E-05 1.73 E-05 2.69 E-05	0.078
SA TP06	2.5	8.69 E-07	0.003
SA TP08	2.5	7.37 E-07	0.003
SA TP09	2.5	7.42 E-05 1.53 E-04 8.04 E-05	0.369
SA TP11	2.3	2.99 E-05 4.53 E-05	0.135
SA TP12	2.3	1.28 E-06	0.005
SA TP16	2.3	3.65 E-05	0.131
SA TP17	2.3	5.98 E-06	0.022
SA TP18	2.1	5.67 E-05 9.52 E-05 3.08 E-04	0.552
SA TP19	2.3	2.51 E-05	0.09
SA TP20	2	1.20 E-05 9.88 E-05 9.02 E-05	0.371

Table 2: Summary of Soil Infiltration Rates

The soil infiltration rates shown in Table 2 were recorded by Priority Geotechnical Ltd. after carrying out 13 no. BRE Digest 365 tests across the site. The site investigation report from Priority Geotechnical is included with this application. The infiltration rates vary across the site but are generally poor along the eastern side and improve towards the centre and west. In the design of the surface water network, infiltration rates have been applied to features corresponding to the test result closest to that feature.

To incorporate under-drained roadside swales into the design, the adjacent estate roads are designed to have a single crossfall towards the verge containing the swale.

In accordance with the Wallingford Procedure, using only impermeable areas in the modified rational method, a Cv (Volumetric Runoff Coefficient) of 0.75 was used for summer events

and 0.84 for winter. For the purpose of calculating the volume and rate of flow in the network, the maximum hardstanding area contributing to each pipe run was measured. The hardstanding consists of all roofs, driveways, parking spaces, roads, footpaths and other paved sections within the contributing area.

Permeable paving is proposed in areas of the development, however, for the sake of the network design, it is conservatively assumed that, whilst the permeable paving will serve in an interception and attenuation capacity and there will be varying amounts of infiltration to the soil across the site, the attenuation and infiltration functions of the paving are not included. As a result, the runoff will be slowed down and filtered but full runoff to the sewer is assumed from permeable paving. This adds further redundancy or safety factor to the surface water network.

The proposed surface water network has been tested with the Causeway Flow software, simulating rainfall events up to and including the 24-hour, 100-year storm with a 20% addition allowed for climate change. Modelling shows that no flooding occurs in any rainfall event tested.

4.1.3. Road Gullies

Gullies shall be used in some areas of the site as shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-002. It is not practical to use roadside swales in these areas so the sewers are located under the estate road and the runoff from the surrounding hardstanding areas is collected by a number of gullies.

All gullies will be precast concrete complying with the requirements of BS 5911: Part 230. The outlet from the gullies will be 150mm diameter pipe set a minimum of 375mm off the floor of the chamber. This allows for debris and silt that falls through the grating to settle below the invert of the outlet pipe. The silt in gullies must be regularly cleaned out as part of the silt management and maintenance schedule in the operational phase of the housing development.

The class of gully grating required will be D400 as per the manhole covers. Gully gratings in roads will be set with the direction of the openings at right angles to the direction of traffic.

4.2. Drainage Impact Assessment

SuDS measures are proposed for the development in both public and private areas in accordance with the guidance from the County Development Plan 2022 Advice Note 1 on Surface Water management and the CIRIA SuDS Manual C753.

The Measures proposed will decrease the impact of the development on the receiving environment and also provide amenity and biodiversity in many cases. Regular maintenance of the SuDS measures will be required to ensure that they are effective throughout their design life. The following paragraphs describe the SuDS features proposed: detention basins, permeable paving, under-drained roadside swales, bio-retention tree pits, bio-retention raingardens and water butts.

4.2.1. Detention Basins

The primary means of attenuating runoff prior to its outfall to the Spa Stream or infiltration into the soil shall be the proposed detention basins. The basins are designed to have a depth of less than 1.2m, side slopes with a gradient of 4 horizontal to one vertical. The basins have been designed so that no flooding would occur in the drainage network in any event up to and including the 24-hour 100-year storm with 20% added for climate change. See WDG drawings 22054-XX-XX-XX-XX-DR-WDG-CE-002, 22054-XX-XX-XX-XX-DR-WDG-CE-004 and 22054-XX-XX-XX-XX-DR-WDG-CE-300 for further details of the basins.

Basins 1, 2 and 3 shall be constructed in series in the central amenity area.
Basin 1 shall have the following characteristics:

- a base area of 6.7m^2 and a surface area, when full, of 68.2m^2,
- Maximum depth of 0.8m,
- Side slopes of 4 horizontal to 1 vertical,
- 145mm dia. Orifice plate at the outlet limiting flow to 45l/s.

Basin 2 shall have the following characteristics:

- a base area of 2.7m^2 and a surface area, when full, of 53.5m^2,
- Maximum depth of 0.8m,
- Side slopes of 4 horizontal to 1 vertical,
- 135mm dia. Orifice plate at the outlet limiting flow to 17l/s.

Basin 3 shall have the following characteristics:

- a base area of 41m^2 and a surface area, when full, of 145.8m^2,
- Maximum depth of 0.8m,
- Side slopes of 4 horizontal to 1 vertical,
- A hydrobrake at the outlet manhole limits flow to 6.5l/s.

Basins 4 and 5 shall be constructed in series in the northwestern green area just prior to the surface water network leaving the site.
Basin 4 shall have the following characteristics:

- a base area of 50m^2 and a surface area, when full, of 200.5m^2,
- Maximum depth of 1.0m,
- Side slopes of 4 horizontal to 1 vertical,
- A hydrobrake at the outlet manhole limits flow to 28l/s.
-

Basin 5 shall have the following characteristics:

- a base area of 52m^2 and a surface area, when full, of 204.5m^2,
- Maximum depth of 1.0m,
- Side slopes of 4 horizontal to 1 vertical,
- A hydrobrake at the outlet manhole limits flow to QBAR of 14.2l/s.

Figure 8: Basin inlet/outlet with concrete surround and cobbled spillway to prevent overgrowth & erosion

It is worth noting that the basins are designed to be dry most of the time and will only hold water temporarily, during heavy rainfall events. With their shallow depths and relatively gentle side slopes it is basically a shallow depression in the green area that fills with water quite rarely and for a short period. At all other times it will be dry and can function as green open space containing planting and/or furniture that is compatible with getting wet occasionally. See examples in Figure 9.

Figure 9: Examples of detention basins by Peterborough City Council in the UK (CIRIA SuDS Manual C753)

Grassed slopes of 1:3 or less can be mowed with ride-on lawn mowers for ease of maintenance. The 1:4 side slopes are also important in terms of safety as the change of water depth is gradual rather than sudden should someone enter the basins.

4.2.2. Underdrained Roadside Swales

Traditionally storm sewers were constructed under roadways for the most part. It is proposed here to move the storm sewer into road verges where possible. It is proposed to construct

linear swales parallel with the roads and to have dropped kerbs at the adjacent road edges to allow runoff to fall evenly into the swale. Where swales are in place, the road will be constructed with a single 1:40 crossfall to allow the full surface width to drain towards that side of the road. Under the swale the sewer pipe will be perforated and the trench that the pipe is laid in will be filled with suitable filter material. Runoff from the road surface will be gathered in the shallow swale, drain down through the fill material and enter the sewer pipe having been slowed down and filtered in the process, see Figure 10.

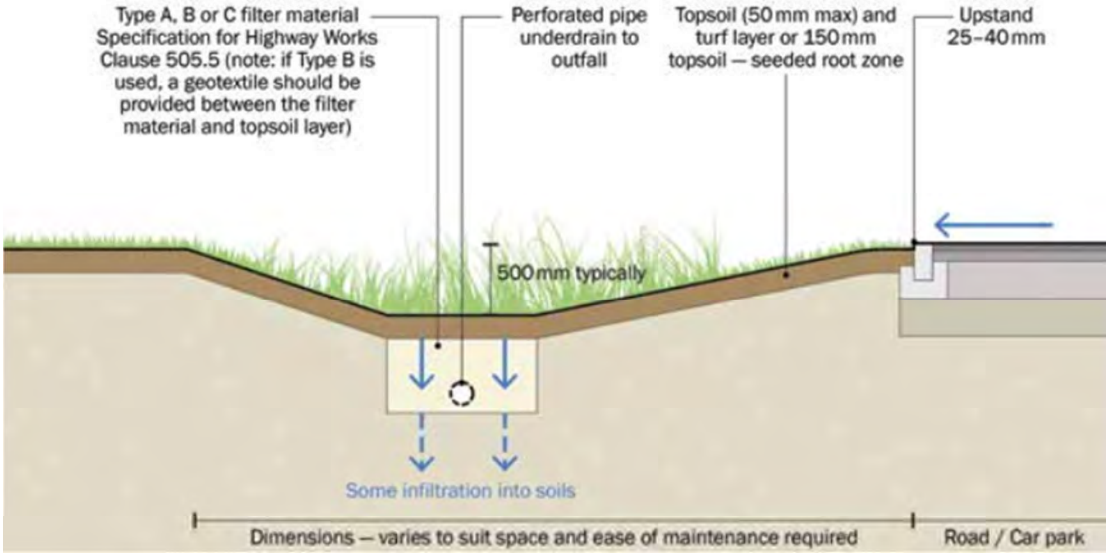


Figure 10: Underdrained Roadside Swale (CIRIA C753 SuDS Manual)

Swales shall be constructed in accordance with the guidance in the CIRIA SuDS Manual Chapter 16 and the detail on the accompanying drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504. The dimensions of the swale can be variable to suit the available space but the depth will be a maximum of 500mm and the side slopes will be at a maximum gradient of 1:3. The swales shall be set with grass and/or wildflowers which can be mown normally due to the shallow side slopes, see example in Figure 11. Where possible, the longitudinal gradient of the swale should be maintained at 1:100 or less in order to slow flows and allow full interception.

Figure 11: Example of roadside swale from the CIRIA SuDS Manual (C753)

CIRIA C753 (The SuDS Manual) Table 24.6 notes that filter swales can be considered to provide Interception when draining the runoff from impermeable surfaces, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter. The stone filled trenches also provide temporary attenuation storage as there is up to 30% voids in the filter material.

4.2.3. Permeable Paving

Permeable paving is proposed for all car parking spaces in the development. The permeable paving will allow surface water to soak into the subsoil and ground water rather than leaving the site via the sewer network which is preferable in terms of SuDS. See the accompanying WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504 for the construction details of the permeable paving, see example in Figure 12.

CIRIA C753 (The SuDS Manual) notes that studies have shown that runoff typically does not occur from permeable pavements for rainfall events of up to 5 minutes in length. The paving's substrate intercepts and stores the runoff before some of it percolates into the surrounding soil and any overflow is piped to the sewer network. The substrate shall be a minimum of 300mm deep and formed with washed, coarse, graded aggregate with 30% voids for water storage.

Figure 12: Example of permeable paving.

4.2.4. Roadside Bioretention Tree Pits

Bioretention tree pits, constructed in accordance with CIRIA SuDS Manual Chapter 19 and the detail provided in drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-504, are proposed in roadside green areas of the site where a proportion of the surface water from the hard road and footpath surfaces can be channelled towards the tree base for temporary storage and percolation to ground water. The tree pits can be placed in isolated green planters where gaps in the kerbing or kerb drains allow surface water to fall to the base of the trees as per the examples in Figure 13 or tree pits can be arranged to fill an available green space. In all cases, an overflow pipe will carry any overflow back to the sewer in heavier rainfall events. This prevents the tree's roots from being inundated for long periods, causing damage or disease.

Figure 13: Examples of tree pits in isolated green planters from the CIRIA SuDS Manual

Whilst the grass along the top of the roadside verges will most likely be mowed the local area around the base of each tree pit is to be set with a variety of planting including native wildflower grass seed mixes to promote urban biodiversity - providing habitat and food for native insects, invertebrates, and birds. This planting scheme will not be mowed regularly but

occasionally cleaned and weeded. The bioretention tree pits offer runoff interception, filtration and water storage as well as offering further benefits such as evapotranspiration, cooling of runoff in the shade and the promotion of biodiversity.

CIRIA C753 (The SuDS Manual) Table 24.6 notes that, regarding interception design of tree root system (bio retention areas), pavements drained by tree root systems can be considered to provide Interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter.

See the accompanying WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-004 for the proposed locations of the tree pits.

4.2.5. Bio-retention Rain Garden Planters

It is proposed that dwelling roofs can discharge to rain garden planters in back yards where they will provide treatment to roof runoff through evapotranspiration within the filter media of the rain garden structure. The planters will consist of small, raised gardens enclosed in robust treated timber boxes with high permeability soil and a perforated surface water drain is to be provided at a low level to drain any excess surface water to the drainage network, see diagram in Figure 14.

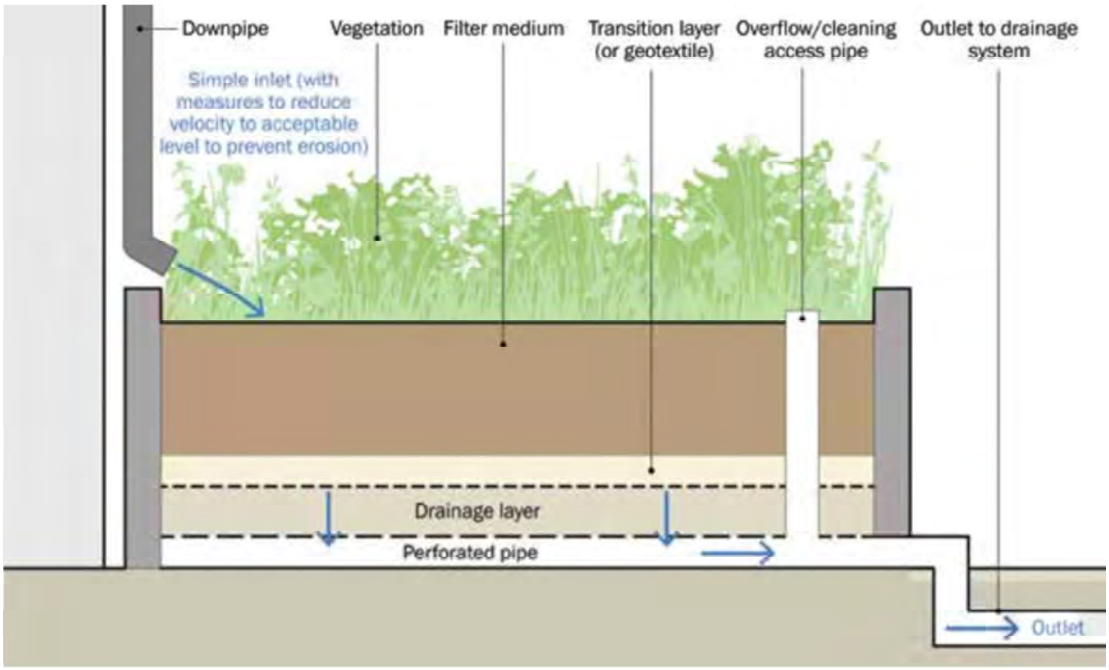


Figure 14: Section through a simple rain garden with outlet pipe (CIRIA C753)

CIRIA C753 (The SuDS Manual) Table 24.6 notes that regarding interception design of rain gardens (bio retention areas), pavements drained by rain gardens can be considered to provide Interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter.

4.2.6. Bio-retention Rain Garden Soakaways

It is proposed that some dwelling roofs can discharge to rain garden soakaway in back yards where testing has shown that the infiltration rate of the soil is suitable. The soakaways will measure approximately 1.5m x 1.5m in plan and consist of 350mm depth of 40% compost and 60% coarse sand mix to allow drainage whistle promoting plant growth, 1000mm depth of 50mm clean crushed limestone filling wrapped in Terram underneath, see diagram in Figure 15.

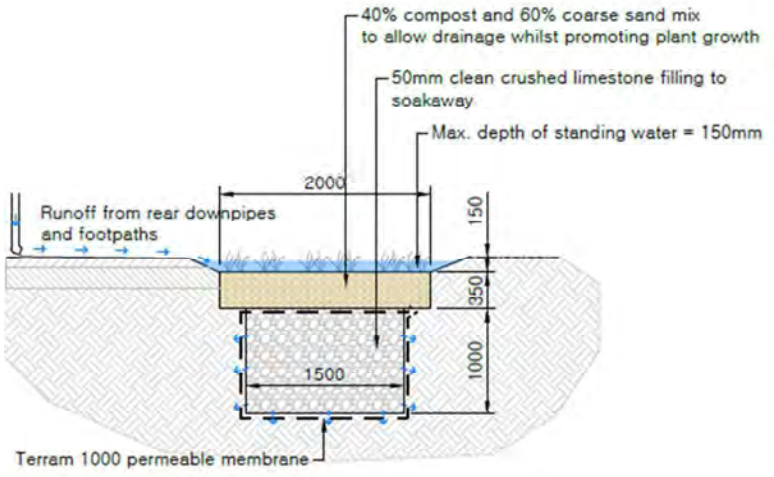


Figure 15: Section through a simple rain garden soakaway.

CIRIA C753 (The SuDS Manual) Table 24.6 notes that regarding interception design of rain gardens (bio retention areas), pavements drained by rain gardens can be considered to provide Interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter. Together with the infiltration to the soil there shall be no runoff to the surface water network from these houses. See WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-004 for soakaway locations.

4.2.7. Water Butts

It is proposed to install a 300-litre water butt to the rear of each dwelling that has a rear garden. The water butt shall be designed to collect water from the downpipes with a bypass system so that they do not overtop and flood the yard/garden. The overflows shall be connected back to the raingarden soakaways in this development. A tap on the water butt will allow the water to be used for gardening or car washing etc. and reduce demand on the local authority water supply whilst also slightly reducing the roof runoff entering the surface water sewer. See the accompanying WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-004 for an example of a water butt.

5.0 Wastewater Drainage

The layout of the proposed wastewater drainage network for the development is shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-002 and the typical details for the wastewater infrastructure are shown on drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-501. One conventional piped, gravity sewer network is proposed. The network will generally fall from the south and east to the northwest where it will connect to existing Irish Water infrastructure in the N72 to the west of the site.

All sewers within the curtilage of individual houses are to be installed in accordance with TGD Part H (2010) and will consist of 100 mm diameter uPVC Sewers from individual houses laid to falls of min 1:60 to connect to a 150mm and 225mm uPVC sewer to be laid under the estate roads. Inspection chambers will be constructed within 1m of the boundary of each private property in accordance with Irish Water Standard Details.

All wastewater sewers in the public realm have been designed in compliance with Irish Water's Code of Practice for Wastewater Infrastructure – A Design and Construction Guide for Developers (Revision 2) July 2020. All construction details within the public realm will be in accordance with Irish Water, Wastewater Infrastructure Standard Details (Revision 4), July 2020.

A pre-connection enquiry was submitted to Irish Water to assess the feasibility of providing a connection to the site and Irish Water subsequently issued a confirmation of feasibility for the development (see Appendix C). Irish Water responded to say that; *"in order to accommodate the proposed connection, upgrade works are required to increase the capacity of Mallow WWTP. Irish Water currently has a project underway which will provide the necessary upgrade and capacity. This upgrade project is scheduled to be completed by Q3 2023 (this may be subject to change) and the proposed connection could be completed as soon as possibly practicable after this date."*

5.1. Wastewater Design Criteria

For the purposes of clarity, the wastewater sewer system has been designed using the following parameters, as required in Irish Water document IW-CDS-5030-03 Section 3.6:

- Frequency of use (kDU) 0.5 (Domestic),
- Flow per person: 150 L/day,
- Average persons per household: 2.7 persons,
- Unit consumption allowance (infiltration) 10%,
- Minimum velocity for pipe running full: 0.75 m/sec,
- Peak flow: 6 DWF.

The population equivalent (PE) for the development is:

Dwellings	138 x 2.7 = 373.
Creche	42 children + 8 Staff = 50.
Total PE	423.

The detailed hydraulic design parameters and calculations for the wastewater network are included in Appendix B to this document.

6.0 Water Supply

It is proposed that a connection to the existing Irish Water infrastructure will be made in St. Joseph's Road, to the north of the Aldworth Heights entrance. The water main layout is shown on WDG drawing no. 22054-XX-XX-XX-XX-DR-WDG-CE-003 and the water main typical details are shown on drawings 22054-XX-XX-XX-XX-DR-WDG-CE-502 and 22054-XX-XX-XX-XX-DR-WDG-CE-503.

A pre-connection enquiry was submitted to Irish Water to assess the feasibility of providing a connection to the site. Irish Water issued a confirmation of feasibility for the development but stating that; *"In order to accommodate the proposed connection, approximately 500m of water network upgrades will be required to provide additional network capacity. Irish Water does not currently have any plans to undertake these works, therefore the applicant will be required to fund these local network upgrades. The fee for these works will be calculated at a connection application stage".* (see Appendix C). The upgrade is required as the existing main in St. Joseph's Road, directly outside the development, is only 100mm in diameter. A 150mm diameter main is available to the north and it is to this main that the connection must be made.

Private properties will each have a separate service connection, fitted with an Irish Water approved boundary box immediately outside the boundary. Fire hydrants are placed so that no domestic property within the development is more than 46m from a hydrant. All potable water infrastructure will be constructed in accordance with the following Irish Water documents:

- IW-CDS-5020-03 Code of Practice for Water Infrastructure – Connections and Developer Services, July 2020 (Revision 2),
- IW-CDS-5020-01 Water Infrastructure Standard Details - Connections and Developer Services, July 2020 (Revision 4).

6.1. Water Demand

The mains water demand for the development is calculated, according to Irish Water criteria, using the following parameters:

- 150 litres/person/day,
- 2.7 persons per housing unit,
- Domestic ADPW = 1.25,
- 138 Housing Units + Creche.

7.0 Utilities

7.1. Electricity

Medium voltage overhead power lines cross the development site in the northeast corner and in the south near the proposed development entrance. An NW1 form was submitted to the ESB requesting a rerouting of this infrastructure around the site to allow development.

Any works on site shall be carried out in accordance with the following ESB document:

- Safe Construction with Electricity.

7.2. Gas

Gas Networks Ireland was contacted regarding the gas supply services in the vicinity of the proposed development site. GNI responded with a map to show that there are no gas mains in the vicinity, *see* Appendix D.

Appendix A

Surface Water Design

- Surface Water Sewer Network Design (see drawing 22054-XX-XX-XX-XX-DR-WDG-CE-002 for layout)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	18.100	Minimum Backdrop Height (m)	0.650
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.033	5.00	84.920	1200	556708.015	599049.197	1.577
S2	0.007	5.00	86.032	1200	556738.161	599056.307	1.737
S3	0.015	5.00	86.247	1200	556733.973	599066.530	3.088
S4	0.069	5.00	85.600	1200	556725.413	599088.207	2.579
S5	0.129	5.00	82.081	1200	556690.098	599141.777	2.681
S6	0.112	5.00	79.630	1200	556686.678	599194.619	1.627
S7			77.397	1200	556683.563	599241.153	1.514
S8			77.190	1200	556675.264	599244.631	2.990
S9			75.994	1800	556653.311	599250.260	1.994
S10			74.750	1200	556648.960	599252.859	1.900
S11			74.201	1500	556637.073	599251.910	1.425
S12			73.800	1200	556635.978	599245.732	1.950
S13			73.180	1200	556619.497	599242.175	1.430
S14	0.076	5.00	82.600	1200	556686.498	599131.464	2.600
S15	0.028	5.00	80.750	1500	556654.371	599111.084	2.750
S16	0.009	5.00	79.020	1500	556631.266	599127.137	1.920
S17	0.108	5.00	78.200	1200	556615.387	599135.515	3.000
S18			76.300	1500	556612.768	599171.488	1.600
S19	0.082	5.00	76.164	1200	556613.543	599176.560	2.664
S20	0.082	5.00	74.450	1200	556611.474	599205.078	2.550
S22	0.010	5.00	72.750	1200	556607.949	599242.392	1.500
S23	0.010	5.00	72.600	1200	556607.082	599256.604	1.900
S24	0.038	5.00	71.700	1200	556612.756	599264.315	1.500
S25	0.230	5.00	76.811	1200	556688.806	599248.368	1.425
S26	0.019	5.00	73.677	1200	556683.512	599329.673	1.425
S27	0.006	5.00	73.311	1200	556682.668	599340.245	1.425
S28	0.024	5.00	74.400	1200	556707.870	599350.384	1.425
S29	0.047	5.00	73.196	1200	556680.632	599345.400	1.425
S30	0.021	5.00	69.420	1200	556608.332	599363.481	1.425
S31			69.120	1200	556613.845	599333.435	1.425
S32	0.020	5.00	69.500	1200	556615.687	599322.248	1.920
S33			69.800	1200	556609.777	599314.934	3.800
S34			67.195	1200	556602.711	599316.076	2.495
S35			66.171	1800	556597.028	599298.813	1.780
S36			66.169	1200	556598.941	599293.230	3.369
S37			64.258	1500	556589.041	599274.322	2.258
S38			63.593	1350	556580.050	599263.938	2.493
S39			62.313	1350	556573.689	599253.368	4.063
S40			58.818	1350	556560.898	599235.953	2.818
S41			57.288	1350	556555.315	599229.510	3.038
S42			55.569	1350	556549.056	599223.190	2.769

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S43			54.213	1350	556544.133	599219.012	3.913
S44			52.595	1350	556538.271	599214.964	2.595

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S3	31.213	0.600	83.343	83.159	0.184	169.6	225	5.52	50.0
2.000	S2	S3	11.048	0.600	84.295	84.229	0.066	167.4	225	5.18	50.0
1.001	S3	S4	23.306	0.600	83.159	83.021	0.138	168.9	225	5.91	50.0
1.002	S4	S5	64.163	0.600	83.021	80.247	2.774	23.1	225	6.30	50.0
1.003	S5	S6	52.953	0.600	79.400	78.003	1.397	37.9	225	6.71	50.0
1.004	S6	S7	46.638	0.600	78.003	75.883	2.120	22.0	300	6.94	50.0
1.005	S7	S8	8.998	0.600	75.883	75.683	0.200	45.0	300	7.01	50.0
1.006	S8	S9	22.663	0.600	74.200	74.000	0.200	113.3	300	7.26	50.0
1.007	S9	S10	5.068	0.600	74.000	73.970	0.030	168.9	300	7.33	50.0
1.008	S10	S11	11.925	0.600	72.850	72.776	0.074	161.1	300	7.49	50.0
1.009	S11	S12	6.274	0.600	72.776	72.500	0.276	22.7	300	7.53	50.0
1.010	S12	S13	16.860	0.600	71.850	71.750	0.100	168.6	300	7.76	50.0
1.011	S13	S22	11.550	0.600	71.750	71.325	0.425	27.2	300	7.82	50.0
3.000	S14	S15	38.046	0.600	80.000	79.300	0.700	54.4	225	5.36	50.0
3.001	S15	S16	28.134	0.600	78.000	77.550	0.450	62.5	225	5.64	50.0
3.002	S16	S17	17.954	0.600	77.100	76.700	0.400	44.9	300	5.77	50.0
3.003	S17	S18	36.068	0.600	75.200	74.700	0.500	72.1	300	6.09	50.0
3.004	S18	S19	5.131	0.600	74.700	74.650	0.050	102.6	300	6.15	50.0
3.005	S19	S20	28.593	0.600	73.500	72.900	0.600	47.7	300	6.36	50.0
3.006	S20	S22	37.480	0.600	71.900	71.250	0.650	57.7	300	6.66	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.001	39.8	4.5	1.352	2.863	0.033	0.0	51	0.664
2.000	1.007	40.1	0.9	1.512	1.793	0.007	0.0	24	0.424
1.001	1.003	39.9	7.5	2.863	2.354	0.055	0.0	65	0.770
1.002	2.732	108.6	16.8	2.354	1.609	0.124	0.0	59	1.992
1.003	2.131	84.7	34.3	2.456	1.402	0.253	0.0	100	2.024
1.004	3.366	237.9	49.5	1.327	1.214	0.365	0.0	92	2.675
1.005	2.350	166.1	49.5	1.214	1.207	0.365	0.0	112	2.056
1.006	1.476	104.3	49.5	2.690	1.694	0.365	0.0	146	1.458
1.007	1.207	85.3	49.5	1.694	0.480	0.365	0.0	164	1.250
1.008	1.236	87.3	49.5	1.600	1.125	0.365	0.0	162	1.273
1.009	3.311	234.1	49.5	1.125	1.000	0.365	0.0	93	2.640
1.010	1.208	85.4	49.5	1.650	1.130	0.365	0.0	164	1.250
1.011	3.027	214.0	49.5	1.130	1.125	0.365	0.0	98	2.476
3.000	1.778	70.7	10.3	2.375	1.225	0.076	0.0	58	1.274
3.001	1.657	65.9	14.1	2.525	1.245	0.104	0.0	71	1.328
3.002	2.353	166.3	15.3	1.620	1.200	0.113	0.0	61	1.488
3.003	1.853	131.0	30.0	2.700	1.300	0.221	0.0	97	1.510
3.004	1.552	109.7	30.0	1.300	1.214	0.221	0.0	107	1.329
3.005	2.283	161.4	41.1	2.364	1.250	0.303	0.0	103	1.918
3.006	2.074	146.6	52.2	2.250	1.200	0.385	0.0	123	1.904

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.012	S22	S23	14.238	0.600	71.250	70.700	0.550	25.9	300	7.90	50.0
1.013	S23	S24	9.574	0.600	70.700	70.200	0.500	19.1	300	7.94	50.0
1.014	S24	S33	50.707	0.600	70.200	68.300	1.900	26.7	300	8.22	50.0
4.000	S25	S26	81.477	0.600	75.386	72.252	3.134	26.0	225	5.53	50.0
4.001	S26	S27	10.606	0.600	72.252	71.886	0.366	29.0	225	5.60	50.0
4.002	S27	S29	5.542	0.600	71.886	71.771	0.115	48.2	225	5.65	50.0
5.000	S28	S29	27.690	0.600	72.975	71.771	1.204	23.0	225	5.17	50.0
4.003	S29	S31	67.851	0.600	71.771	67.695	4.076	16.6	225	6.00	50.0
6.000	S30	S31	30.547	0.600	67.995	67.695	0.300	101.8	225	5.39	50.0
4.004	S31	S32	11.338	0.600	67.695	67.655	0.040	283.5	300	6.20	50.0
4.005	S32	S33	9.403	0.600	67.580	67.521	0.059	159.4	300	6.33	50.0
1.015	S33	S34	7.158	0.600	66.000	65.696	0.304	23.5	300	8.26	50.0
1.016	S34	S35	18.174	0.600	64.700	64.541	0.159	114.3	375	8.43	50.0
1.017	S35	S36	5.902	0.600	64.391	64.379	0.012	491.8	525	8.53	50.0
1.018	S36	S37	21.343	0.600	62.800	62.700	0.100	213.4	525	8.77	50.0
1.019	S37	S38	13.736	0.600	62.000	61.600	0.400	34.3	375	8.84	50.0
1.020	S38	S39	12.336	0.600	61.100	60.588	0.512	24.1	375	8.89	50.0
1.021	S39	S40	21.608	0.600	58.250	57.093	1.157	18.7	375	8.98	50.0
1.022	S40	S41	8.525	0.600	56.000	55.563	0.437	19.5	375	9.02	50.0
1.023	S41	S42	8.895	0.600	54.250	53.844	0.406	21.9	375	9.05	50.0
1.024	S42	S43	6.457	0.600	52.800	52.488	0.312	20.7	375	9.08	50.0
1.025	S43	S44	7.124	0.600	50.300	50.000	0.300	23.7	375	9.11	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.012	3.102	219.3	103.0	1.200	1.600	0.760	0.0	144	3.054
1.013	3.609	255.1	104.4	1.600	1.200	0.770	0.0	133	3.432
1.014	3.055	215.9	109.5	1.200	1.200	0.808	0.0	151	3.067
4.000	2.576	102.4	31.2	1.200	1.200	0.230	0.0	85	2.266
4.001	2.439	97.0	33.7	1.200	1.200	0.249	0.0	92	2.230
4.002	1.889	75.1	34.6	1.200	1.200	0.255	0.0	107	1.848
5.000	2.740	108.9	3.3	1.200	1.200	0.024	0.0	27	1.243
4.003	3.222	128.1	44.2	1.200	1.200	0.326	0.0	91	2.933
6.000	1.295	51.5	2.8	1.200	1.200	0.021	0.0	36	0.698
4.004	0.929	65.6	47.0	1.125	1.545	0.347	0.0	188	1.007
4.005	1.243	87.8	49.7	1.620	1.979	0.367	0.0	162	1.281
1.015	3.253	230.0	159.2	3.500	1.199	1.175	0.0	184	3.503
1.016	1.694	187.1	159.2	2.120	1.255	1.175	0.0	267	1.892
1.017	1.003	217.1	159.2	1.255	1.265	1.175	0.0	335	1.091
1.018	1.529	331.0	159.2	2.844	1.033	1.175	0.0	257	1.515
1.019	3.100	342.4	159.2	1.883	1.618	1.175	0.0	180	3.048
1.020	3.704	409.1	159.2	2.118	1.350	1.175	0.0	162	3.482
1.021	4.209	464.9	159.2	3.688	1.350	1.175	0.0	151	3.832
1.022	4.118	454.8	159.2	2.443	1.350	1.175	0.0	153	3.766
1.023	3.885	429.1	159.2	2.663	1.350	1.175	0.0	158	3.607
1.024	3.998	441.5	159.2	2.394	1.350	1.175	0.0	156	3.688
1.025	3.731	412.1	159.2	3.538	2.220	1.175	0.0	161	3.501

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	31.213	169.6	225	Circular	84.920	83.343	1.352	86.247	83.159	2.863
2.000	11.048	167.4	225	Circular	86.032	84.295	1.512	86.247	84.229	1.793
1.001	23.306	168.9	225	Circular	86.247	83.159	2.863	85.600	83.021	2.354
1.002	64.163	23.1	225	Circular	85.600	83.021	2.354	82.081	80.247	1.609
1.003	52.953	37.9	225	Circular	82.081	79.400	2.456	79.630	78.003	1.402
1.004	46.638	22.0	300	Circular	79.630	78.003	1.327	77.397	75.883	1.214
1.005	8.998	45.0	300	Circular	77.397	75.883	1.214	77.190	75.683	1.207
1.006	22.663	113.3	300	Circular	77.190	74.200	2.690	75.994	74.000	1.694
1.007	5.068	168.9	300	Circular	75.994	74.000	1.694	74.750	73.970	0.480
1.008	11.925	161.1	300	Circular	74.750	72.850	1.600	74.201	72.776	1.125
1.009	6.274	22.7	300	Circular	74.201	72.776	1.125	73.800	72.500	1.000
1.010	16.860	168.6	300	Circular	73.800	71.850	1.650	73.180	71.750	1.130
1.011	11.550	27.2	300	Circular	73.180	71.750	1.130	72.750	71.325	1.125
3.000	38.046	54.4	225	Circular	82.600	80.000	2.375	80.750	79.300	1.225
3.001	28.134	62.5	225	Circular	80.750	78.000	2.525	79.020	77.550	1.245
3.002	17.954	44.9	300	Circular	79.020	77.100	1.620	78.200	76.700	1.200
3.003	36.068	72.1	300	Circular	78.200	75.200	2.700	76.300	74.700	1.300
3.004	5.131	102.6	300	Circular	76.300	74.700	1.300	76.164	74.650	1.214
3.005	28.593	47.7	300	Circular	76.164	73.500	2.364	74.450	72.900	1.250
3.006	37.480	57.7	300	Circular	74.450	71.900	2.250	72.750	71.250	1.200
1.012	14.238	25.9	300	Circular	72.750	71.250	1.200	72.600	70.700	1.600
1.013	9.574	19.1	300	Circular	72.600	70.700	1.600	71.700	70.200	1.200
1.014	50.707	26.7	300	Circular	71.700	70.200	1.200	69.800	68.300	1.200
4.000	81.477	26.0	225	Circular	76.811	75.386	1.200	73.677	72.252	1.200
4.001	10.606	29.0	225	Circular	73.677	72.252	1.200	73.311	71.886	1.200

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
2.000	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
1.001	S3	1200	Manhole	Adoptable	S4	1200	Manhole	Adoptable
1.002	S4	1200	Manhole	Adoptable	S5	1200	Manhole	Adoptable
1.003	S5	1200	Manhole	Adoptable	S6	1200	Manhole	Adoptable
1.004	S6	1200	Manhole	Adoptable	S7	1200	Manhole	Adoptable
1.005	S7	1200	Manhole	Adoptable	S8	1200	Manhole	Adoptable
1.006	S8	1200	Manhole	Adoptable	S9	1800	Manhole	Adoptable
1.007	S9	1800	Manhole	Adoptable	S10	1200	Manhole	Adoptable
1.008	S10	1200	Manhole	Adoptable	S11	1500	Manhole	Adoptable
1.009	S11	1500	Manhole	Adoptable	S12	1200	Manhole	Adoptable
1.010	S12	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
1.011	S13	1200	Manhole	Adoptable	S22	1200	Manhole	Adoptable
3.000	S14	1200	Manhole	Adoptable	S15	1500	Manhole	Adoptable
3.001	S15	1500	Manhole	Adoptable	S16	1500	Manhole	Adoptable
3.002	S16	1500	Manhole	Adoptable	S17	1200	Manhole	Adoptable
3.003	S17	1200	Manhole	Adoptable	S18	1500	Manhole	Adoptable
3.004	S18	1500	Manhole	Adoptable	S19	1200	Manhole	Adoptable
3.005	S19	1200	Manhole	Adoptable	S20	1200	Manhole	Adoptable
3.006	S20	1200	Manhole	Adoptable	S22	1200	Manhole	Adoptable
1.012	S22	1200	Manhole	Adoptable	S23	1200	Manhole	Adoptable
1.013	S23	1200	Manhole	Adoptable	S24	1200	Manhole	Adoptable
1.014	S24	1200	Manhole	Adoptable	S33	1200	Manhole	Adoptable
4.000	S25	1200	Manhole	Adoptable	S26	1200	Manhole	Adoptable
4.001	S26	1200	Manhole	Adoptable	S27	1200	Manhole	Adoptable

Pipeline Schedule

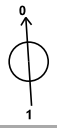
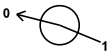
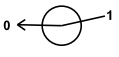
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.002	5.542	48.2	225	Circular	73.311	71.886	1.200	73.196	71.771	1.200
5.000	27.690	23.0	225	Circular	74.400	72.975	1.200	73.196	71.771	1.200
4.003	67.851	16.6	225	Circular	73.196	71.771	1.200	69.120	67.695	1.200
6.000	30.547	101.8	225	Circular	69.420	67.995	1.200	69.120	67.695	1.200
4.004	11.338	283.5	300	Circular	69.120	67.695	1.125	69.500	67.655	1.545
4.005	9.403	159.4	300	Circular	69.500	67.580	1.620	69.800	67.521	1.979
1.015	7.158	23.5	300	Circular	69.800	66.000	3.500	67.195	65.696	1.199
1.016	18.174	114.3	375	Circular	67.195	64.700	2.120	66.171	64.541	1.255
1.017	5.902	491.8	525	Circular	66.171	64.391	1.255	66.169	64.379	1.265
1.018	21.343	213.4	525	Circular	66.169	62.800	2.844	64.258	62.700	1.033
1.019	13.736	34.3	375	Circular	64.258	62.000	1.883	63.593	61.600	1.618
1.020	12.336	24.1	375	Circular	63.593	61.100	2.118	62.313	60.588	1.350
1.021	21.608	18.7	375	Circular	62.313	58.250	3.688	58.818	57.093	1.350
1.022	8.525	19.5	375	Circular	58.818	56.000	2.443	57.288	55.563	1.350
1.023	8.895	21.9	375	Circular	57.288	54.250	2.663	55.569	53.844	1.350
1.024	6.457	20.7	375	Circular	55.569	52.800	2.394	54.213	52.488	1.350
1.025	7.124	23.7	375	Circular	54.213	50.300	3.538	52.595	50.000	2.220

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.002	S27	1200	Manhole	Adoptable	S29	1200	Manhole	Adoptable
5.000	S28	1200	Manhole	Adoptable	S29	1200	Manhole	Adoptable
4.003	S29	1200	Manhole	Adoptable	S31	1200	Manhole	Adoptable
6.000	S30	1200	Manhole	Adoptable	S31	1200	Manhole	Adoptable
4.004	S31	1200	Manhole	Adoptable	S32	1200	Manhole	Adoptable
4.005	S32	1200	Manhole	Adoptable	S33	1200	Manhole	Adoptable
1.015	S33	1200	Manhole	Adoptable	S34	1200	Manhole	Adoptable
1.016	S34	1200	Manhole	Adoptable	S35	1800	Manhole	Adoptable
1.017	S35	1800	Manhole	Adoptable	S36	1200	Manhole	Adoptable
1.018	S36	1200	Manhole	Adoptable	S37	1500	Manhole	Adoptable
1.019	S37	1500	Manhole	Adoptable	S38	1350	Manhole	Adoptable
1.020	S38	1350	Manhole	Adoptable	S39	1350	Manhole	Adoptable
1.021	S39	1350	Manhole	Adoptable	S40	1350	Manhole	Adoptable
1.022	S40	1350	Manhole	Adoptable	S41	1350	Manhole	Adoptable
1.023	S41	1350	Manhole	Adoptable	S42	1350	Manhole	Adoptable
1.024	S42	1350	Manhole	Adoptable	S43	1350	Manhole	Adoptable
1.025	S43	1350	Manhole	Adoptable	S44	1350	Manhole	Adoptable

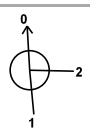
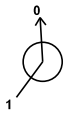
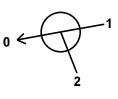
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	556708.015	599049.197	84.920	1.577	1200	 0	1.000	83.343	225
S2	556738.161	599056.307	86.032	1.737	1200	 0	2.000	84.295	225

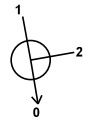
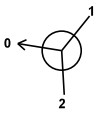
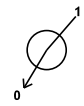
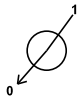
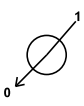
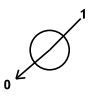
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S3	556733.973	599066.530	86.247	3.088	1200		1	2.000	84.229	225
							2	1.000	83.159	225
							0	1.001	83.159	225
S4	556725.413	599088.207	85.600	2.579	1200		1	1.001	83.021	225
							0	1.002	83.021	225
S5	556690.098	599141.777	82.081	2.681	1200		1	1.002	80.247	225
							0	1.003	79.400	225
S6	556686.678	599194.619	79.630	1.627	1200		1	1.003	78.003	225
							0	1.004	78.003	300
S7	556683.563	599241.153	77.397	1.514	1200		1	1.004	75.883	300
							0	1.005	75.883	300
S8	556675.264	599244.631	77.190	2.990	1200		1	1.005	75.683	300
							0	1.006	74.200	300
S9	556653.311	599250.260	75.994	1.994	1800		1	1.006	74.000	300
							0	1.007	74.000	300
S10	556648.960	599252.859	74.750	1.900	1200		1	1.007	73.970	300
							0	1.008	72.850	300
S11	556637.073	599251.910	74.201	1.425	1500		1	1.008	72.776	300
							0	1.009	72.776	300
S12	556635.978	599245.732	73.800	1.950	1200		1	1.009	72.500	300
							0	1.010	71.850	300
S13	556619.497	599242.175	73.180	1.430	1200		1	1.010	71.750	300
							0	1.011	71.750	300
S14	556686.498	599131.464	82.600	2.600	1200		0	3.000	80.000	225
S15	556654.371	599111.084	80.750	2.750	1500		1	3.000	79.300	225
							0	3.001	78.000	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S16	556631.266	599127.137	79.020	1.920	1500		1	3.001	77.550	225
							0	3.002	77.100	300
S17	556615.387	599135.515	78.200	3.000	1200		1	3.002	76.700	300
							0	3.003	75.200	300
S18	556612.768	599171.488	76.300	1.600	1500		1	3.003	74.700	300
							0	3.004	74.700	300
S19	556613.543	599176.560	76.164	2.664	1200		1	3.004	74.650	300
							0	3.005	73.500	300
S20	556611.474	599205.078	74.450	2.550	1200		1	3.005	72.900	300
							0	3.006	71.900	300
S22	556607.949	599242.392	72.750	1.500	1200		1	3.006	71.250	300
							2	1.011	71.325	300
							0	1.012	71.250	300
S23	556607.082	599256.604	72.600	1.900	1200		1	1.012	70.700	300
							0	1.013	70.700	300
S24	556612.756	599264.315	71.700	1.500	1200		1	1.013	70.200	300
							0	1.014	70.200	300
S25	556688.806	599248.368	76.811	1.425	1200		0	4.000	75.386	225
S26	556683.512	599329.673	73.677	1.425	1200		1	4.000	72.252	225
							0	4.001	72.252	225
S27	556682.668	599340.245	73.311	1.425	1200		1	4.001	71.886	225
							0	4.002	71.886	225
S28	556707.870	599350.384	74.400	1.425	1200		0	5.000	72.975	225
S29	556680.632	599345.400	73.196	1.425	1200		1	5.000	71.771	225
							2	4.002	71.771	225
							0	4.003	71.771	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S30	556608.332	599363.481	69.420	1.425	1200		0	6.000	67.995	225
S31	556613.845	599333.435	69.120	1.425	1200		1	6.000	67.695	225
							2	4.003	67.695	225
							0	4.004	67.695	300
S32	556615.687	599322.248	69.500	1.920	1200		1	4.004	67.655	300
							0	4.005	67.580	300
S33	556609.777	599314.934	69.800	3.800	1200		1	4.005	67.521	300
							2	1.014	68.300	300
							0	1.015	66.000	300
S34	556602.711	599316.076	67.195	2.495	1200		1	1.015	65.696	300
							0	1.016	64.700	375
S35	556597.028	599298.813	66.171	1.780	1800		1	1.016	64.541	375
							0	1.017	64.391	525
S36	556598.941	599293.230	66.169	3.369	1200		1	1.017	64.379	525
							0	1.018	62.800	525
S37	556589.041	599274.322	64.258	2.258	1500		1	1.018	62.700	525
							0	1.019	62.000	375
S38	556580.050	599263.938	63.593	2.493	1350		1	1.019	61.600	375
							0	1.020	61.100	375
S39	556573.689	599253.368	62.313	4.063	1350		1	1.020	60.588	375
							0	1.021	58.250	375
S40	556560.898	599235.953	58.818	2.818	1350		1	1.021	57.093	375
							0	1.022	56.000	375
S41	556555.315	599229.510	57.288	3.038	1350		1	1.022	55.563	375
							0	1.023	54.250	375
S42	556549.056	599223.190	55.569	2.769	1350		1	1.023	53.844	375
							0	1.024	52.800	375

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S43	556544.133	599219.012	54.213	3.913	1350	1	1.024	52.488	375
						0	1.025	50.300	375
S44	556538.271	599214.964	52.595	2.595	1350	1	1.025	50.000	375

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	18.100	Drain Down Time (mins)	800
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node S27 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	71.886	Product Number	CTL-SHE-0101-5000-1300-5000
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node S9 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.800	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	45.0		
Invert Level (m)	74.000	Diameter (m)	0.145		

Node S11 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.200	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	17.0		
Invert Level (m)	72.776	Diameter (m)	0.135		

Node S13 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	71.750	Product Number	CTL-SHE-0117-6500-1200-6500
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.5	Min Node Diameter (mm)	1200

Node S35 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	64.391	Product Number	CTL-SHE-0222-2800-1600-2800
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	28.0	Min Node Diameter (mm)	1800

Node S37 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	62.000	Product Number	CTL-SHE-0155-1420-2050-1420
Design Depth (m)	2.050	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	14.2	Min Node Diameter (mm)	1500

Node S27 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.04000	Safety Factor	2.0	Invert Level (m)	71.886
Side Inf Coefficient (m/hr)	0.04000	Porosity	1.00	Time to half empty (mins)	148

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	75.0	1.200	75.0	75.0	1.201	0.0	75.0

Node S9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Safety Factor	2.0	Invert Level (m)	74.940
Side Inf Coefficient (m/hr)	0.37000	Porosity	1.00	Time to half empty (mins)	10

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	6.7	6.7	0.800	68.2	68.2	0.801	0.0	68.2

Node S11 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Safety Factor	2.0	Invert Level (m)	73.000
Side Inf Coefficient (m/hr)	0.37000	Porosity	1.00	Time to half empty (mins)	19

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2.7	2.7	0.800	53.5	53.5	0.801	0.0	53.5

Node S13 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Safety Factor	2.0	Invert Level (m)	72.000
Side Inf Coefficient (m/hr)	0.37000	Porosity	1.00	Time to half empty (mins)	76

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	41.0	41.0	0.800	145.8	145.8	0.801	0.0	145.8

Node S35 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.25000	Safety Factor	2.0	Invert Level (m)	65.000
Side Inf Coefficient (m/hr)	0.25000	Porosity	1.00	Time to half empty (mins)	59

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	50.0	1.000	200.5	200.5	1.001	0.0	200.5

Node S37 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.25000	Safety Factor	2.0	Invert Level (m)	63.050
Side Inf Coefficient (m/hr)	0.25000	Porosity	1.00	Time to half empty (mins)	210

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	52.0	52.0	1.000	204.5	204.5	1.001	0.0	204.5

Node S15 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.05000	Porosity	0.30	Link	3.000
Side Inf Coefficient (m/hr)	0.05000	Invert Level (m)	79.300	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S16 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.28200	Porosity	0.30	Link	3.001
Side Inf Coefficient (m/hr)	0.28200	Invert Level (m)	77.550	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S18 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.40000	Porosity	0.30	Link	3.003
Side Inf Coefficient (m/hr)	0.40000	Invert Level (m)	74.700	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S22 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Porosity	0.30	Link	3.006
Side Inf Coefficient (m/hr)	0.37000	Invert Level (m)	71.250	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S23 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Porosity	0.30	Link	1.012
Side Inf Coefficient (m/hr)	0.37000	Invert Level (m)	70.700	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S24 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.37000	Porosity	0.30	Link	1.013
Side Inf Coefficient (m/hr)	0.37000	Invert Level (m)	70.200	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S33 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.20000	Porosity	0.30	Link	1.014
Side Inf Coefficient (m/hr)	0.20000	Invert Level (m)	68.300	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S34 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.20000	Porosity	0.30	Link	1.015
Side Inf Coefficient (m/hr)	0.20000	Invert Level (m)	65.696	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S29 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.05000	Porosity	0.30	Link	5.000
Side Inf Coefficient (m/hr)	0.05000	Invert Level (m)	71.771	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S31 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.17000	Porosity	0.30	Link	4.003
Side Inf Coefficient (m/hr)	0.17000	Invert Level (m)	67.695	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Node S31 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.26000	Porosity	0.30	Link	6.000
Side Inf Coefficient (m/hr)	0.26000	Invert Level (m)	67.695	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	900

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	83.396	0.053	5.1	0.0825	0.0000	OK
15 minute winter	S2	10	84.320	0.025	1.1	0.0308	0.0000	OK
15 minute winter	S3	11	83.230	0.071	8.3	0.0877	0.0000	OK
15 minute winter	S4	11	83.084	0.063	18.6	0.1051	0.0000	OK
15 minute winter	S5	11	79.508	0.108	37.4	0.2267	0.0000	OK
15 minute winter	S6	11	78.099	0.096	53.9	0.2418	0.0000	OK
15 minute winter	S7	11	76.018	0.135	54.0	0.1524	0.0000	OK
15 minute winter	S8	12	75.046	0.846	54.1	0.9570	0.0000	SURCHARGED
15 minute winter	S9	13	75.005	1.005	50.5	3.1611	0.0000	SURCHARGED
15 minute winter	S10	16	73.368	0.518	42.4	0.5856	0.0000	SURCHARGED
15 minute winter	S11	17	73.356	0.580	41.5	6.0137	0.0000	SURCHARGED
60 minute winter	S12	53	72.299	0.449	24.6	0.5083	0.0000	SURCHARGED
60 minute winter	S13	53	72.299	0.549	24.3	18.7226	0.0000	SURCHARGED
15 minute winter	S14	10	80.062	0.062	11.8	0.1069	0.0000	OK
15 minute winter	S15	11	78.077	0.077	15.8	0.1509	0.0000	OK
15 minute winter	S16	11	77.167	0.067	17.0	0.1251	0.0000	OK
15 minute winter	S17	10	75.302	0.102	33.1	0.1892	0.0000	OK
15 minute winter	S18	11	74.828	0.128	33.0	0.3475	0.0000	OK
15 minute winter	S19	11	73.612	0.112	44.3	0.1958	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S3	5.0	0.562	0.125	0.2795	
15 minute winter	S2	2.000	S3	1.0	0.432	0.026	0.0267	
15 minute winter	S3	1.001	S4	8.2	0.829	0.207	0.2319	
15 minute winter	S4	1.002	S5	18.4	2.035	0.169	0.5788	
15 minute winter	S5	1.003	S6	37.4	2.130	0.441	0.9301	
15 minute winter	S6	1.004	S7	54.0	2.172	0.227	1.1706	
15 minute winter	S7	1.005	S8	54.1	1.934	0.326	0.2520	
15 minute winter	S8	1.006	S9	50.5	0.827	0.484	1.5959	
15 minute winter	S9	Orifice	S10	42.4				
15 minute winter	S9	Infiltration		0.4				
15 minute winter	S10	1.008	S11	41.5	0.635	0.475	0.8398	
15 minute winter	S11	Orifice	S12	27.2				
15 minute winter	S11	Infiltration		1.2				
60 minute winter	S12	1.010	S13	24.3	0.563	0.285	1.1873	
60 minute winter	S13	Hydro-Brake®	S22	6.5				
60 minute winter	S13	Infiltration		3.9				
15 minute winter	S14	3.000	S15	11.5	1.303	0.162	0.3350	
15 minute winter	S15	3.001	S16	15.7	1.345	0.238	0.3281	
15 minute winter	S15	Infiltration		0.0				
15 minute winter	S16	3.002	S17	17.1	1.496	0.103	0.2050	
15 minute winter	S16	Infiltration		0.0				
15 minute winter	S17	3.003	S18	33.0	1.338	0.252	0.8990	
15 minute winter	S18	3.004	S19	32.4	1.240	0.296	0.1344	
15 minute winter	S18	Infiltration		0.6				
15 minute winter	S19	3.005	S20	44.4	1.914	0.275	0.6634	

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S20	11	72.035	0.135	56.3	0.2399	0.0000	OK
15 minute winter	S22	11	71.371	0.121	64.3	0.2384	0.0000	OK
15 minute winter	S23	11	70.814	0.114	65.3	0.1758	0.0000	OK
15 minute winter	S24	11	70.320	0.120	70.5	0.2252	0.0000	OK
15 minute winter	S25	10	75.476	0.090	35.6	0.3928	0.0000	OK
15 minute winter	S26	10	72.362	0.110	37.8	0.1536	0.0000	OK
120 minute winter	S27	88	72.164	0.278	14.4	21.1591	0.0000	SURCHARGED
15 minute winter	S28	10	73.003	0.028	3.7	0.0414	0.0000	OK
15 minute winter	S29	11	71.821	0.050	14.2	0.0965	0.0000	OK
15 minute winter	S30	10	68.033	0.038	3.2	0.0535	0.0000	OK
15 minute winter	S31	12	67.801	0.106	17.2	0.2638	0.0000	OK
15 minute winter	S32	12	67.680	0.100	18.3	0.1340	0.0000	OK
15 minute winter	S33	12	66.156	0.156	87.2	0.1761	0.0000	OK
30 minute winter	S34	27	65.280	0.580	75.8	0.6557	0.0000	SURCHARGED
30 minute winter	S35	28	65.274	0.883	75.2	21.6644	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S20	3.006	S22	56.4	1.969	0.385	1.0741	
15 minute winter	S22	1.012	S23	63.8	2.495	0.291	0.3640	
15 minute winter	S22	Infiltration		0.5				
15 minute winter	S23	1.013	S24	65.0	2.550	0.255	0.2441	
15 minute winter	S23	Infiltration		0.2				
15 minute winter	S24	1.014	S33	69.6	2.702	0.322	1.3070	
15 minute winter	S24	Infiltration		0.1				
15 minute winter	S25	4.000	S26	34.9	2.065	0.341	1.3882	
15 minute winter	S26	4.001	S27	38.2	2.518	0.393	0.2311	
120 minute winter	S27	Hydro-Brake®	S29	4.9				
120 minute winter	S27	Infiltration		0.4				
15 minute winter	S28	5.000	S29	3.7	0.835	0.034	0.1298	
15 minute winter	S29	4.003	S31	14.1	1.216	0.110	0.8369	
15 minute winter	S29	Infiltration		0.0				
15 minute winter	S30	6.000	S31	3.1	0.387	0.061	0.3396	
15 minute winter	S31	4.004	S32	15.9	0.768	0.242	0.2348	
15 minute winter	S31	Infiltration		0.1				
15 minute winter	S31	Infiltration		0.4				
15 minute winter	S32	4.005	S33	18.4	0.945	0.209	0.1828	
15 minute winter	S33	1.015	S34	87.4	2.678	0.380	0.2337	
15 minute winter	S33	Infiltration		0.0				
30 minute winter	S34	1.016	S35	75.2	1.161	0.402	2.0045	
30 minute winter	S34	Infiltration		0.0				
30 minute winter	S35	Hydro-Brake®	S36	28.0				
30 minute winter	S35	Infiltration		3.0				

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	S36	180	63.549	0.749	28.0	0.8471	0.0000	SURCHARGED
240 minute winter	S37	180	63.549	1.549	27.9	47.6443	0.0000	SURCHARGED
480 minute winter	S38	192	61.150	0.050	14.2	0.0709	0.0000	OK
480 minute winter	S39	192	58.296	0.046	14.2	0.0654	0.0000	OK
480 minute winter	S40	192	56.048	0.048	14.2	0.0683	0.0000	OK
480 minute winter	S41	192	54.299	0.049	14.2	0.0702	0.0000	OK
720 minute summer	S42	330	52.849	0.049	14.2	0.0706	0.0000	OK
720 minute summer	S43	330	50.351	0.051	14.2	0.0726	0.0000	OK
720 minute summer	S44	330	50.047	0.047	14.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	S36	1.018	S37	27.9	0.803	0.084	4.6108	
240 minute winter	S37	Hydro-Brake®	S38	14.2				
240 minute winter	S37	Infiltration		4.3				
480 minute winter	S38	1.020	S39	14.2	1.710	0.035	0.1024	
480 minute winter	S39	1.021	S40	14.2	1.894	0.031	0.1620	
480 minute winter	S40	1.022	S41	14.2	1.819	0.031	0.0665	
480 minute winter	S41	1.023	S42	14.2	1.749	0.033	0.0722	
720 minute summer	S42	1.024	S43	14.2	1.759	0.032	0.0521	
720 minute summer	S43	1.025	S44	14.2	1.683	0.034	0.0602	261.5

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	83.424	0.081	11.4	0.1252	0.0000	OK
15 minute winter	S2	10	84.333	0.038	2.4	0.0460	0.0000	OK
15 minute winter	S3	11	83.270	0.111	18.7	0.1369	0.0000	OK
15 minute winter	S4	11	83.119	0.098	41.8	0.1626	0.0000	OK
15 minute winter	S5	11	79.606	0.206	84.6	0.4320	0.0000	OK
15 minute winter	S6	11	78.153	0.150	120.5	0.3756	0.0000	OK
15 minute winter	S7	11	76.117	0.234	120.6	0.2650	0.0000	OK
15 minute winter	S8	12	75.733	1.533	120.9	1.7333	0.0000	SURCHARGED
15 minute winter	S9	15	75.525	1.525	119.0	20.9706	0.0000	SURCHARGED
30 minute winter	S10	34	73.755	0.905	52.6	1.0231	0.0000	SURCHARGED
30 minute winter	S11	35	73.729	0.953	52.0	20.5314	0.0000	SURCHARGED
120 minute winter	S12	100	72.676	0.826	32.6	0.9342	0.0000	SURCHARGED
120 minute winter	S13	102	72.674	0.924	32.3	58.3979	0.0000	SURCHARGED
15 minute winter	S14	10	80.096	0.096	26.1	0.1651	0.0000	OK
15 minute winter	S15	10	78.121	0.121	35.1	0.2393	0.0000	OK
15 minute winter	S16	11	77.203	0.103	37.7	0.1921	0.0000	OK
15 minute winter	S17	10	75.366	0.166	74.2	0.3075	0.0000	OK
15 minute winter	S18	11	74.912	0.212	73.6	0.6902	0.0000	OK
15 minute winter	S19	11	73.684	0.184	99.5	0.3210	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S3	11.2	0.692	0.281	0.5045	
15 minute winter	S2	2.000	S3	2.4	0.546	0.059	0.0476	
15 minute winter	S3	1.001	S4	18.5	1.025	0.464	0.4207	
15 minute winter	S4	1.002	S5	41.3	2.536	0.380	1.0448	
15 minute winter	S5	1.003	S6	83.9	2.531	0.990	1.7536	
15 minute winter	S6	1.004	S7	120.6	2.557	0.507	2.1961	
15 minute winter	S7	1.005	S8	120.9	2.283	0.728	0.4741	
15 minute winter	S8	1.006	S9	119.0	1.690	1.140	1.5959	
15 minute winter	S9	Orifice	S10	52.9				
15 minute winter	S9	Infiltration		2.6				
30 minute winter	S10	1.008	S11	52.0	0.739	0.596	0.8398	
30 minute winter	S11	Orifice	S12	35.8				
30 minute winter	S11	Infiltration		2.5				
120 minute winter	S12	1.010	S13	32.3	0.551	0.379	1.1873	
120 minute winter	S13	Hydro-Brake®	S22	6.5				
120 minute winter	S13	Infiltration		6.6				
15 minute winter	S14	3.000	S15	25.5	1.614	0.361	0.6020	
15 minute winter	S15	3.001	S16	34.8	1.645	0.528	0.5945	
15 minute winter	S15	Infiltration		0.0				
15 minute winter	S16	3.002	S17	37.9	1.849	0.228	0.3684	
15 minute winter	S16	Infiltration		0.0				
15 minute winter	S17	3.003	S18	73.6	1.596	0.562	1.6733	
15 minute winter	S18	3.004	S19	72.9	1.510	0.664	0.2471	
15 minute winter	S18	Infiltration		1.1				
15 minute winter	S19	3.005	S20	99.8	2.320	0.619	1.2304	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S20	11	72.135	0.235	126.4	0.4167	0.0000	OK
15 minute winter	S22	11	71.447	0.197	136.5	0.4658	0.0000	OK
15 minute winter	S23	11	70.888	0.188	138.9	0.3225	0.0000	OK
15 minute winter	S24	11	70.393	0.193	150.8	0.3857	0.0000	OK
15 minute winter	S25	10	75.532	0.146	79.1	0.6348	0.0000	OK
120 minute winter	S26	114	72.628	0.376	29.7	0.5256	0.0000	SURCHARGED
120 minute winter	S27	116	72.627	0.741	29.6	56.4556	0.0000	SURCHARGED
15 minute winter	S28	10	73.017	0.042	8.3	0.0612	0.0000	OK
15 minute winter	S29	10	71.843	0.072	29.1	0.1421	0.0000	OK
15 minute winter	S30	10	68.051	0.056	7.2	0.0799	0.0000	OK
15 minute winter	S31	11	67.857	0.162	35.6	0.5138	0.0000	OK
15 minute winter	S32	11	67.737	0.157	40.2	0.2101	0.0000	OK
15 minute winter	S33	11	66.346	0.346	189.6	0.3912	0.0000	SURCHARGED
60 minute winter	S34	50	65.755	1.055	112.5	1.2023	0.0000	SURCHARGED
60 minute winter	S35	52	65.749	1.358	111.7	83.0639	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S20	3.006	S22	126.8	2.339	0.865	2.0257	
15 minute winter	S22	1.012	S23	135.7	2.843	0.619	0.6796	
15 minute winter	S22	Infiltration		0.8				
15 minute winter	S23	1.013	S24	138.5	2.933	0.543	0.4521	
15 minute winter	S23	Infiltration		0.3				
15 minute winter	S24	1.014	S33	149.6	3.233	0.693	2.3454	
15 minute winter	S24	Infiltration		0.3				
15 minute winter	S25	4.000	S26	77.8	2.426	0.760	2.6539	
120 minute winter	S26	4.001	S27	28.9	1.790	0.298	0.4218	
120 minute winter	S27	Hydro-Brake®	S29	5.0				
120 minute winter	S27	Infiltration		0.4				
15 minute winter	S28	5.000	S29	8.2	1.047	0.075	0.2211	
15 minute winter	S29	4.003	S31	28.5	1.469	0.223	1.4046	
15 minute winter	S29	Infiltration		0.0				
15 minute winter	S30	6.000	S31	7.1	0.455	0.137	0.5825	
15 minute winter	S31	4.004	S32	33.7	0.946	0.514	0.4042	
15 minute winter	S31	Infiltration		0.1				
15 minute winter	S31	Infiltration		0.7				
15 minute winter	S32	4.005	S33	40.1	1.151	0.456	0.3273	
15 minute winter	S33	1.015	S34	187.9	3.000	0.817	0.4342	
15 minute winter	S33	Infiltration		0.0				
60 minute winter	S34	1.016	S35	111.7	1.169	0.597	2.0045	
60 minute winter	S34	Infiltration		0.0				
60 minute winter	S35	Hydro-Brake®	S36	28.0				
60 minute winter	S35	Infiltration		5.6				

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	S36	420	63.915	1.115	28.0	1.2614	0.0000	SURCHARGED
600 minute winter	S37	420	63.915	1.915	27.9	105.3889	0.0000	SURCHARGED
960 minute summer	S38	390	61.150	0.050	14.2	0.0709	0.0000	OK
960 minute summer	S39	390	58.296	0.046	14.2	0.0654	0.0000	OK
960 minute summer	S40	390	56.048	0.048	14.2	0.0683	0.0000	OK
960 minute winter	S41	345	54.299	0.049	14.2	0.0702	0.0000	OK
960 minute winter	S42	345	52.849	0.049	14.2	0.0706	0.0000	OK
960 minute winter	S43	345	50.351	0.051	14.2	0.0726	0.0000	OK
960 minute winter	S44	345	50.047	0.047	14.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	S36	1.018	S37	27.9	0.784	0.084	4.6108	
600 minute winter	S37	Hydro-Brake®	S38	14.2				
600 minute winter	S37	Infiltration		6.3				
960 minute summer	S38	1.020	S39	14.2	1.710	0.035	0.1024	
960 minute summer	S39	1.021	S40	14.2	1.894	0.031	0.1620	
960 minute summer	S40	1.022	S41	14.2	1.819	0.031	0.0665	
960 minute winter	S41	1.023	S42	14.2	1.749	0.033	0.0722	
960 minute winter	S42	1.024	S43	14.2	1.759	0.032	0.0521	
960 minute winter	S43	1.025	S44	14.2	1.683	0.034	0.0602	543.1

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	83.436	0.093	14.8	0.1443	0.0000	OK
15 minute winter	S2	10	84.338	0.043	3.1	0.0522	0.0000	OK
15 minute winter	S3	11	83.289	0.130	24.2	0.1601	0.0000	OK
15 minute winter	S4	11	83.135	0.114	54.4	0.1895	0.0000	OK
15 minute winter	S5	12	80.362	0.962	110.2	2.0135	0.0000	SURCHARGED
15 minute winter	S6	11	78.168	0.165	142.7	0.4150	0.0000	OK
15 minute winter	S7	13	76.196	0.313	142.3	0.3540	0.0000	SURCHARGED
15 minute winter	S8	13	75.999	1.799	140.4	2.0350	0.0000	SURCHARGED
30 minute winter	S9	24	75.734	1.734	119.9	34.0000	0.0000	FLOOD RISK
60 minute winter	S10	51	74.209	1.359	54.0	1.5373	0.0000	SURCHARGED
60 minute winter	S11	51	74.176	1.400	53.6	24.9821	0.0000	FLOOD RISK
120 minute winter	S12	106	73.173	1.323	36.7	1.4964	0.0000	SURCHARGED
120 minute winter	S13	106	73.169	1.419	36.5	76.4184	0.0000	FLOOD RISK
15 minute winter	S14	10	80.112	0.112	34.0	0.1930	0.0000	OK
15 minute winter	S15	10	78.145	0.145	45.8	0.2855	0.0000	OK
15 minute winter	S16	11	77.220	0.120	49.0	0.2233	0.0000	OK
15 minute winter	S17	10	75.401	0.201	96.6	0.3727	0.0000	OK
15 minute winter	S18	11	74.958	0.258	95.7	0.9259	0.0000	OK
15 minute winter	S19	11	73.724	0.224	129.2	0.3910	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	1.000	S3	14.5	0.739	0.365	0.6133	
15 minute winter	S2	2.000	S3	3.0	0.585	0.075	0.0570	
15 minute winter	S3	1.001	S4	23.9	1.088	0.600	0.5122	
15 minute winter	S4	1.002	S5	53.7	2.710	0.495	1.2721	
15 minute winter	S5	1.003	S6	97.0	2.555	1.145	1.8818	
15 minute winter	S6	1.004	S7	142.3	2.600	0.598	2.5459	
15 minute winter	S7	1.005	S8	140.4	2.310	0.845	0.6336	
15 minute winter	S8	1.006	S9	137.6	1.954	1.319	1.5959	
30 minute winter	S9	Orifice	S10	56.6				
30 minute winter	S9	Infiltration		3.5				
60 minute winter	S10	1.008	S11	53.6	0.761	0.614	0.8398	
60 minute winter	S11	Orifice	S12	43.9				
60 minute winter	S11	Infiltration		2.7				
120 minute winter	S12	1.010	S13	36.5	0.518	0.428	1.1873	
120 minute winter	S13	Hydro-Brake®	S22	7.0				
120 minute winter	S13	Infiltration		7.5				
15 minute winter	S14	3.000	S15	33.3	1.724	0.471	0.7347	
15 minute winter	S15	3.001	S16	45.2	1.741	0.687	0.7307	
15 minute winter	S15	Infiltration		0.0				
15 minute winter	S16	3.002	S17	49.4	1.977	0.297	0.4487	
15 minute winter	S16	Infiltration		0.0				
15 minute winter	S17	3.003	S18	95.7	1.679	0.731	2.0619	
15 minute winter	S18	3.004	S19	94.7	1.599	0.864	0.3019	
15 minute winter	S18	Infiltration		1.4				
15 minute winter	S19	3.005	S20	129.6	2.431	0.803	1.5230	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S20	11	72.477	0.577	164.1	1.0237	0.0000	SURCHARGED
15 minute winter	S22	11	71.487	0.237	171.7	0.6135	0.0000	OK
15 minute winter	S23	12	70.926	0.226	173.1	0.4066	0.0000	OK
15 minute winter	S24	12	70.431	0.231	187.6	0.4770	0.0000	OK
15 minute winter	S25	11	75.567	0.181	102.9	0.7904	0.0000	OK
180 minute winter	S26	168	72.925	0.673	28.7	0.9405	0.0000	SURCHARGED
180 minute winter	S27	168	72.923	1.037	27.8	79.0655	0.0000	SURCHARGED
15 minute winter	S28	10	73.022	0.047	10.7	0.0694	0.0000	OK
15 minute winter	S29	10	71.852	0.081	36.5	0.1621	0.0000	OK
15 minute winter	S30	10	68.059	0.064	9.4	0.0914	0.0000	OK
15 minute winter	S31	11	67.882	0.187	45.2	0.6556	0.0000	OK
15 minute winter	S32	11	67.763	0.183	51.4	0.2452	0.0000	OK
15 minute winter	S33	12	66.617	0.617	237.5	0.6976	0.0000	SURCHARGED
60 minute winter	S34	52	65.952	1.252	142.5	1.5653	0.0000	SURCHARGED
60 minute winter	S35	54	65.944	1.553	141.5	118.1569	0.0000	FLOOD RISK

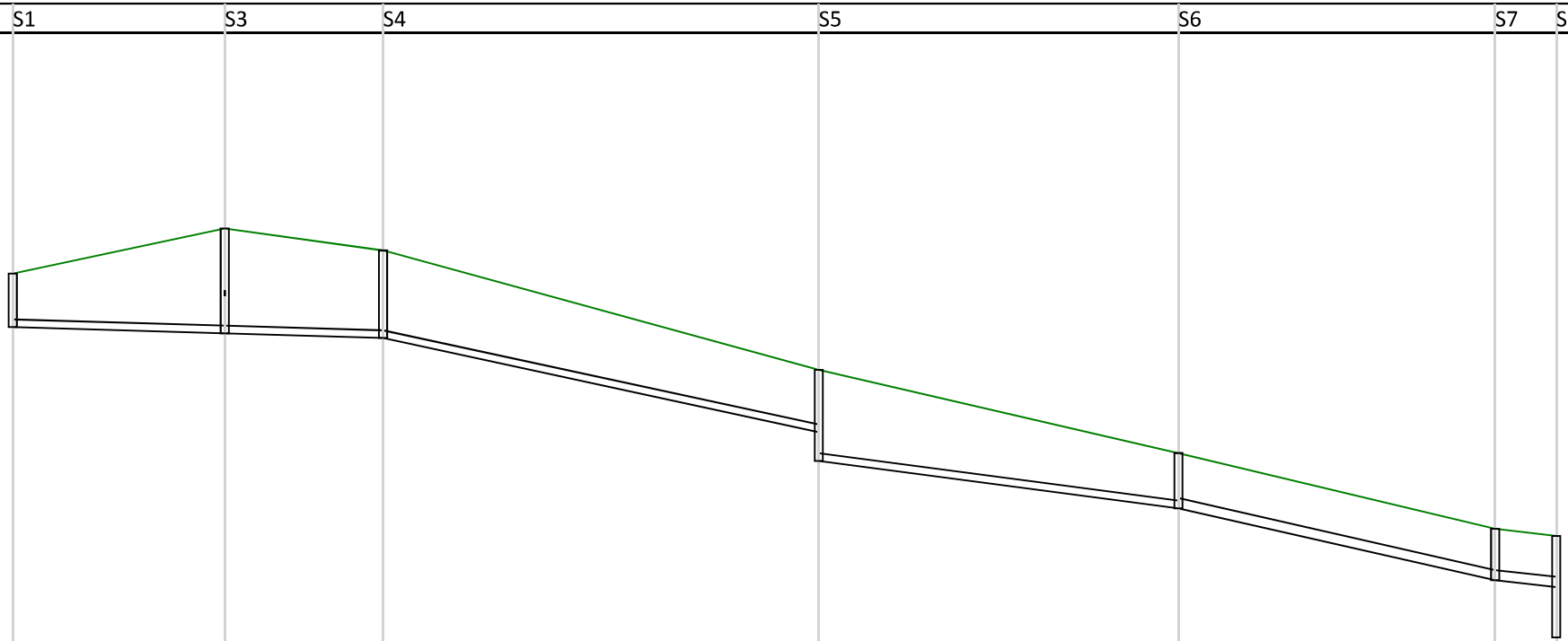
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S20	3.006	S22	161.0	2.336	1.098	2.4378	
15 minute winter	S22	1.012	S23	169.0	2.911	0.771	0.8283	
15 minute winter	S22	Infiltration		1.0				
15 minute winter	S23	1.013	S24	173.1	3.014	0.679	0.5505	
15 minute winter	S23	Infiltration		0.4				
15 minute winter	S24	1.014	S33	188.1	3.361	0.871	2.8370	
15 minute winter	S24	Infiltration		0.3				
15 minute winter	S25	4.000	S26	99.9	2.557	0.975	3.0173	
180 minute winter	S26	4.001	S27	27.1	1.709	0.279	0.4218	
180 minute winter	S27	Hydro-Brake®	S29	5.0				
180 minute winter	S27	Infiltration		0.4				
15 minute winter	S28	5.000	S29	10.6	1.138	0.097	0.2621	
15 minute winter	S29	4.003	S31	35.9	1.540	0.280	1.6308	
15 minute winter	S29	Infiltration		0.0				
15 minute winter	S30	6.000	S31	9.2	0.481	0.179	0.6788	
15 minute winter	S31	4.004	S32	43.0	1.017	0.656	0.4795	
15 minute winter	S31	Infiltration		0.1				
15 minute winter	S31	Infiltration		0.8				
15 minute winter	S32	4.005	S33	51.4	1.222	0.585	0.3951	
15 minute winter	S33	1.015	S34	238.2	3.383	1.036	0.5040	
15 minute winter	S33	Infiltration		0.0				
60 minute winter	S34	1.016	S35	141.5	1.283	0.756	2.0045	
60 minute winter	S34	Infiltration		0.2				
60 minute winter	S35	Hydro-Brake®	S36	28.0				
60 minute winter	S35	Infiltration		6.7				

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.49%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	S36	630	64.033	1.233	28.0	1.3940	0.0000	SURCHARGED
960 minute winter	S37	630	64.032	2.032	28.0	128.1852	0.0000	FLOOD RISK
360 minute winter	S38	88	61.150	0.050	14.2	0.0709	0.0000	OK
360 minute winter	S39	88	58.296	0.046	14.2	0.0654	0.0000	OK
360 minute winter	S40	88	56.048	0.048	14.2	0.0683	0.0000	OK
360 minute winter	S41	88	54.299	0.049	14.2	0.0702	0.0000	OK
360 minute winter	S42	88	52.849	0.049	14.2	0.0706	0.0000	OK
240 minute winter	S43	36	50.351	0.051	14.2	0.0726	0.0000	OK
240 minute winter	S44	36	50.047	0.047	14.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	S36	1.018	S37	28.0	0.778	0.084	4.6108	
960 minute winter	S37	Hydro-Brake®	S38	14.2				
960 minute winter	S37	Infiltration		7.0				
360 minute winter	S38	1.020	S39	14.2	1.710	0.035	0.1024	
360 minute winter	S39	1.021	S40	14.2	1.894	0.031	0.1620	
360 minute winter	S40	1.022	S41	14.2	1.819	0.031	0.0665	
360 minute winter	S41	1.023	S42	14.2	1.749	0.033	0.0722	
360 minute winter	S42	1.024	S43	14.2	1.759	0.032	0.0521	
240 minute winter	S43	1.025	S44	14.2	1.683	0.034	0.0601	357.8

CAUSEWAY	Walsh Design Group The Mall, Maryborough Woods, Douglas, Cork	File: Mallow_Site_Model_05.pfd Network: IR 10/07/2024	Page 1 Residential Development Ard an Ghleanna, Mallow Co. Cork

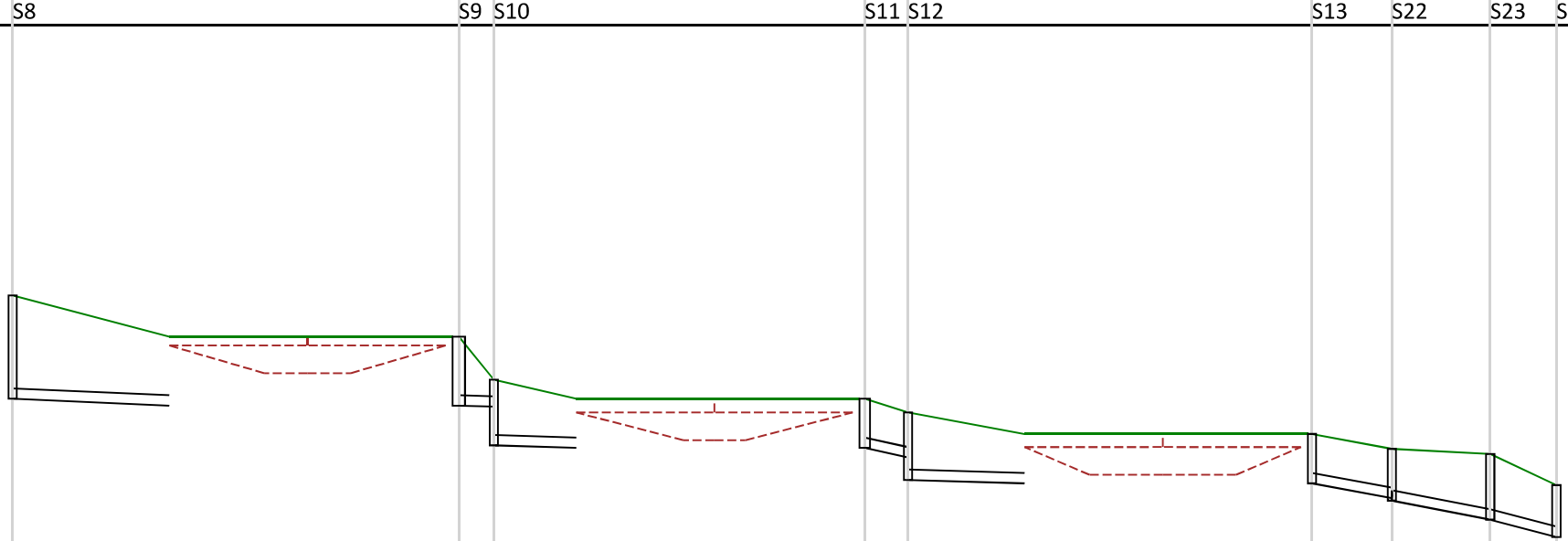


A4 drawing

Hor Scale 1000
Ver Scale 200

Datum (m) 69.000

Node Name	S1	S3	S4	S5	S6	S7	S8
Link Name	1.000	1.001	1.002	1.003	1.004	1.005	
Section Type	225mm	225mm	225mm	225mm	300mm	300mm	
Slope (1:X)	169.6	168.9	23.1	37.9	22.0	45.0	
Cover Level (m)	84.920	86.247	85.600	82.081	79.630	77.397	77.190
Invert Level (m)	83.343	83.159 / 83.159	83.021 / 83.021	80.247 / 79.400	78.003 / 78.003	75.883 / 75.883	75.683
Length (m)	31.213	23.306	64.163	52.953	46.638	8.998	

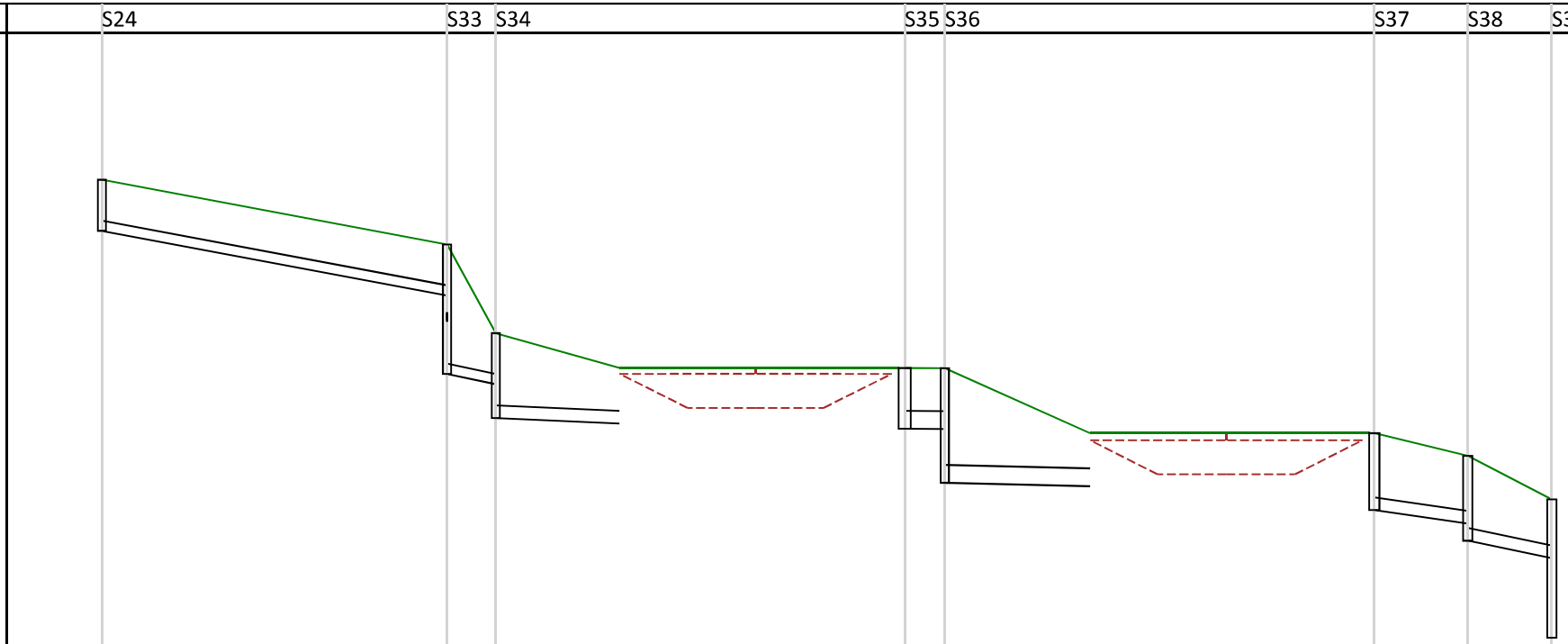


A4 drawing

Hor Scale 1000
Ver Scale 200

Datum (m) 62.000

Node Name	S8		S9	S10		S11	S12		S13	S22	S23	S24
Link Name	1.006		1.0(	1.008		1.00	1.010		1.011	1.012	1.013	
Section Type	300mm		300	300mm		300	300mm		300mm	300mm	300mr	
Slope (1:X)	113.3		168	161.1		22.7	168.6		27.2	25.9	19.1	
Cover Level (m)	77.190		75.994	74.750		74.201	73.800		73.180	72.750	72.600	71.700
Invert Level (m)	74.200	74.000	74.000	72.850	72.776	72.500	71.850	71.750	71.750	71.325	71.250	70.700	70.700	70.200
Length (m)	22.663		5.0(	11.925		6.27	16.860		11.550	14.238	9.574	

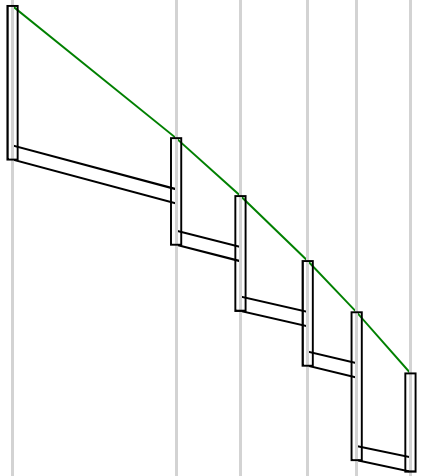


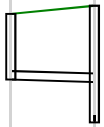
A4 drawing

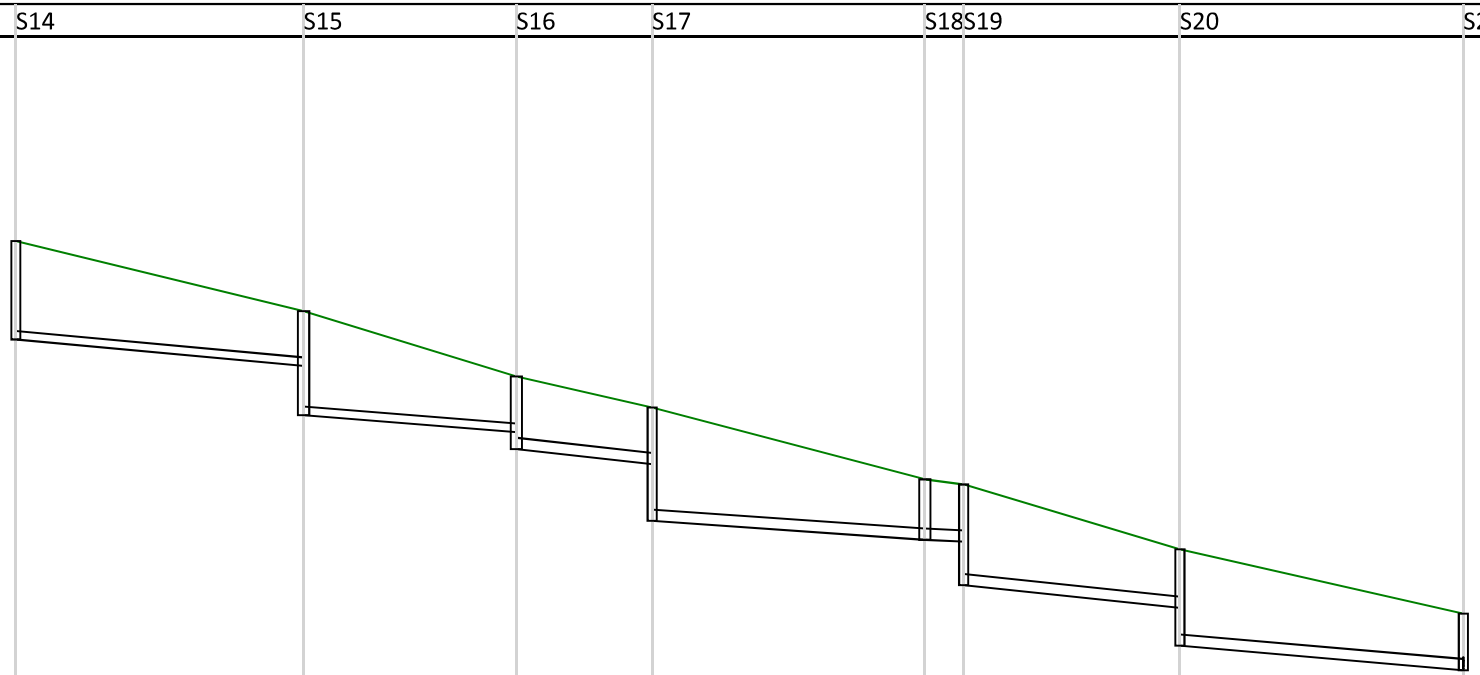
Hor Scale 1000
Ver Scale 200

Datum (m) 53.000

Node Name	S24		S33	S34		S35	S36		S37	S38	S39
Link Name	1.014		1.015	1.016		1.017	1.018		1.019	1.020	
Section Type	300mm		300mm	375mm		525mm	525mm		375mm	375mm	
Slope (1:X)	26.7		23.5	114.3		491	213.4		34.3	24.1	
Cover Level (m)	71.700		69.800	67.195		66.171	66.169		64.258	63.593	62.313
Invert Level (m)	70.200	68.300	66.000	65.696	64.700	64.541	64.391	64.379	62.800	62.700	62.000	61.600	61.100	60.588
Length (m)	50.707		7.158	18.174		5.900	21.343		13.736	12.336	

Node Name	S39	S40	S41	S42	S43	S44
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 45.000						
Link Name	1.021	1.022	1.023	1.02	1.02	
Section Type	375mm	375m	375m	375r	375n	
Slope (1:X)	18.7	19.5	21.9	20.7	23.7	
Cover Level (m)	62.313	58.818	57.288	55.569	54.213	52.595
Invert Level (m)	58.250 / 57.093	56.000 / 55.563	54.250 / 53.844	52.800 / 52.488	50.300 / 50.000	
Length (m)	21.608	8.525	8.895	6.45	7.12	

Node Name		S2	S3
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 73.000			
Link Name		2.000	
Section Type		225mm	
Slope (1:X)		167.4	
Cover Level (m)		86.032	86.247
Invert Level (m)		84.295	84.229
Length (m)		11.048	

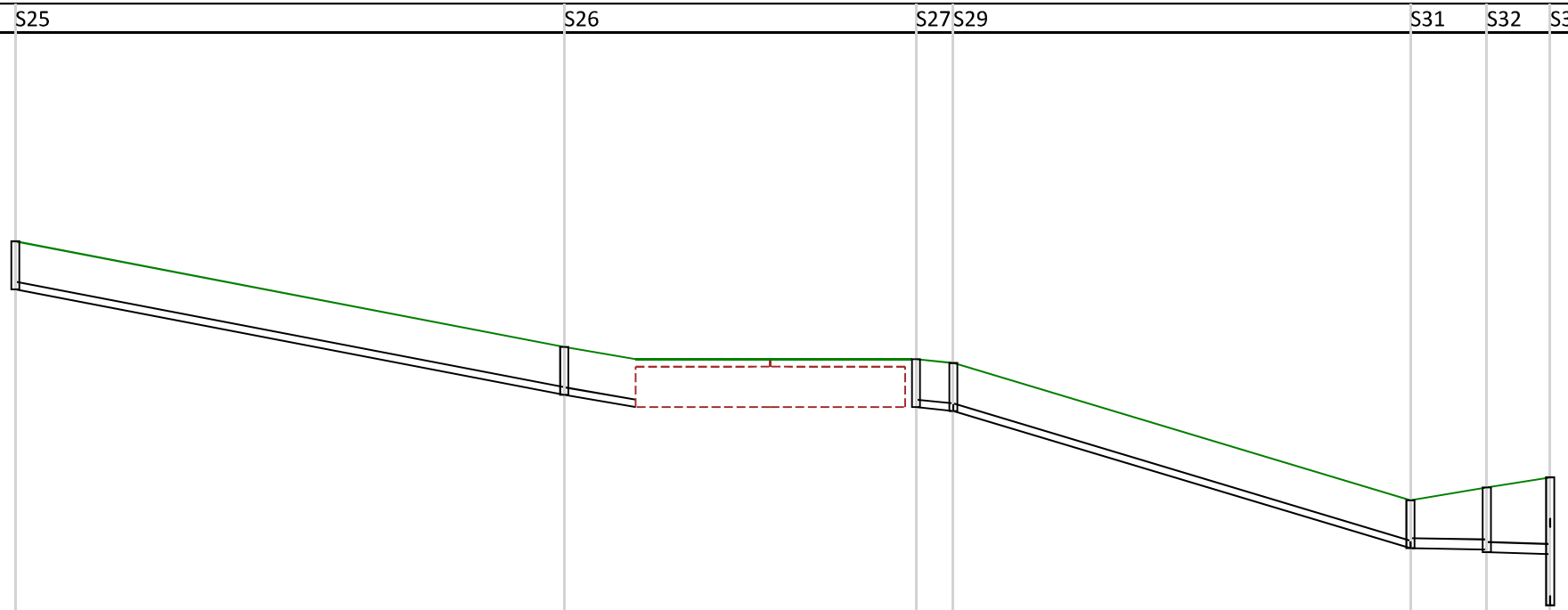


A4 drawing

Hor Scale 1000
Ver Scale 200

Datum (m) 65.000

Node Name	S14	S15	S16	S17	S18	S19	S20	S22
Link Name	3.000	3.001	3.002	3.003	3.0(	3.005	3.006	
Section Type	225mm	225mm	300mm	300mm	300	300mm	300mm	
Slope (1:X)	54.4	62.5	44.9	72.1	102	47.7	57.7	
Cover Level (m)	82.600	80.750	79.020	78.200	76.300	76.164	74.450	72.750
Invert Level (m)	80.000	79.300	78.000	77.550	77.100	76.700	75.200	74.700	74.[illegible]	73.500	72.900	71.900	71.250	
Length (m)	38.046	28.134	17.954	36.068	5.1(	28.593	37.480	

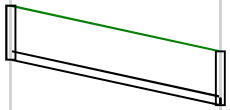


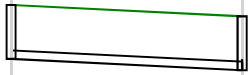
A4 drawing

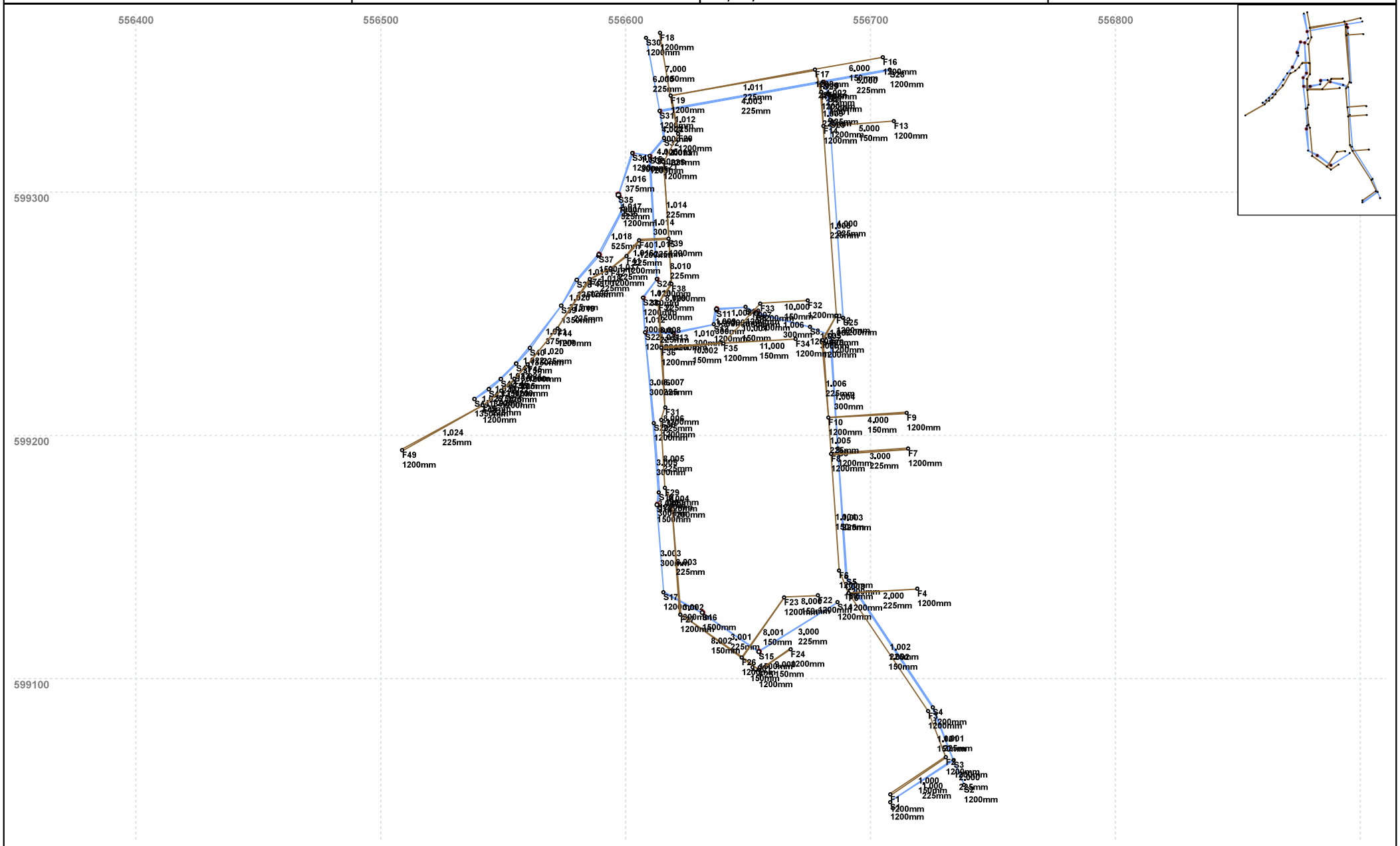
Hor Scale 1000
Ver Scale 200

Datum (m) 60.000

Node Name	S25	S26	S27	S29	S31	S32	S33
Link Name	4.000	4.001	4.00	4.003	4.004	4.005	
Section Type	225mm	225mm	225	225mm	300mm	300mr	
Slope (1:X)	26.0	29.0	48.2	16.6	283.5	159.4	
Cover Level (m)	76.811	73.677	73.311	73.196	69.120	69.500	69.800
Invert Level (m)	75.386	72.252 / 72.252	71.886 / 71.996	71.771	67.695 / 67.695	67.655 / 67.580	67.521
Length (m)	81.477	10.606	5.54	67.851	11.338	9.403	

Node Name		S28	S29
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 62.000			
Link Name		5.000	
Section Type		225mm	
Slope (1:X)		23.0	
Cover Level (m)		74.400	73.196
Invert Level (m)		72.975	71.771
Length (m)		27.690	

Node Name		S30	S31
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 57.000			
Link Name		6.000	
Section Type		225mm	
Slope (1:X)		101.8	
Cover Level (m)		69.420	69.120
Invert Level (m)		67.995	67.695
Length (m)		30.547	



Appendix B

Wastewater Design

- Wastewater Sewer Network Design. (see drawing 22054-XX-XX-XX-XX-DR-WDG-CE-002 for layout)

Design Settings

Frequency of use (kDU)	0.50	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	2430	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.650
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	10	Include Intermediate Ground	✓

Nodes

Name	Units	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F1	6.0	85.001	Adoptable	556708.073	599052.412	1.350
F2		86.281	Adoptable	556730.729	599067.719	3.086
F3		85.635	Adoptable	556723.502	599086.662	2.778
F4	2.0	83.100	Adoptable	556719.091	599136.991	1.425
F5		82.591	Adoptable	556691.062	599135.169	1.591
F6	10.0	81.914	Adoptable	556687.140	599144.461	1.372
F7	2.0	80.480	Adoptable	556715.335	599194.592	1.680
F8	3.0	79.723	Adoptable	556683.877	599192.402	2.356
F9	2.0	79.260	Adoptable	556714.767	599209.280	1.350
F10	5.0	79.038	Adoptable	556682.783	599207.354	2.271
F11	1.0	77.534	Adoptable	556680.457	599239.171	2.134
F12	19.0	76.779	Adoptable	556685.979	599249.242	1.507
F13	2.0	75.127	Adoptable	556709.503	599329.202	1.927
F14		73.756	Adoptable	556680.735	599327.208	2.305
F15		73.270	Adoptable	556679.869	599341.271	2.054
F16	6.0	74.228	Adoptable	556705.016	599355.512	1.350
F17	6.0	72.890	Adoptable	556677.314	599350.420	2.053
F18	2.0	69.419	Adoptable	556614.029	599365.529	1.350
F19		69.110	Adoptable	556618.387	599339.744	1.533
F20		69.385	Adoptable	556621.416	599324.008	2.034
F21	8.0	70.004	Adoptable	556615.329	599312.541	2.761
F22	2.0	82.000	Adoptable	556678.511	599134.266	1.350
F23		81.400	Adoptable	556664.710	599133.386	1.350
F24	8.0	81.854	Adoptable	556667.388	599112.069	1.754
F25	4.0	80.768	Adoptable	556654.376	599103.661	1.372
F26	8.0	80.379	Adoptable	556647.390	599108.677	1.679
F27	12.0	78.700	Adoptable	556622.318	599126.334	2.400
F28		76.376	Adoptable	556618.677	599173.399	2.222
F29	8.0	76.101	Adoptable	556616.039	599178.471	1.985
F30	2.0	74.745	Adoptable	556614.549	599206.352	1.560
F31	8.0	74.507	Adoptable	556616.174	599211.542	1.569
F32	2.0	75.900	Adoptable	556674.369	599255.473	1.500
F33		74.900	Adoptable	556654.929	599254.180	1.386
F34	2.0	77.456	Adoptable	556669.369	599239.662	2.136
F35		75.333	Adoptable	556639.908	599237.792	2.258
F36		73.341	Adoptable	556614.563	599236.071	2.341
F37	2.0	72.436	Adoptable	556613.411	599254.546	1.693
F38	6.0	71.988	Adoptable	556618.734	599262.305	1.433
F39		71.214	Adoptable	556617.522	599280.889	4.183
F40		70.600	Adoptable	556605.480	599280.232	4.325
F41		67.000	Adoptable	556600.358	599273.740	1.900
F42		65.600	Adoptable	556593.839	599268.618	1.800
F43		64.300	Adoptable	556585.349	599264.240	2.300
F44		61.937	Adoptable	556572.198	599243.920	3.537

Nodes

Name	Units	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F45		58.582	Adoptable	556559.951	599229.199	2.132
F46		57.100	Adoptable	556554.547	599223.306	2.200
F47		55.630	Adoptable	556549.204	599218.405	2.730
F48		53.552	Adoptable	556541.585	599212.406	4.327
F49		52.340	Adoptable	556508.705	599193.946	3.290

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	F1	F2	27.342	1.500	83.651	83.195	0.456	60.0	150
1.001	F2	F3	20.275	1.500	83.195	82.857	0.338	60.0	150
1.002	F3	F5	58.355	1.500	82.857	81.236	1.621	36.0	150
2.000	F4	F5	28.088	1.500	81.675	81.166	0.509	55.2	225
1.003	F5	F6	10.086	1.500	81.000	80.542	0.458	22.0	150
1.004	F6	F8	48.052	1.500	80.542	78.298	2.244	21.4	150
3.000	F7	F8	31.534	1.500	78.800	77.367	1.433	22.0	225
1.005	F8	F10	14.992	1.500	77.367	77.067	0.300	50.0	225
4.000	F9	F10	32.042	1.500	77.910	76.842	1.068	30.0	150
1.006	F10	F11	31.902	1.500	76.767	76.058	0.709	45.0	225
1.007	F11	F12	11.486	1.500	75.400	75.272	0.128	89.7	225
1.008	F12	F14	78.142	1.500	75.272	71.451	3.821	20.5	225
5.000	F13	F14	28.837	1.500	73.200	71.526	1.674	17.2	150
1.009	F14	F15	14.090	1.500	71.451	71.216	0.235	60.0	225
1.010	F15	F17	9.499	1.500	71.216	70.837	0.379	25.1	225
6.000	F16	F17	28.166	1.500	72.878	71.536	1.342	21.0	150
1.011	F17	F19	59.887	1.500	70.837	67.577	3.260	18.4	225
7.000	F18	F19	26.151	1.500	68.069	67.727	0.342	76.5	150
1.012	F19	F20	16.025	1.500	67.577	67.351	0.226	70.9	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.446	1.132	20.0	1.3	1.200	2.936	0.000	0	6.0	0.0	27	0.638
1.001	0.457	1.132	20.0	1.3	2.936	2.628	0.000	0	6.0	0.0	27	0.638
1.002	0.531	1.463	25.9	1.3	2.628	1.205	0.000	0	6.0	0.0	24	0.766
2.000	0.368	1.547	61.5	0.8	1.200	1.200	0.000	0	2.0	0.0	18	0.522
1.003	0.660	1.872	33.1	1.6	1.441	1.222	0.000	0	8.0	0.0	23	0.949
1.004	0.769	1.899	33.5	2.3	1.222	1.275	0.000	0	18.0	0.0	27	1.086
3.000	0.515	2.453	97.5	0.8	1.455	2.131	0.000	0	2.0	0.0	15	0.714
1.005	0.567	1.626	64.6	2.6	2.131	1.746	0.000	0	23.0	0.0	31	0.792
4.000	0.472	1.603	28.3	0.8	1.200	2.046	0.000	0	2.0	0.0	17	0.680
1.006	0.598	1.714	68.1	3.0	2.046	1.251	0.000	0	30.0	0.0	32	0.850
1.007	0.486	1.212	48.2	3.1	1.909	1.282	0.000	0	31.0	0.0	38	0.671
1.008	0.861	2.544	101.2	3.9	1.282	2.080	0.000	0	50.0	0.0	30	1.219
5.000	0.572	2.117	37.4	0.8	1.777	2.080	0.000	0	2.0	0.0	16	0.836
1.009	0.596	1.484	59.0	4.0	2.080	1.829	0.000	0	52.0	0.0	40	0.846
1.010	0.803	2.298	91.4	4.0	1.829	1.828	0.000	0	52.0	0.0	32	1.141
6.000	0.655	1.918	33.9	1.3	1.200	1.204	0.000	0	6.0	0.0	21	0.922
1.011	0.939	2.685	106.7	4.4	1.828	1.308	0.000	0	64.0	0.0	31	1.310
7.000	0.352	1.002	17.7	0.8	1.200	1.233	0.000	0	2.0	0.0	22	0.498
1.012	0.588	1.364	54.2	4.5	1.308	1.809	0.000	0	66.0	0.0	44	0.819

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.013	F20	F21	12.982	1.500	67.351	67.243	0.108	120.2	225
1.014	F21	F39	31.728	1.500	67.243	67.031	0.212	149.7	225
8.000	F22	F23	13.829	1.500	80.650	80.050	0.600	23.0	150
8.001	F23	F26	30.175	1.500	80.050	79.028	1.022	29.5	150
9.000	F24	F25	15.492	1.500	80.100	79.396	0.704	22.0	150
9.001	F25	F26	8.600	1.500	79.396	79.007	0.389	22.1	150
8.002	F26	F27	30.666	1.500	78.700	77.306	1.394	22.0	150
8.003	F27	F28	47.206	1.500	76.300	74.154	2.146	22.0	225
8.004	F28	F29	5.717	1.500	74.154	74.116	0.038	150.4	225
8.005	F29	F30	27.921	1.500	74.116	73.185	0.931	30.0	225
8.006	F30	F31	5.438	1.500	73.185	72.938	0.247	22.0	225
8.007	F31	F36	24.582	1.500	72.938	71.905	1.033	23.8	225
10.000	F32	F33	19.483	1.500	74.400	73.514	0.886	22.0	150
10.001	F33	F35	22.231	1.500	73.514	73.075	0.439	50.6	150
11.000	F34	F35	29.520	1.500	75.320	73.978	1.342	22.0	150
10.002	F35	F36	25.403	1.500	73.075	71.920	1.155	22.0	150
8.008	F36	F37	18.511	1.500	71.000	70.743	0.257	72.0	225
8.009	F37	F38	9.409	1.500	70.743	70.555	0.188	50.0	225
8.010	F38	F39	18.623	1.500	70.555	69.745	0.810	23.0	225
1.015	F39	F40	12.060	1.500	67.031	66.275	0.756	16.0	225
1.016	F40	F41	8.269	1.500	66.275	65.899	0.376	22.0	225
1.017	F41	F42	8.290	1.500	65.100	64.723	0.377	22.0	225
1.018	F42	F43	9.552	1.500	63.800	63.366	0.434	22.0	225
1.019	F43	F44	24.204	1.500	62.000	60.900	1.100	22.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.013	0.490	1.046	41.6	4.5	1.809	2.536	0.000	0	66.0	0.0	50	0.680
1.014	0.464	0.937	37.3	4.7	2.536	3.958	0.000	0	74.0	0.0	54	0.640
8.000	0.517	1.830	32.3	0.8	1.200	1.200	0.000	0	2.0	0.0	16	0.741
8.001	0.476	1.616	28.6	0.8	1.200	1.201	0.000	0	2.0	0.0	17	0.686
9.000	0.660	1.873	33.1	1.6	1.604	1.222	0.000	0	8.0	0.0	23	0.949
9.001	0.718	1.868	33.0	1.9	1.222	1.222	0.000	0	12.0	0.0	25	1.010
8.002	0.777	1.873	33.1	2.6	1.529	1.244	0.000	0	22.0	0.0	28	1.101
8.003	0.802	2.453	97.5	3.2	2.175	1.997	0.000	0	34.0	0.0	28	1.107
8.004	0.411	0.935	37.2	3.2	1.997	1.760	0.000	0	34.0	0.0	44	0.567
8.005	0.734	2.100	83.5	3.6	1.760	1.335	0.000	0	42.0	0.0	32	1.042
8.006	0.830	2.452	97.5	3.6	1.335	1.344	0.000	0	44.0	0.0	30	1.174
8.007	0.824	2.358	93.8	4.0	1.344	1.211	0.000	0	52.0	0.0	32	1.171
10.000	0.529	1.873	33.1	0.8	1.350	1.236	0.000	0	2.0	0.0	16	0.759
10.001	0.406	1.233	21.8	0.8	1.236	2.108	0.000	0	2.0	0.0	20	0.569
11.000	0.529	1.873	33.1	0.8	1.986	1.205	0.000	0	2.0	0.0	16	0.759
10.002	0.597	1.873	33.1	1.1	2.108	1.271	0.000	0	4.0	0.0	19	0.849
8.008	0.571	1.353	53.8	4.1	2.116	1.468	0.000	0	56.0	0.0	43	0.802
8.009	0.653	1.624	64.6	4.2	1.468	1.208	0.000	0	58.0	0.0	39	0.914
8.010	0.865	2.399	95.4	4.4	1.208	1.244	0.000	0	64.0	0.0	33	1.212
1.015	1.101	2.881	114.6	6.5	3.958	4.100	0.000	0	138.0	0.0	36	1.553
1.016	0.988	2.453	97.5	6.5	4.100	0.876	0.000	0	138.0	0.0	39	1.381
1.017	0.988	2.453	97.5	6.5	1.675	0.652	0.000	0	138.0	0.0	39	1.381
1.018	0.987	2.452	97.5	6.5	1.575	0.709	0.000	0	138.0	0.0	39	1.380
1.019	0.988	2.453	97.5	6.5	2.075	0.812	0.000	0	138.0	0.0	39	1.380

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.020	F44	F45	19.149	1.500	58.400	57.530	0.870	22.0	225
1.021	F45	F46	7.996	1.500	56.450	56.087	0.363	22.0	225
1.022	F46	F47	7.250	1.500	54.900	54.570	0.330	22.0	225
1.023	F47	F48	9.697	1.500	52.900	52.459	0.441	22.0	225
1.024	F48	F49	37.708	1.500	49.225	49.050	0.175	215.5	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.020	0.987	2.452	97.5	6.5	3.312	0.827	0.000	0	138.0	0.0	39	1.380
1.021	0.987	2.451	97.5	6.5	1.907	0.788	0.000	0	138.0	0.0	39	1.380
1.022	0.988	2.455	97.6	6.5	1.975	0.835	0.000	0	138.0	0.0	39	1.382
1.023	0.988	2.453	97.6	6.5	2.505	0.868	0.000	0	138.0	0.0	39	1.381
1.024	0.444	0.780	31.0	6.5	4.102	3.065	0.000	0	138.0	0.0	70	0.617

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	27.342	60.0	150	Circular	85.001	83.651	1.200	86.281	83.195	2.936
1.001	20.275	60.0	150	Circular	86.281	83.195	2.936	85.635	82.857	2.628
1.002	58.355	36.0	150	Circular	85.635	82.857	2.628	82.591	81.236	1.205
2.000	28.088	55.2	225	Circular	83.100	81.675	1.200	82.591	81.166	1.200
1.003	10.086	22.0	150	Circular	82.591	81.000	1.441	81.914	80.542	1.222
1.004	48.052	21.4	150	Circular	81.914	80.542	1.222	79.723	78.298	1.275
3.000	31.534	22.0	225	Circular	80.480	78.800	1.455	79.723	77.367	2.131
1.005	14.992	50.0	225	Circular	79.723	77.367	2.131	79.038	77.067	1.746
4.000	32.042	30.0	150	Circular	79.260	77.910	1.200	79.038	76.842	2.046
1.006	31.902	45.0	225	Circular	79.038	76.767	2.046	77.534	76.058	1.251
1.007	11.486	89.7	225	Circular	77.534	75.400	1.909	76.779	75.272	1.282
1.008	78.142	20.5	225	Circular	76.779	75.272	1.282	73.756	71.451	2.080
5.000	28.837	17.2	150	Circular	75.127	73.200	1.777	73.756	71.526	2.080
1.009	14.090	60.0	225	Circular	73.756	71.451	2.080	73.270	71.216	1.829
1.010	9.499	25.1	225	Circular	73.270	71.216	1.829	72.890	70.837	1.828

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	F1	1200	Manhole	Adoptable	F2	1200	Manhole	Adoptable
1.001	F2	1200	Manhole	Adoptable	F3	1200	Manhole	Adoptable
1.002	F3	1200	Manhole	Adoptable	F5	1200	Manhole	Adoptable
2.000	F4	1200	Manhole	Adoptable	F5	1200	Manhole	Adoptable
1.003	F5	1200	Manhole	Adoptable	F6	1200	Manhole	Adoptable
1.004	F6	1200	Manhole	Adoptable	F8	1200	Manhole	Adoptable
3.000	F7	1200	Manhole	Adoptable	F8	1200	Manhole	Adoptable
1.005	F8	1200	Manhole	Adoptable	F10	1200	Manhole	Adoptable
4.000	F9	1200	Manhole	Adoptable	F10	1200	Manhole	Adoptable
1.006	F10	1200	Manhole	Adoptable	F11	1200	Manhole	Adoptable
1.007	F11	1200	Manhole	Adoptable	F12	1200	Manhole	Adoptable
1.008	F12	1200	Manhole	Adoptable	F14	1200	Manhole	Adoptable
5.000	F13	1200	Manhole	Adoptable	F14	1200	Manhole	Adoptable
1.009	F14	1200	Manhole	Adoptable	F15	1200	Manhole	Adoptable
1.010	F15	1200	Manhole	Adoptable	F17	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
6.000	28.166	21.0	150	Circular	74.228	72.878	1.200	72.890	71.536	1.204
1.011	59.887	18.4	225	Circular	72.890	70.837	1.828	69.110	67.577	1.308
7.000	26.151	76.5	150	Circular	69.419	68.069	1.200	69.110	67.727	1.233
1.012	16.025	70.9	225	Circular	69.110	67.577	1.308	69.385	67.351	1.809
1.013	12.982	120.2	225	Circular	69.385	67.351	1.809	70.004	67.243	2.536
1.014	31.728	149.7	225	Circular	70.004	67.243	2.536	71.214	67.031	3.958
8.000	13.829	23.0	150	Circular	82.000	80.650	1.200	81.400	80.050	1.200
8.001	30.175	29.5	150	Circular	81.400	80.050	1.200	80.379	79.028	1.201
9.000	15.492	22.0	150	Circular	81.854	80.100	1.604	80.768	79.396	1.222
9.001	8.600	22.1	150	Circular	80.768	79.396	1.222	80.379	79.007	1.222
8.002	30.666	22.0	150	Circular	80.379	78.700	1.529	78.700	77.306	1.244
8.003	47.206	22.0	225	Circular	78.700	76.300	2.175	76.376	74.154	1.997
8.004	5.717	150.4	225	Circular	76.376	74.154	1.997	76.101	74.116	1.760
8.005	27.921	30.0	225	Circular	76.101	74.116	1.760	74.745	73.185	1.335
8.006	5.438	22.0	225	Circular	74.745	73.185	1.335	74.507	72.938	1.344
8.007	24.582	23.8	225	Circular	74.507	72.938	1.344	73.341	71.905	1.211
10.000	19.483	22.0	150	Circular	75.900	74.400	1.350	74.900	73.514	1.236
10.001	22.231	50.6	150	Circular	74.900	73.514	1.236	75.333	73.075	2.108
11.000	29.520	22.0	150	Circular	77.456	75.320	1.986	75.333	73.978	1.205
10.002	25.403	22.0	150	Circular	75.333	73.075	2.108	73.341	71.920	1.271
8.008	18.511	72.0	225	Circular	73.341	71.000	2.116	72.436	70.743	1.468
8.009	9.409	50.0	225	Circular	72.436	70.743	1.468	71.988	70.555	1.208
8.010	18.623	23.0	225	Circular	71.988	70.555	1.208	71.214	69.745	1.244
1.015	12.060	16.0	225	Circular	71.214	67.031	3.958	70.600	66.275	4.100
1.016	8.269	22.0	225	Circular	70.600	66.275	4.100	67.000	65.899	0.876

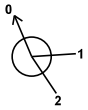
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
6.000	F16	1200	Manhole	Adoptable	F17	1200	Manhole	Adoptable
1.011	F17	1200	Manhole	Adoptable	F19	1200	Manhole	Adoptable
7.000	F18	1200	Manhole	Adoptable	F19	1200	Manhole	Adoptable
1.012	F19	1200	Manhole	Adoptable	F20	1200	Manhole	Adoptable
1.013	F20	1200	Manhole	Adoptable	F21	1200	Manhole	Adoptable
1.014	F21	1200	Manhole	Adoptable	F39	1200	Manhole	Adoptable
8.000	F22	1200	Manhole	Adoptable	F23	1200	Manhole	Adoptable
8.001	F23	1200	Manhole	Adoptable	F26	1200	Manhole	Adoptable
9.000	F24	1200	Manhole	Adoptable	F25	1200	Manhole	Adoptable
9.001	F25	1200	Manhole	Adoptable	F26	1200	Manhole	Adoptable
8.002	F26	1200	Manhole	Adoptable	F27	1200	Manhole	Adoptable
8.003	F27	1200	Manhole	Adoptable	F28	1200	Manhole	Adoptable
8.004	F28	1200	Manhole	Adoptable	F29	1200	Manhole	Adoptable
8.005	F29	1200	Manhole	Adoptable	F30	1200	Manhole	Adoptable
8.006	F30	1200	Manhole	Adoptable	F31	1200	Manhole	Adoptable
8.007	F31	1200	Manhole	Adoptable	F36	1200	Manhole	Adoptable
10.000	F32	1200	Manhole	Adoptable	F33	1200	Manhole	Adoptable
10.001	F33	1200	Manhole	Adoptable	F35	1200	Manhole	Adoptable
11.000	F34	1200	Manhole	Adoptable	F35	1200	Manhole	Adoptable
10.002	F35	1200	Manhole	Adoptable	F36	1200	Manhole	Adoptable
8.008	F36	1200	Manhole	Adoptable	F37	1200	Manhole	Adoptable
8.009	F37	1200	Manhole	Adoptable	F38	1200	Manhole	Adoptable
8.010	F38	1200	Manhole	Adoptable	F39	1200	Manhole	Adoptable
1.015	F39	1200	Manhole	Adoptable	F40	1200	Manhole	Adoptable
1.016	F40	1200	Manhole	Adoptable	F41	1200	Manhole	Adoptable

Pipeline Schedule

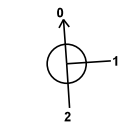
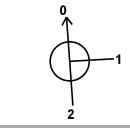
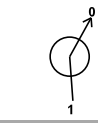
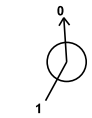
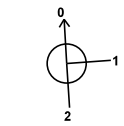
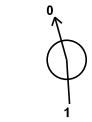
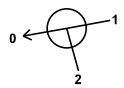
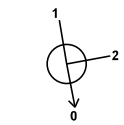
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.017	8.290	22.0	225	Circular	67.000	65.100	1.675	65.600	64.723	0.652
1.018	9.552	22.0	225	Circular	65.600	63.800	1.575	64.300	63.366	0.709
1.019	24.204	22.0	225	Circular	64.300	62.000	2.075	61.937	60.900	0.812
1.020	19.149	22.0	225	Circular	61.937	58.400	3.312	58.582	57.530	0.827
1.021	7.996	22.0	225	Circular	58.582	56.450	1.907	57.100	56.087	0.788
1.022	7.250	22.0	225	Circular	57.100	54.900	1.975	55.630	54.570	0.835
1.023	9.697	22.0	225	Circular	55.630	52.900	2.505	53.552	52.459	0.868
1.024	37.708	215.5	225	Circular	53.552	49.225	4.102	52.340	49.050	3.065

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.017	F41	1200	Manhole	Adoptable	F42	1200	Manhole	Adoptable
1.018	F42	1200	Manhole	Adoptable	F43	1200	Manhole	Adoptable
1.019	F43	1200	Manhole	Adoptable	F44	1200	Manhole	Adoptable
1.020	F44	1200	Manhole	Adoptable	F45	1200	Manhole	Adoptable
1.021	F45	1200	Manhole	Adoptable	F46	1200	Manhole	Adoptable
1.022	F46	1200	Manhole	Adoptable	F47	1200	Manhole	Adoptable
1.023	F47	1200	Manhole	Adoptable	F48	1200	Manhole	Adoptable
1.024	F48	1200	Manhole	Adoptable	F49	1200	Manhole	Adoptable

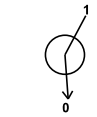
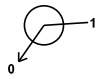
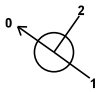
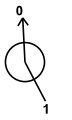
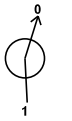
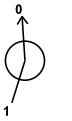
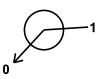
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1	556708.073	599052.412	85.001	1.350	1200				
						0	1.000	83.651	150
F2	556730.729	599067.719	86.281	3.086	1200		1	1.000	83.195	150
							0	1.001	83.195	150
F3	556723.502	599086.662	85.635	2.778	1200		1	1.001	82.857	150
							0	1.002	82.857	150
F4	556719.091	599136.991	83.100	1.425	1200				
						0	2.000	81.675	225
F5	556691.062	599135.169	82.591	1.591	1200		1	2.000	81.166	225
							2	1.002	81.236	150
							0	1.003	81.000	150
F6	556687.140	599144.461	81.914	1.372	1200		1	1.003	80.542	150
							0	1.004	80.542	150
F7	556715.335	599194.592	80.480	1.680	1200				
						0	3.000	78.800	225

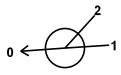
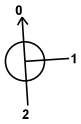
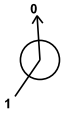
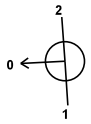
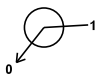
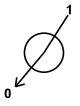
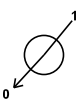
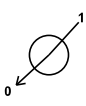
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F8	556683.877	599192.402	79.723	2.356	1200		1	3.000	77.367	225
							2	1.004	78.298	150
							0	1.005	77.367	225
F9	556714.767	599209.280	79.260	1.350	1200		0	4.000	77.910	150
F10	556682.783	599207.354	79.038	2.271	1200		1	4.000	76.842	150
							2	1.005	77.067	225
							0	1.006	76.767	225
F11	556680.457	599239.171	77.534	2.134	1200		1	1.006	76.058	225
							0	1.007	75.400	225
F12	556685.979	599249.242	76.779	1.507	1200		1	1.007	75.272	225
							0	1.008	75.272	225
F13	556709.503	599329.202	75.127	1.927	1200		0	5.000	73.200	150
F14	556680.735	599327.208	73.756	2.305	1200		1	5.000	71.526	150
							2	1.008	71.451	225
							0	1.009	71.451	225
F15	556679.869	599341.271	73.270	2.054	1200		1	1.009	71.216	225
							0	1.010	71.216	225
F16	556705.016	599355.512	74.228	1.350	1200		0	6.000	72.878	150
F17	556677.314	599350.420	72.890	2.053	1200		1	6.000	71.536	150
							2	1.010	70.837	225
							0	1.011	70.837	225
F18	556614.029	599365.529	69.419	1.350	1200		0	7.000	68.069	150
F19	556618.387	599339.744	69.110	1.533	1200		1	7.000	67.727	150
							2	1.011	67.577	225
							0	1.012	67.577	225
F20	556621.416	599324.008	69.385	2.034	1200		1	1.012	67.351	225
							0	1.013	67.351	225

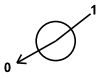
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F21	556615.329	599312.541	70.004	2.761	1200	 1	1.013	67.243	225
						0	1.014	67.243	225
F22	556678.511	599134.266	82.000	1.350	1200				
						0	8.000	80.650	150
F23	556664.710	599133.386	81.400	1.350	1200	1	8.000	80.050	150
						 0	8.001	80.050	150
F24	556667.388	599112.069	81.854	1.754	1200				
						0	9.000	80.100	150
F25	556654.376	599103.661	80.768	1.372	1200	1	9.000	79.396	150
						 0	9.001	79.396	150
F26	556647.390	599108.677	80.379	1.679	1200	1	9.001	79.007	150
						 2	8.001	79.028	150
						0	8.002	78.700	150
F27	556622.318	599126.334	78.700	2.400	1200	 1	8.002	77.306	150
						0	8.003	76.300	225
F28	556618.677	599173.399	76.376	2.222	1200	 1	8.003	74.154	225
						0	8.004	74.154	225
F29	556616.039	599178.471	76.101	1.985	1200	 1	8.004	74.116	225
						0	8.005	74.116	225
F30	556614.549	599206.352	74.745	1.560	1200	 1	8.005	73.185	225
						0	8.006	73.185	225
F31	556616.174	599211.542	74.507	1.569	1200	 1	8.006	72.938	225
						0	8.007	72.938	225
F32	556674.369	599255.473	75.900	1.500	1200				
						0	10.000	74.400	150
F33	556654.929	599254.180	74.900	1.386	1200	1	10.000	73.514	150
						 0	10.001	73.514	150

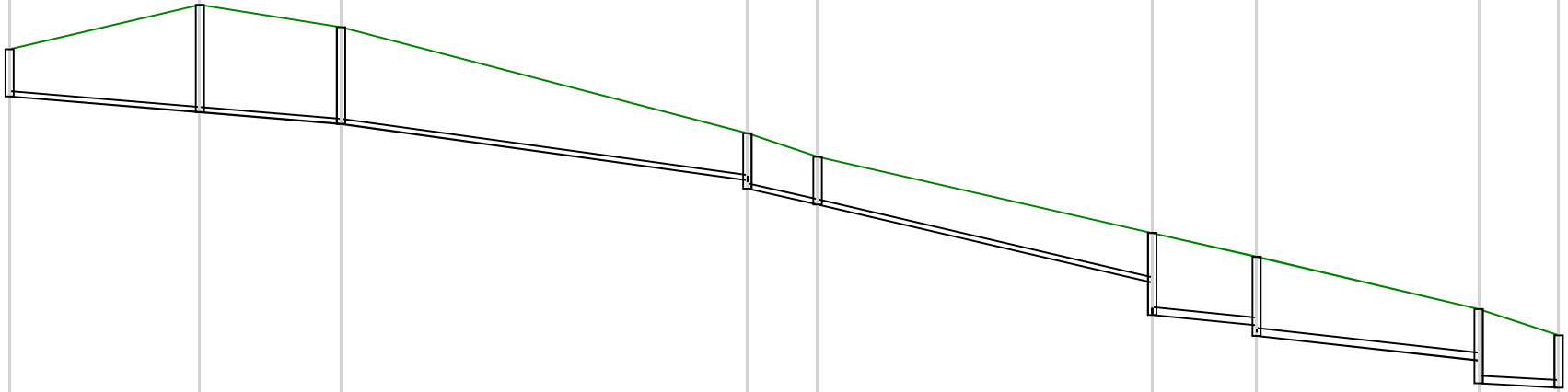
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F34	556669.369	599239.662	77.456	2.136	1200		0	11.000	75.320	150
F35	556639.908	599237.792	75.333	2.258	1200		1	11.000	73.978	150
							2	10.001	73.075	150
							0	10.002	73.075	150
F36	556614.563	599236.071	73.341	2.341	1200		1	10.002	71.920	150
							2	8.007	71.905	225
							0	8.008	71.000	225
F37	556613.411	599254.546	72.436	1.693	1200		1	8.008	70.743	225
							0	8.009	70.743	225
F38	556618.734	599262.305	71.988	1.433	1200		1	8.009	70.555	225
							0	8.010	70.555	225
F39	556617.522	599280.889	71.214	4.183	1200		1	8.010	69.745	225
							2	1.014	67.031	225
							0	1.015	67.031	225
F40	556605.480	599280.232	70.600	4.325	1200		1	1.015	66.275	225
							0	1.016	66.275	225
F41	556600.358	599273.740	67.000	1.900	1200		1	1.016	65.899	225
							0	1.017	65.100	225
F42	556593.839	599268.618	65.600	1.800	1200		1	1.017	64.723	225
							0	1.018	63.800	225
F43	556585.349	599264.240	64.300	2.300	1200		1	1.018	63.366	225
							0	1.019	62.000	225
F44	556572.198	599243.920	61.937	3.537	1200		1	1.019	60.900	225
							0	1.020	58.400	225
F45	556559.951	599229.199	58.582	2.132	1200		1	1.020	57.530	225
							0	1.021	56.450	225
F46	556554.547	599223.306	57.100	2.200	1200		1	1.021	56.087	225
							0	1.022	54.900	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F47	556549.204	599218.405	55.630	2.730	1200	1	1.022	54.570	225
									
						0	1.023	52.900	225
F48	556541.585	599212.406	53.552	4.327	1200	1	1.023	52.459	225
									
						0	1.024	49.225	225
F49	556508.705	599193.946	52.340	3.290	1200	1	1.024	49.050	225
									

CAUSEWAY	Walsh Design Group The Mall, Maryborough Woods, Douglas, Cork	File: Mallow_Site_Model_05.pfd Network: IR 10/07/2024	Page 1 Residential Development Ard an Ghleanna, Mallow Co. Cork

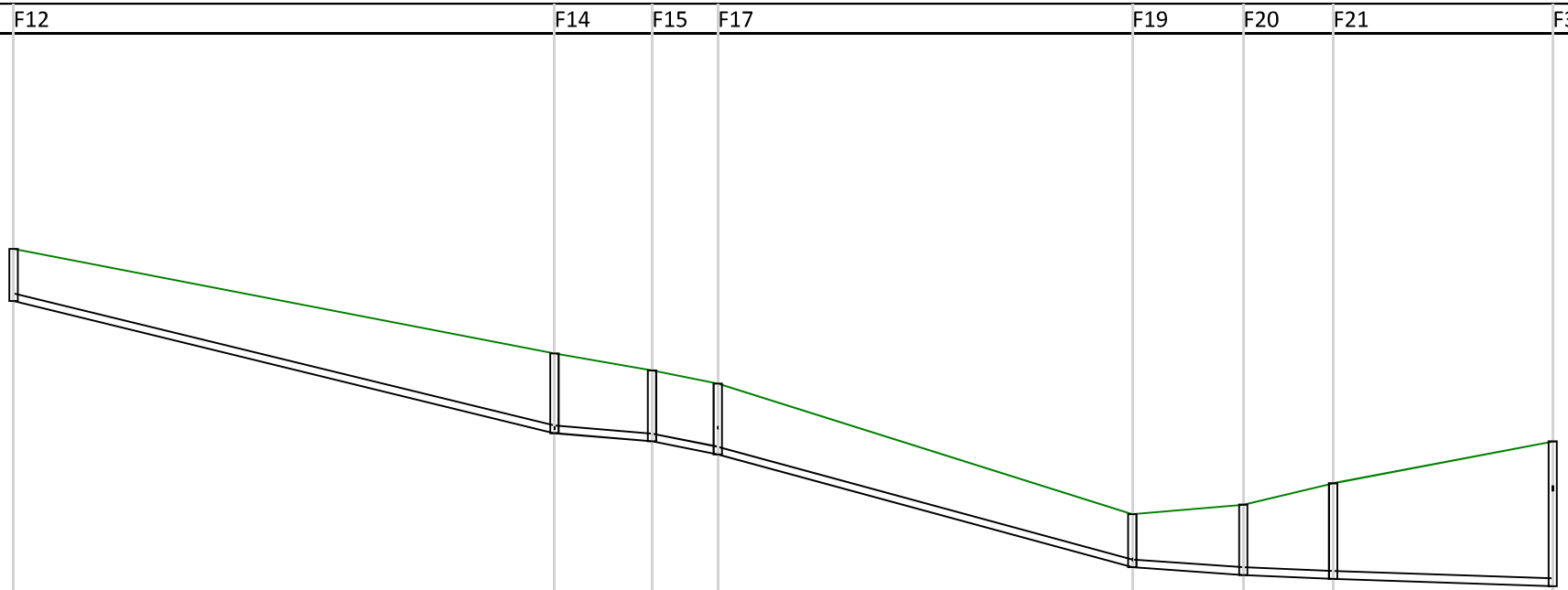


A4 drawing

Hor Scale 1000
Ver Scale 200

Datum (m) 69.000

Node Name	F1	F2	F3	F5	F6	F8	F10	F11	F12
Link Name	1.000	1.001	1.002	1.003	1.004	1.005	1.006	1.007	
Section Type	150mm	150mm	150mm	150mm	150mm	225mm	225mm	225mm	
Slope (1:X)	60.0	60.0	36.0	22.0	21.4	50.0	45.0	89.7	
Cover Level (m)	85.001	86.281	85.635	82.591	81.914	79.723	79.038	77.534	76.779
Invert Level (m)	83.651	83.195 / 83.195	82.857 / 82.857	81.236 / 81.000	80.542 / 80.542	78.298 / 77.367	77.067 / 76.767	76.058 / 75.400	75.272
Length (m)	27.342	20.275	58.355	10.086	48.052	14.992	31.902	11.486	



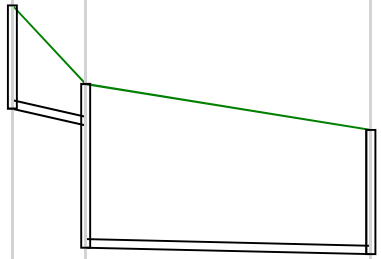
A4 drawing

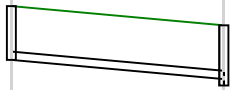
Hor Scale 1000
Ver Scale 200

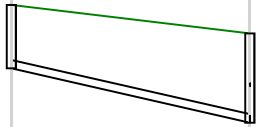
Datum (m) 60.000

Node Name	F12	F14	F15	F17	F19	F20	F21	F39
Link Name	1.008	1.009	1.010	1.011	1.012	1.013	1.014	
Section Type	225mm	225mm	225mm	225mm	225mm	225mm	225mm	
Slope (1:X)	20.5	60.0	25.1	18.4	70.9	120.2	149.7	
Cover Level (m)	76.779	73.756	73.270	72.890	69.110	69.385	70.004	71.214
Invert Level (m)	75.272	71.451 / 71.451	71.216 / 71.216	70.837 / 70.837	67.577 / 67.577	67.351 / 67.351	67.243 / 67.243	67.031
Length (m)	78.142	14.090	9.499	59.887	16.025	12.982	31.728	

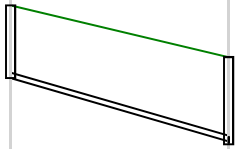
Node Name	F39	F40	F41	F42	F43	F44	F45	F46	F47
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 51.000									
Link Name	1.015	1.016	1.017	1.018	1.019	1.020	1.021	1.022	
Section Type	225mm	225m	225m	225mr	225mm	225mm	225m	225m	
Slope (1:X)	16.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	
Cover Level (m)	71.214	70.600	67.000	65.600	64.300	61.937	58.582	57.100	55.630
Invert Level (m)	67.031 66.275	66.275 65.899	65.100 64.723	63.800 63.366	62.000 60.900	58.400 57.530	56.450 56.087	54.900 54.570	
Length (m)	12.060	8.269	8.290	9.552	24.204	19.149	7.996	7.250	

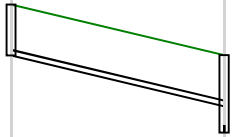
Node Name		F47	F48	F49
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 41.000				
Link Name		1.023	1.024	
Section Type		225mm	225mm	
Slope (1:X)		22.0	215.5	
Cover Level (m)		55.630	53.552	52.340
Invert Level (m)		52.900 52.459	49.225	49.050
Length (m)		9.697	37.708	

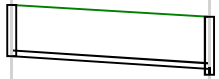
Node Name		F4	F5
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 71.000			
Link Name		2.000	
Section Type		225mm	
Slope (1:X)		55.2	
Cover Level (m)		83.100	82.591
Invert Level (m)		81.675	81.166
Length (m)		28.088	

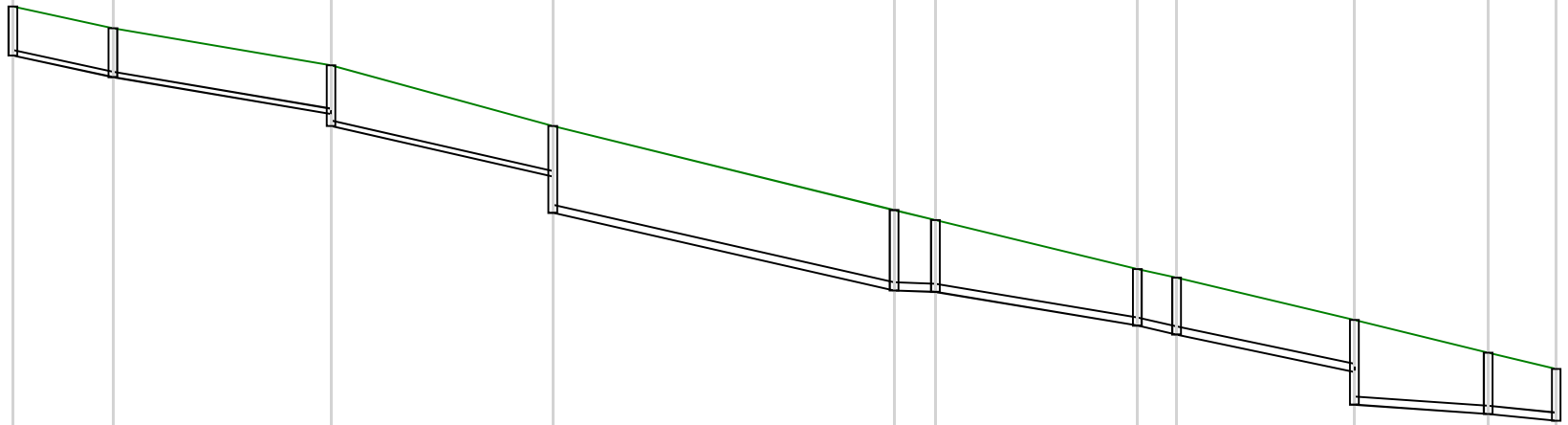
Node Name		F7	F8
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 67.000			
Link Name		3.000	
Section Type		225mm	
Slope (1:X)		22.0	
Cover Level (m)		80.480	79.723
Invert Level (m)		78.800	77.367
Length (m)		31.534	

Node Name		F9	F10
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 67.000			
Link Name		4.000	
Section Type		150mm	
Slope (1:X)		30.0	
Cover Level (m)		79.260	79.038
Invert Level (m)		77.910	76.842
Length (m)		32.042	

Node Name		F13	F14
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 62.000			
Link Name		5.000	
Section Type		150mm	
Slope (1:X)		17.2	
Cover Level (m)		75.127	73.756
Invert Level (m)		73.200	71.526
Length (m)		28.837	

Node Name		F16	F17
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 61.000			
Link Name		6.000	
Section Type		150mm	
Slope (1:X)		21.0	
Cover Level (m)		74.228	72.890
Invert Level (m)		72.878	71.536
Length (m)		28.166	

Node Name		F18	F19
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 57.000			
Link Name		7.000	
Section Type		150mm	
Slope (1:X)		76.5	
Cover Level (m)		69.419	69.110
Invert Level (m)		68.069	67.727
Length (m)		26.151	

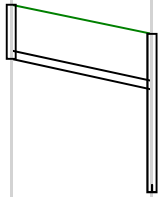


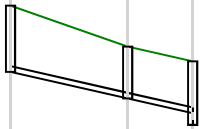
A4 drawing

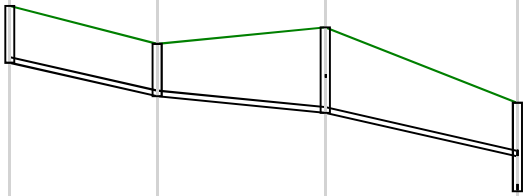
Hor Scale 1000
Ver Scale 200

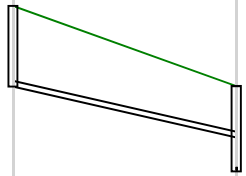
Datum (m) 65.000

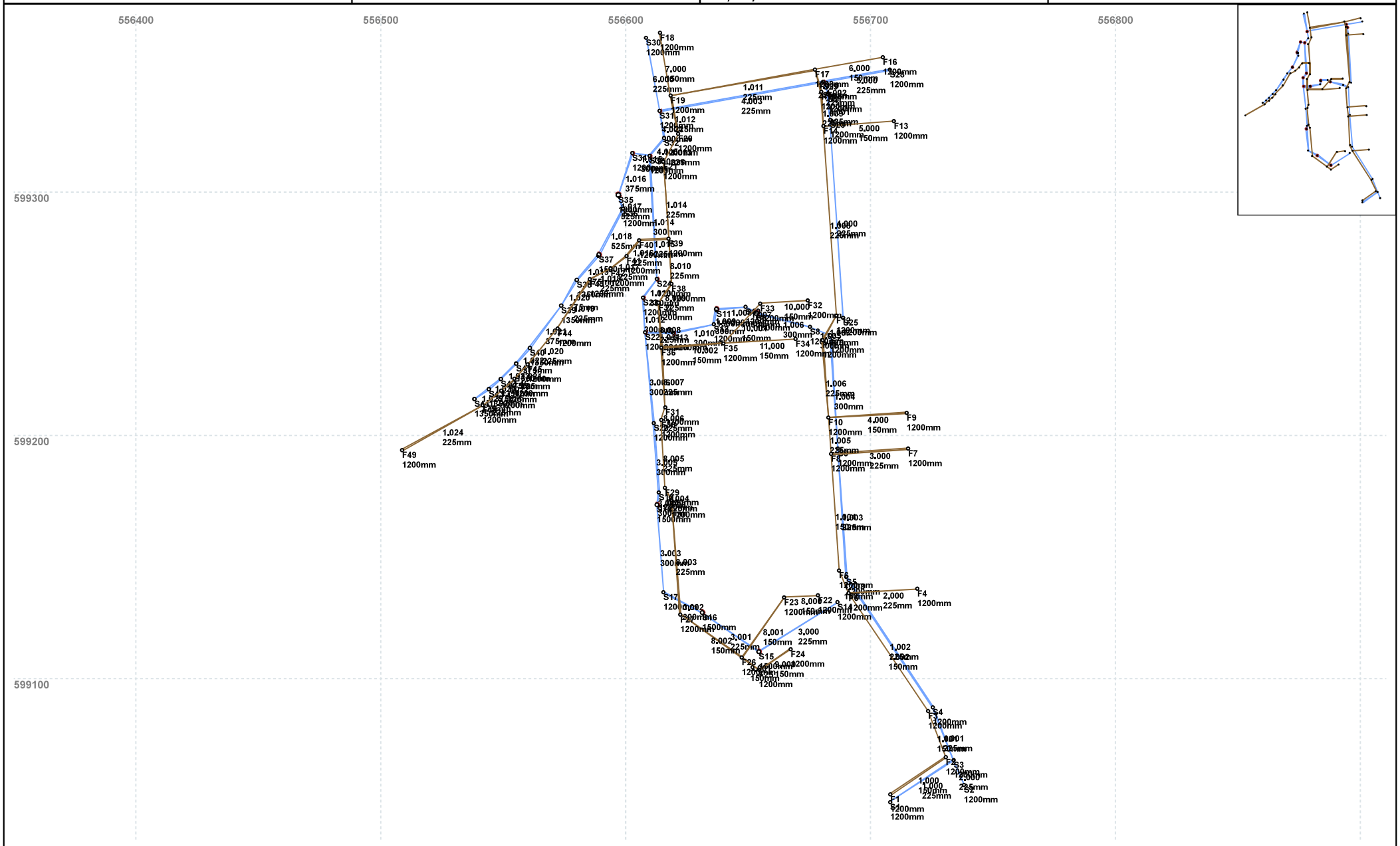
Node Name	F22	F23	F26	F27	F28	F29	F30	F31	F36	F37	F38
Link Name	8.000	8.001	8.002	8.003	8.00	8.005	8.00	8.007	8.008	8.009	
Section Type	150mm	150mm	150mm	225mm	225	225mm	225	225mm	225mm	225mr	
Slope (1:X)	23.0	29.5	22.0	22.0	150	30.0	22.(	23.8	72.0	50.0	
Cover Level (m)	82.000	81.400	80.379	78.700	76.376	76.101	74.745	74.507	73.341	72.436	71.988
Invert Level (m)	80.650 80.050	80.050 79.028	78.700 77.306	76.300 74.154	74.154 74.116	74.116 73.185	73.185 72.938	72.938 71.905	71.000 70.743	70.743 70.555	
Length (m)	13.829	30.175	30.666	47.206	5.71	27.921	5.4	24.582	18.511	9.409	

Node Name		F38	F39
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 58.000			
Link Name		8.010	
Section Type		225mm	
Slope (1:X)		23.0	
Cover Level (m)		71.988	71.214
Invert Level (m)		70.555	69.745
Length (m)		18.623	

Node Name		F24	F25	F26
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 69.000				
Link Name		9.000	9.001	
Section Type		150mm	150m	
Slope (1:X)		22.0	22.1	
Cover Level (m)		81.854	80.768	80.379
Invert Level (m)		80.100 / 79.396	79.396 / 79.007	
Length (m)		15.492	8.600	

Node Name		F32	F33	F35	F36
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 62.000					
Link Name		10.000	10.001	10.002	
Section Type		150mm	150mm	150mm	
Slope (1:X)		22.0	50.6	22.0	
Cover Level (m)		75.900	74.900	75.333	73.341
Invert Level (m)		74.400	73.514 / 73.514	73.075 / 73.075	71.920
Length (m)		19.483	22.231	25.403	

Node Name		F34	F35
A4 drawing Hor Scale 1000 Ver Scale 200 Datum (m) 64.000			
Link Name		11.000	
Section Type		150mm	
Slope (1:X)		22.0	
Cover Level (m)		77.456	75.333
Invert Level (m)		75.320	73.978
Length (m)		29.520	



Appendix C

Irish Water Documents

Irish Water Documents:

- Confirmation of feasibility Letter.

CONFIRMATION OF FEASIBILITY

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

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

www.water.ie

Ian Reilly

Walsh Design Group
The Mall
Maryborough Woods
Douglas
Co. Cork
T12 K8YT

15 June 2023

Our Ref: CDS23003646 Pre-Connection Enquiry
Ard an Ghleanna, St. Joseph's Road, Mallow, Co. Cork

Dear Applicant/Agent,

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

Irish Water has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 157 unit(s) at Ard an Ghleanna, St. Joseph's Road, Mallow, Co. Cork **(the Development)**.

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

- **Water Connection** - Feasible Subject to upgrades:

  In order to accommodate the proposed connection, approximately 500m of water network upgrades will be required to provide additional network capacity. Irish Water does not currently have any plans to undertake these works, therefore the applicant will be required to fund these local network upgrades. The fee for these works will be calculated at a connection application stage.

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

  In order to accommodate the proposed connection, upgrade works are required to increase the capacity of Mallow WWTP. Irish Water currently has a project underway which will provide the necessary upgrade and capacity. This upgrade project is scheduled to be completed by Q3 2023 (this may be subject to change) and the proposed connection could be completed as soon as possibly practicable after this date.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water 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 Irish Water.

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/

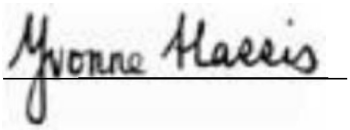
Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Irish Water's Network(s)

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

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

Yours sincerely,



Yvonne Harris
Head of Customer Operations

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 Irish Water's network(s). • Before the Development can connect to Irish Water's network(s), you must submit a connection application and be granted and sign a connection agreement with Irish Water.
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?	• Irish Water connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Irish Water's network(s), including works in the public space, must be carried out by Irish Water*. *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. • **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. • **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 Irish Water's network(s)?	• Requests for maps showing Irish Water'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 Irish Water 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). • More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Section B – Details of Irish Water's Network(s)

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

Existing Water Infrastructure:

Existing Wastewater Infrastructure:

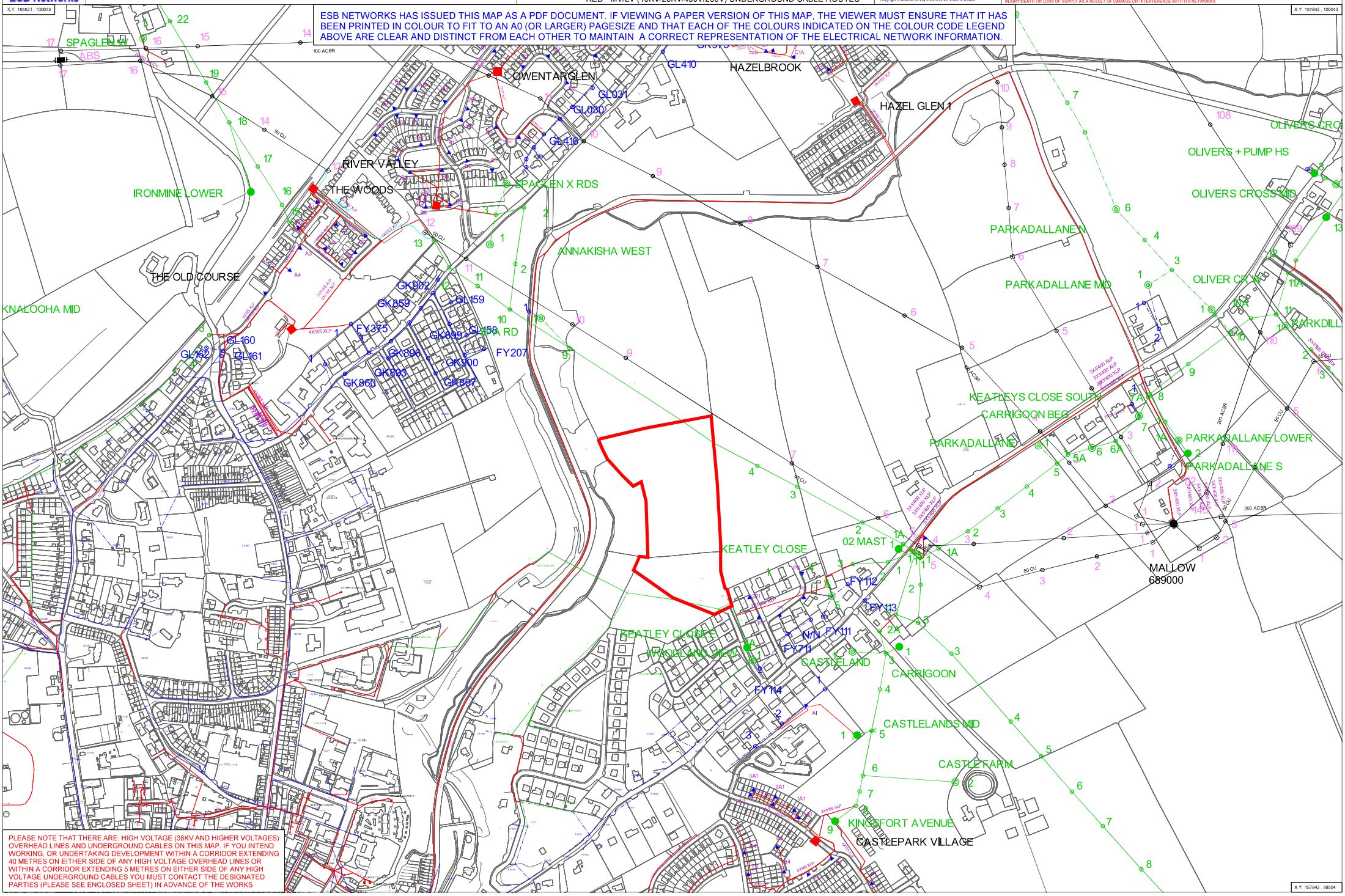
Note: The information provided on the included maps as to the position of Irish Water's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Irish Water.

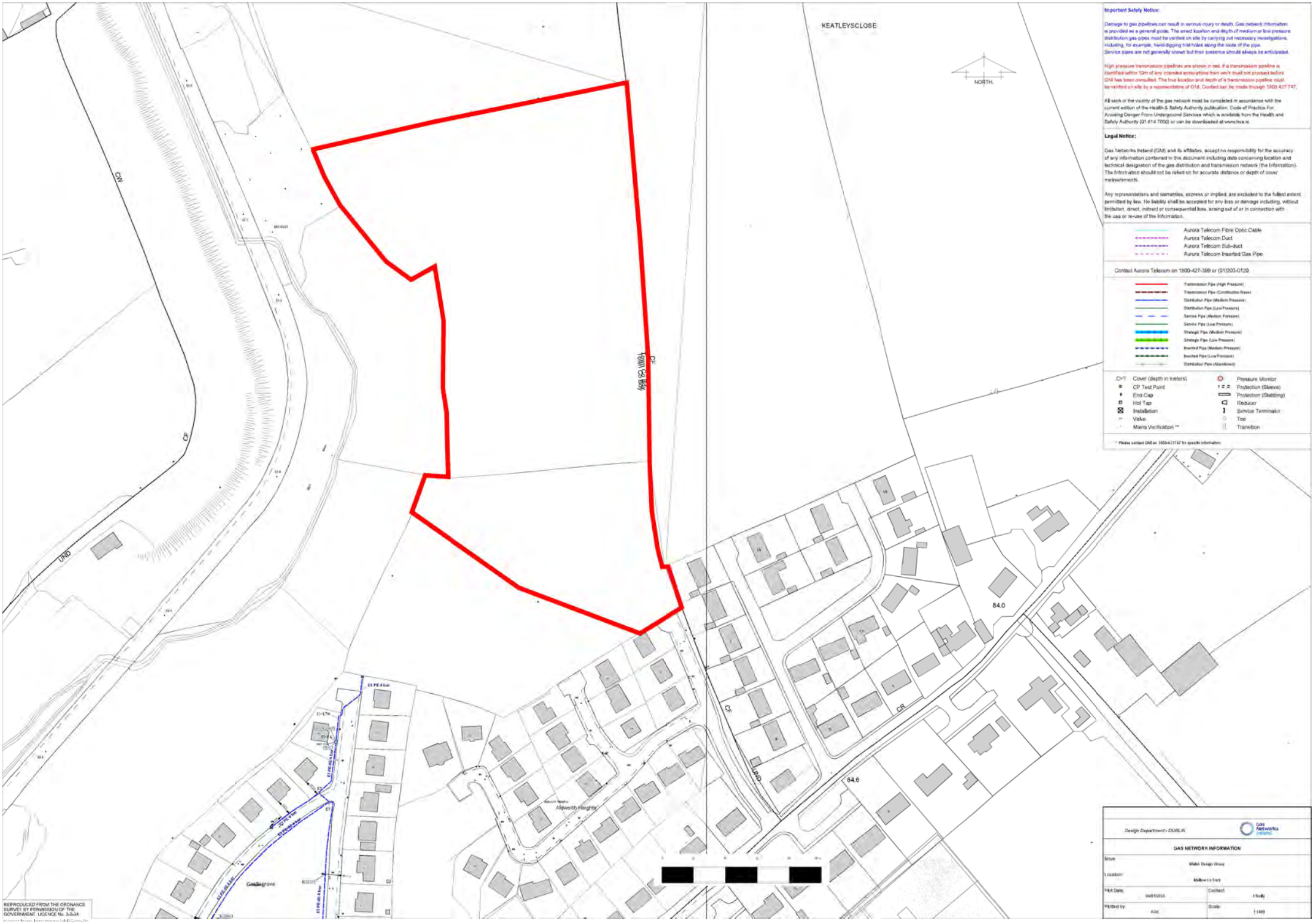
Whilst every care has been taken in respect of the information on Irish Water's network(s), Irish Water assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability 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 Irish Water's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Irish Water'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

Utilities

- ESB Map
- Gas Networks Ireland Map


ESB Networks
TITLE:
20230111-009_A0
COLOUR CODE:
BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES
GREEN - MV(10KV/20KV) OVERHEAD LINES
BLUE - LV (400V/230V) OVERHEAD LINES
CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES
RED - MV/LV (10KV/20KV/400V/230V) UNDERGROUND CABLE ROUTES
DATE: 11-Jan-2023
** SCALE: 1:2000
** SCALE WHEN PRINTED ON AN A0 PAGE.
XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM
Maps reproduced by permission:
Ordnance Survey Ireland Licence No. EN0092320.
Copyright Ordnance Survey Ireland Government of Ireland
WARNING
THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS THE USER'S RESPONSIBILITY TO INDEPENDENTLY VERIFY THE INFORMATION AND THE LOCATION OF UNDERGROUND CABLES AND OVERHEAD LINES. LOW VOLTAGE (230V/400V) SERVICE CABLES (E.G. HOUSE SERVICES, FACTORY/SHOP SERVICES, PUBLIC LIGHTING LAMP SERVICES, ETC) ARE NOT INCLUDED BUT THEIR PRESENCE SHOULD BE ANTICIPATED. THE DEPTHS OF UNDERGROUND CABLES MUST NEVER BE ASSUMED. ADDITIONAL MORE DETAILED INFORMATION IS AVAILABLE FOR HIGH VOLTAGE TRANSMISSION UNDERGROUND CABLES (38KV, 110KV, 220KV, 400KV) FROM THE LOCAL ESB NETWORKS TRANSMISSION REPRESENTATIVE - SEE ATTACHED LIST FOR CONTACT DETAILS OR CALL 1800 372 757. NO WORK SHOULD BE CARRIED OUT IN THE VICINITY OF 38KV OR HIGHER VOLTAGE UNDERGROUND CABLES WITHOUT PRIOR CONSULTATION WITH ESB NETWORKS. BEFORE ANY MECHANICAL EXCAVATION IS UNDERTAKEN, THE ACTUAL LOCATION OF ALL UNDERGROUND ELECTRICITY CABLES MUST BE ESTABLISHED AND VERIFIED ON THE SITE USING:
(A) UP-TO-DATE MAP RECORDS, (B) CABLE LOCATER EQUIPMENT OPERATED IN BOTH POWER AND RADIO MODES.
(C) CAREFUL HAND DIGGING OF TRIAL HOLES USING 'SAFE DIGGING PRACTICE'. REFER ALSO TO 1184 CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES. ESB TAKES NO RESPONSIBILITY FOR AND SHALL BEAR NO LIABILITY, HOWSOEVER ARISING, IN RELATION TO ANY DAMAGE, INJURY/DEATH OR LOSS OF SUPPLY AS A RESULT OF DAMAGE OR INTERFERENCE WITH ITS NETWORKS.
ESB NETWORKS HAS ISSUED THIS MAP AS A PDF DOCUMENT. IF VIEWING A PAPER VERSION OF THIS MAP, THE VIEWER MUST ENSURE THAT IT HAS BEEN PRINTED IN COLOUR TO FIT TO AN A0 (OR LARGER) PAGESIZE AND THAT EACH OF THE COLOURS INDICATED ON THE COLOUR CODE LEGEND ABOVE ARE CLEAR AND DISTINCT FROM EACH OTHER TO MAINTAIN A CORRECT REPRESENTATION OF THE ELECTRICAL NETWORK INFORMATION.
X,Y: 155521 , 100043
X,Y: 157842 , 100043
X,Y: 157842 , 98504
SPAGLEN EW
ABS
OWENTARGLEN
HAZELBROOK
HAZEL GLEN 1
RIVER VALLEY
THE WOODS
SPAGLEN X RDS
IRONMINE LOWER
THE OLD COURSE
ANNAKISHA WEST
KNALOOHA MID
PARKADALLANE N
PARKADALLANE MID
OLIVERS + PUMP HS
OLIVERS CROSS MID
OLIVER CR MID
KEATLEYS CLOSE SOUTH
CARRIGOON BEG
PARKADALLANE
PARKADALLANE LOWER
PARKADALLANE S
KEATLEY CLOSE
KEATLEY CLOSE E
02 MAST
WOODLAND VIEW
CASTLELAND
CARRIGOON
CASTLELANDS MID
CASTLE FARM
KINGSFORT AVENUE
CASTLEPARK VILLAGE
MALLOW
689000
GL410
GL031
GL030
GL416
GK902
GK859
GL159
GK899
GL158
GK896
GK900
GK898
GK897
GK860
FY207
FY375
GL160
GL161
GL162
FY112
FY113
FY111
FY711
FY114
PLEASE NOTE THAT THERE ARE: HIGH VOLTAGE (38KV AND HIGHER VOLTAGES) OVERHEAD LINES AND UNDERGROUND CABLES ON THIS MAP. IF YOU INTEND WORKING, OR UNDERTAKING DEVELOPMENT WITHIN A CORRIDOR EXTENDING 40 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE OVERHEAD LINES OR WITHIN A CORRIDOR EXTENDING 5 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE UNDERGROUND CABLES YOU MUST CONTACT THE DESIGNATED PARTIES (PLEASE SEE ENCLOSED SHEET) IN ADVANCE OF THE WORKS



Important Safety Notice:

Damage to gas pipelines can result in serious injury or death. Gas network information is provided as a general guide. The exact location and depth of medium or low pressure distribution gas pipes must be verified on site by carrying out necessary investigations, including, for example, hand-digging trial holes along the route of the pipe. Service pipes are not generally shown but their presence should always be anticipated.

High pressure transmission pipelines are shown in red. If a transmission pipeline is identified within 10m of any intended excavations then work must not proceed before GNI has been consulted. The true location and depth of a transmission pipeline must be verified on site by a representative of GNI. Contact can be made through 1800 427 747.

All work in the vicinity of the gas network must be completed in accordance with the current edition of the Health & Safety Authority publication, Code of Practice For Avoiding Danger From Underground Services which is available from the Health and Safety Authority (01 614 7000) or can be downloaded at www.hsa.ie.

Legal Notice:

Gas Networks Ireland (GNI) and its affiliates, accept no responsibility for the accuracy of any information contained in this document including data concerning location and technical designation of the gas distribution and transmission network (the Information). The Information should not be relied on for accurate distance or depth of cover measurements.

Any representations and warranties, express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect or consequential loss, arising out of or in connection with the use or re-use of the Information.

- Aurora Telecom Fibre Optic Cable
- Aurora Telecom Duct
- Aurora Telecom Sub-duct
- Aurora Telecom Inserted Gas Pipe

Contact Aurora Telecom on 1800-427-369 or (01)203-0120.

- Transmission Pipe (High Pressure)
- Transmission Pipe (Construction Issue)
- Distribution Pipe (Medium Pressure)
- Distribution Pipe (Low Pressure)
- Service Pipe (Medium Pressure)
- Service Pipe (Low Pressure)
- Strategic Pipe (Medium Pressure)
- Strategic Pipe (Low Pressure)
- Inserted Pipe (Medium Pressure)
- Inserted Pipe (Low Pressure)
- Distribution Pipe (Abandoned)

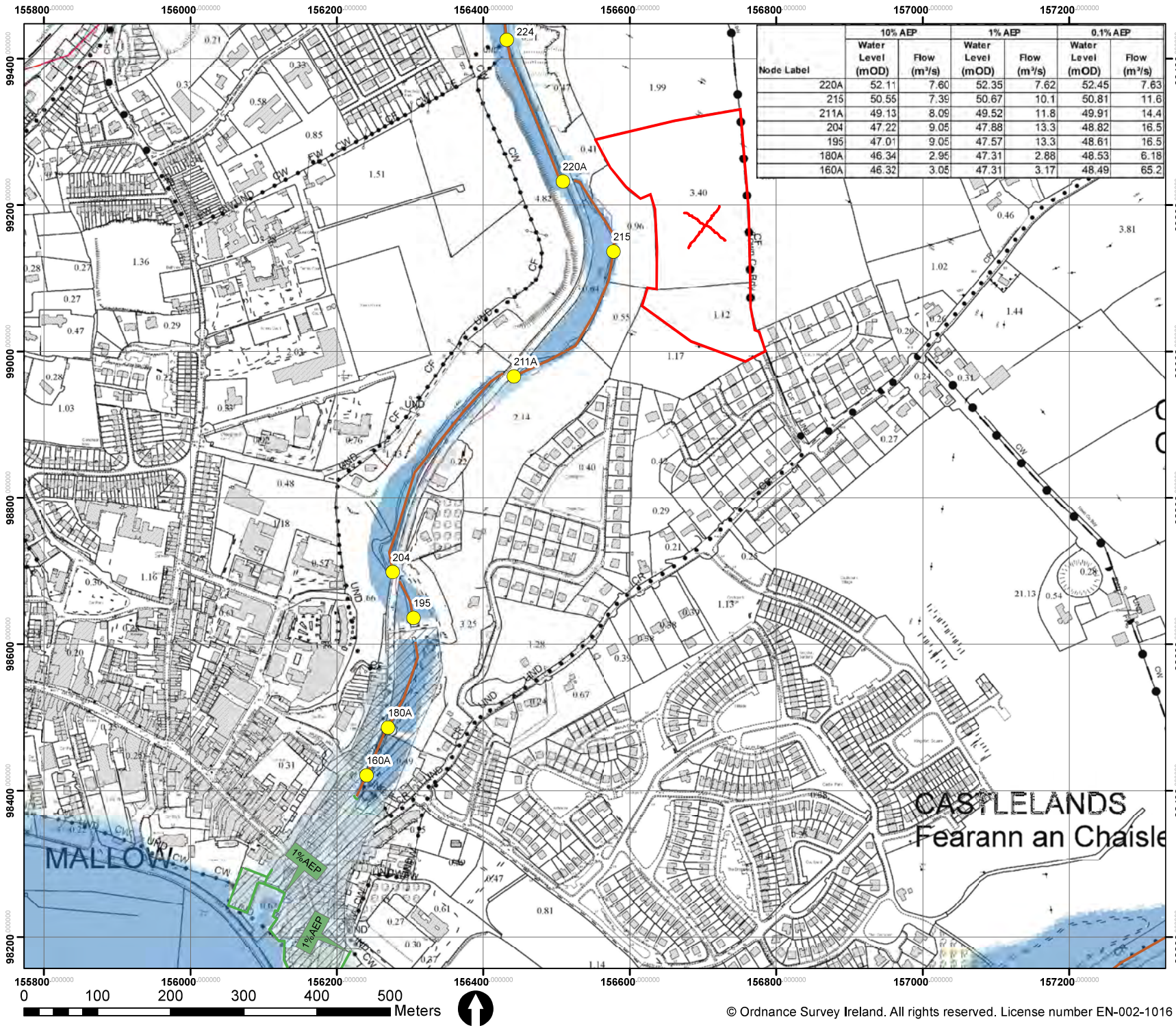
- C>1' Cover (depth in meters)
- CP Test Point
- End Cap
- Hot Tap
- Installation
- Valve
- Mains Verification **
- Pressure Monitor
- Protection (Sleeve)
- Protection (Slabbing)
- Reducer
- Service Terminator
- Tee
- Transition

** Please contact GNI on 1800427747 for specific information.

Appendix E

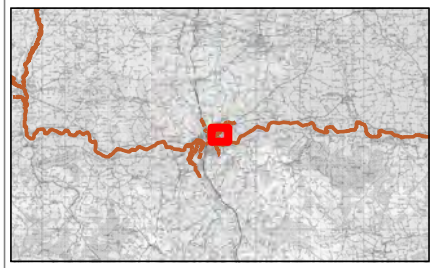
Flood Documents

CFRAM Map – Mallow Tile 11 – Flood Extent (all probabilities).



Node Label	10% AEP Water Level (mOD)	10% AEP Flow (m³/s)	1% AEP Water Level (mOD)	1% AEP Flow (m³/s)	0.1% AEP Water Level (mOD)	0.1% AEP Flow (m³/s)
220A	52.11	7.60	52.35	7.62	52.45	7.63
215	50.55	7.39	50.67	10.1	50.81	11.6
211A	49.13	8.09	49.52	11.8	49.91	14.4
204	47.22	9.05	47.88	13.3	48.82	16.5
195	47.01	9.05	47.57	13.3	48.61	16.5
180A	46.34	2.95	47.31	2.88	48.53	6.18
160A	46.32	3.05	47.31	3.17	48.49	65.2

Location Plan:



Legend:

- Model Nodes
- Flood Defence - Embankment
- Modelled River Centreline
- Defended Area
- AFA Boundary
- 10% AEP Flood Extent
- 1% AEP Flood Extent
- 0.1% AEP Flood Extent

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

SOUTH WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

OPW
Office of Public Works
Jonathan Swift Street
Trim Co. Meath

Mott MacDonald
Mott MacDonald Ireland
5 Eastgate Avenue
Little Island
Co. Cork

Project:
South Western CFRAM Study

Map:
Mallow - Flood Extent

Map type:	Flood Extent
Source:	Fluvial Flooding
Map area:	Urban Area
Scenario:	Current

Drawn by:	Lee Cutting	Date:	June 2016
Checked by:	Marianne Piggott	Date:	June 2016
Approved by:	Christian Hetmank	Date:	June 2016

Map No.:MMD/296235/E/DR/I18HMW/EXFCDEXF/F/Sht011

Sheet: 11 of 12 Revision: F

Drawing Scale: 1:5,000 Plot Scale: 1:1@A3

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Project: Proposed Residential Development at Árd an Ghleanna, Mallow, Co. Cork

Project No: 22054

Document Title: Planning Stage Construction and Environmental Management Plan

Document No: 22054-XX-XX-XX-XX-RP-WDG-CE-002

Author: Ian Reilly BEng MSc MIEI

Date	Revision	Status	Originator	Checked
10.07.2024	0	Planning	IR	MW

Table of Contents

1.0 Introduction

This Construction and Environmental Management Plan (CEMP) has been prepared by Walsh Design Group (WDG) on behalf of Cork County Council for a proposed Housing Development on a site at Árd an Ghleanna, Mallow, Co. Cork. The CEMP has been prepared in parallel with the Environmental Impact Assessment Report (EIAR) for the project and takes cognisance of the specific mitigation measures outlined in the EIAR.
The CEMP provides a framework from which a construction stage CEMP will be developed to implement the mitigation measures described below which are designed to avoid, minimise, or mitigate adverse construction effects on the environment during construction of the development. The CEMP will be finalised following grant of planning permission and prior to construction to include all relevant conditions imposed by the Planning Authority. Additional mitigation measures may be added following consultation with relevant parties.
Should any ambiguity or contradiction arise in the preparation of the construction stage CEMP between the text of the CEMP, the mitigation measures and planning conditions, the following precedence shall apply:

1. Planning conditions
2. Mitigation measures
3. CEMP text

The Contractor shall comply with any conditions arising from the site constraints identified and specified, all Statutory Regulations governing the works, and any additional measures or modifications that may be imposed on the proposed development by the local authority.

1.1. Background

Cork County Council are proposing to develop a site to the northeast of Mallow town centre, just north of the existing Aldworth Heights housing estate, see Figure 1 & Figure 2. The Site will be accessed via the Aldworth Heights Estate Road off St. Joseph's Road (L-1220-0). The site is bounded to the west by woodland and the N72 national road, to the South by the Aldworth Heights estate and to the east and north by agricultural land.

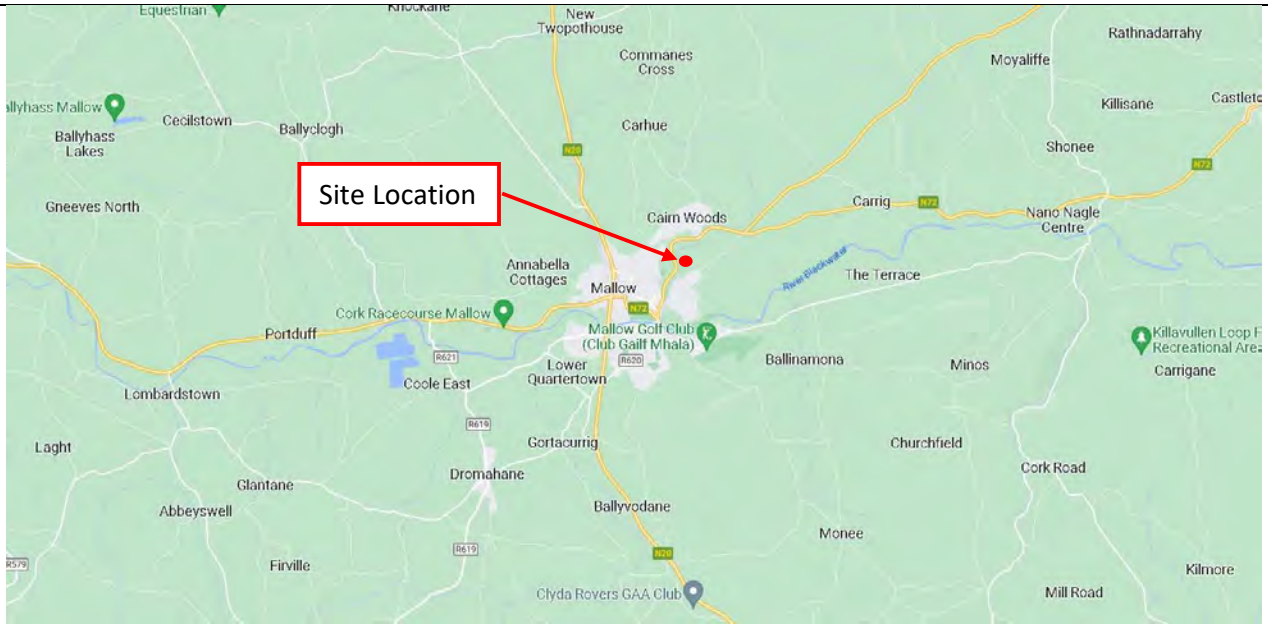

Figure 1 - Development Site Location Map

Figure 2 - Development Site Location Satellite Image – Development site lined in Red

1.2. Site Description

The site area within the application, redline boundary is approximately 4.52ha and the ITM grid coordinates at the approximate centre of the site are E556636, N599227. This is a greenfield site, currently used as agricultural land. The site generally slopes downwards from the southeast corner to the northwest. The high point of approximately 86.2m is near the entrance in the southeast and the low point of approximately 63.0m is at the northwest boundary. A small stream flows southwards beside the N72 roadway to the west of the site.

1.3. Proposed Development

The proposed development would consist of a total of 138no. dwellings comprising 4no. 4 bed semi-detached houses, 14no. 3 bed semi-detached houses, 20no. 3 bed townhouses, 36no. 2 bed townhouses, 32no. 2 bed apartments and 32no. 1 bed apartments and a creche as well as associated green areas, estate roads, boundary treatments, services and all other infrastructure required to develop a large housing project. Architectural, Engineering and Landscaping drawings are included in the planning documentation; an outline of the development is shown in the Architect's site layout in Figure 3.

1.3.1. Access Road

Vehicular access to the development will only be possible via the existing Aldworth Heights estate road, off St. Joseph's Road (L-1220-0). Pedestrian and cycle access will be provided alongside the access road and several potential future connections are indicated in the Architect's Layout drawing, see Figure 3.

Figure 3 - Architect's Site Layout

1.3.2. Estate Roads

Estate roads will be constructed to provide circulation routes around the development. Roads will consist of an asphalt pavement on granular capping and subbase layers. Concrete footpaths will be provided. Services such as foul and surface water drainage, water, electricity, public lighting and telecommunications will be run under or next to the roads. Surface water from the roads and public hardstanding areas will be collected firstly in a selection of SuDS features. Residual runoff that does not infiltrate to the soil in those SuDS features will be conveyed by a drainage network and discharge to the stream to the west of the site, at the greenfield runoff rate, having been attenuated on site.

1.3.3. Housing

The unit breakdown is given in paragraph 1.3 above. The housing units will be of typical domestic construction refer to the planning submission drawings for details. Foundations will be reinforced concrete (RC) strip footings. The buildings will most likely be timber framed inner leaf with masonry/brick outer leaf. Concrete, asphalt or paved parking or driveways will be provided to the front of the units. The development will also include a creche facility.

1.3.4. Landscaped Areas

Several green spaces and landscaped areas are proposed within the development. Refer to the Landscape Architect's design report and drawings for further details.

2.0 Development Construction Management

2.1. Safety Health and Environmental Considerations

The appointed Contractor will be required to prepare a Construction Health & Safety Plan which will be put in place prior to commencement of the works. At a minimum, this plan will include:

- Construction Health & Safety training requirements,
- Induction procedures,
- Emergency protocols,
- Details of welfare facilities,
- Risk assessments and Method Statements.

2.2. Development Phasing

It is envisaged that there will be phasing of the development's construction, as is commonplace for large housing developments. The exact configuration of the phasing has not been finalised at this stage, but the overriding principle will be to fully complete blocks of the development and isolate residents from the construction operations as much as possible.

2.3. Works Description

2.3.1. Site Access

Access to the construction site will be via the gate in the existing paladin fencing at the end of the Aldworth Heights estate road, off St. Joseph's Road (L-1220-0). At the early stages of construction, the access road within the site may be constructed from unbound stone. The access road will be paved and completed, including street furniture, cycle ways and footpaths, in advance of occupation of the first phase of the development.

2.3.2. Site Set-up and Security

The first activity to be carried out at the site will be the establishment of site facilities and security. The site office and welfare facilities (site compound) will be confirmed in advance of the commencement of site works. All the sub-contractors as well as the main contractor and project managers will occupy offices within the construction compound. The site parking for all staff, contractors and visitors will also be located in this area. Erection of perimeter hoarding will take place at the start of the project alongside the site establishment and security works. The hoarding will be installed along the boundaries with neighbouring housing estates and completed phases of the proposed development, except for the dedicated access points. The extent of hoarding will be subject to the detailed phasing of the development and will ensure that areas under construction will be fenced off at all times. Gates will be provided at the access points and will be locked outside of working hours. Hoarding will consist of solid painted plywood on a timber support frame or similar. Hoarding will be properly designed to be secure and durable and will be maintained until it can be dismantled on completion of the development (or phase of the development).

2.3.3. Lighting

Lighting will be provided as necessary at construction compounds. Consideration of best practice and guidance in relation to lighting and wildlife impact such as Bats & Lighting Guidance Notes for Planners, Engineers, Architects and Developers (Bat conservation Ireland, December 2010); All lighting will be directional with appropriate cowling installed to minimise light spillage from the site. The height of lamp posts will be restricted (e.g. <8m where possible) to reduce the amount of light spillage to where it is not

needed. The lights will be positioned facing away from the woodland and stream to the west, where possible, to minimize impact on bats that may use this area as a commuting route as well as other species who may use this habitat. Where possible all light fittings will be LED, have asymmetrical projection i.e. directional, and with colour temperature of 2700K (warm spectrum preferred by bats). The radiation will be above 500nm to avoid the blue or UV light, most disturbing to bats.

Construction work will generally be confined to daylight hours and lighting will generally not be required for the construction phase. There will however be occasions where the provision of portable lighting will be required such as evening work during later winter/early spring, works on roadways and power floating floors. Where possible and without jeopardising site safety, lights will be pointed down at a 45-degree angle and away from sensitive receptors. The site compound will have external lights for safety and security. This lighting will also be controlled by occupancy/motion sensors so that it will remain at a low output unless activated. This will mitigate light overspill as well as avoiding energy wastage. Construction stage lighting will be designed to minimise the broadcast of light to surrounding areas including sensitive receptors.

2.3.4. Site Clearance

To facilitate the earthworks operation, site clearance will have to be carried out to remove vegetation. Removal of woody vegetation shall only take place outside the bird breeding season (1st March to 31st August). No removal of habitats or movement of construction machinery will occur outside of the development works area/footprint during the construction phase. Existing trees and hedgerows shall be retained where possible. Temporary surface water management measures will be put in place prior to stripping of topsoil and will remain in place until the completion of the development, or until the completion of each phase. Refer to paragraph 3.1 for details of the surface water management measures.

Topsoil will be stripped from the area to be developed and from areas where site won fill may be excavated to bring the development to the correct level. All excavated topsoil will be stored in dedicated stockpiles with environmental controls in place. Prior to topsoil clearance, an Invasive Species Management Plan and survey is recommended to ensure areas of invasive plant species (if any) are identified and managed prior to or during site clearance works. There is a responsibility on the Environmental Manager or Ecological Clerk of Works (ECoW) to regularly inspect and supervise maintenance of the environmental controls throughout the process.

2.3.5. Earthworks

Once surface water management measures are in place and topsoil has been stripped, earthworks operations can commence. This will consist of moving fill from the higher ground at the east to the lower ground to the west. Material will be excavated by 360° excavators and transported to the deposition area by articulated dumpers. The fill will then be placed by dozers and compacted using vibratory rollers. A testing regime will be implemented to ensure the acceptability of the fill and that the degree of compaction is sufficient. Fill will be brought to the required level across the site to allow construction of roads and foundations. An overall earthworks balance has been targeted i.e., no imported fill will be required for the bulk earthworks and no soil will be removed from the site.

2.3.6. House Construction

On completion of the bulk earthworks, construction of foundations for housing will commence. The exact construction sequence has not been determined at this stage, but it will be similar to that described below:

- Temporary roads will be constructed to provide access to each row of units. This will include the construction of surface water management and silt control infrastructure, including settlement ponds and silt fencing.
- Construction of foundations. It is envisaged that strip foundations will be used on this site. The locations of foundations will be set out on the ground. Importation of certified stone fill will be required for the layers under the floor slabs in compliance with the Building Regulations. Reinforcement will be fixed, formwork installed, and all required ducting placed prior to placement of concrete. Construction of foundations will require concrete deliveries to the site. Controls will be required to prevent any concrete material reaching local watercourses.
- Once foundations have cured, timber frames will be delivered to site and erected, followed by roofs.
- Scaffolding will be erected, and construction of the masonry/brick outer leaf will then be completed.
- Windows and doors will be installed, and first fix plumbing and wiring will be completed prior to external and internal rendering.
- On completion of rendering, second fix, plumbing wiring and carpentry will be completed, followed by floors, painting and finishing.
- At this stage, installation of drainage and services is likely to be underway, and the roads will be completed. Drives, footpaths, boundary walls and lawns will be finished, and final road pavements will be installed.

2.3.7. Landscaping

Landscaped areas will be completed at the same time as each phase. These areas will be brought to a level below the final grading and will be finished with reclaimed topsoil on completion. Seeding and planting will be in accordance with the landscape plan for the site. Refer to the Landscape Design Report prepared by Forrestbird Design.

3.0 Environmental Management

3.1. Surface Water

The subject site is on high ground that falls generally from south to North but also from the eastern boundary towards the western boundary. There is a steep, wooded embankment from the western boundary down towards the small stream that runs southwards alongside the N72 roadway.

Surface water will naturally tend to flow away from the higher boundaries with the existing Aldworth Heights, Castle Heights and Castle Grove estates in the south, towards the western boundary. Roughly half of the western boundary (southern half) is shared with lands in the same ownership as the subject site whereas the northern half bounds lands in different ownership. The most sensitive part of the site in terms of surface water will be the western boundary due to the natural flow path towards that boundary and onwards to the stream.

Run-off into excavations/earthworks cannot be prevented entirely and is largely a function of prevailing weather conditions. Care will be taken to ensure that exposed soil surfaces are stable to minimise erosion. All exposed soil surfaces will be within the main excavation site which limits the potential for any offsite impacts. All run-off will be prevented from directly entering any water courses as no construction will be undertaken directly adjacent to open water. No significant dewatering will be required during the construction phase which would result in the localised lowering of the water table. There may be localised pumping of surface run-off from the excavations during and after heavy rainfall events to ensure that the excavations are kept safe and relatively dry.

The measures outlined in the following sections will be put in place during the construction phase to ensure protection of surface waterbodies. Construction works will be informed by best practice guidance from Inland Fisheries Ireland on the prevention of pollution during development projects. These measures comply with the following relevant CIRIA and Inland fisheries guidance documents:

- Control of Water Pollution from construction Sites, Guidance for consultants and contractors (C532)
- Environmental Good Practice on Site (3rd edition) (C692)
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (2016)

3.2. Pollution Control

3.2.1. Suspended Solids

Prior to the commencement of topsoil stripping and earthworks operations, the following site-specific surface water management measures will be put in place:

Where possible, significant earthworks operations should be limited to the summer months.

Silt fencing will be installed around the lower sections of the site perimeter. The location of the silt fencing will be determined in the construction stage CEMP and will be subject to a detailed assessment of the area or phase to be developed. The purpose of the silt fencing is to prevent silt laden water leaving the site and entering neighbouring land with the potential to impact nearby watercourses. A typical silt fencing arrangement is shown below in Figure 4. It will consist of a double layer of geotextile membrane fixed to wooden stakes approximately 600mm high. The membrane will be anchored into the ground to form a

continuous barrier to silt laden water from the works site. Silt fences will be monitored via a silt inspection log (to be maintained by the Environmental Manager/ECoW) and periodically maintained during the construction period. Typical maintenance will consist of repairs to damaged sections of membrane and removal of a build-up of silt on the upslope side of the fence. Daily silt fence inspections are recommended as part of their operation ensuring that any necessary repairs can be expedited.

Figure 4 - Typical Silt Fencing Arrangement

Drainage ditches will be installed to intercept surface water where there is a risk of significant water flow into excavations or onto adjoining lands. There will also be a requirement to periodically pump water from excavations. All collected and pumped water will have to be treated prior to discharge. The run-off will be directed through appropriately sized settlement ponds in series to remove suspended solids before being discharged, see Figure 5.

Figure 5 - Settlement Ponds in Series

Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the site compound. These agencies will be notified immediately in the event of a pollution incident.

Site personnel will be trained in the importance of preventing pollution and the mitigation measures described here to ensure same.

The Environmental Manager or ECoW will be responsible for the implementation of these measures. They will be inspected on at least a daily basis for the duration of the works, and a record of these inspections will be maintained.

Any temporary storage of soil, hardcore, crushed concrete or similar material will be stored 50m from any surface water drains. All temporary storage areas should also have surface runoff controls in place to prevent migration of possible materials. There can be no direct pumping of silty water from the works directly to any watercourse. All water from excavations must be treated by infiltration over lands or via settlement ponds, silt busters etc.

3.2.2. Flooding

The subject site is elevated and sloping to a degree that flooding is not anticipated in any event. The flood extent map drawn up as part of the Southwestern CFRAM Study (floodinfo.ie) shows the stream to the west overflowing its normal channel during fluvial flood events but this is significantly below the level of the site's lowest point. The site is not in any risk category in the CFRAM Study Maps.

3.2.3. Control of Cement Run-off

The washing out of concrete delivery vehicles is a potential source of pollution and shall be carried out in designated wash out areas only, see Figure 6.

Wash-out areas on site will be located more than 50m from any natural watercourse and properly designed with an impermeable liner to contain all cement laden water. No wash-out of ready-mix concrete vehicles

shall be located within 10 metres of any temporary or permanent drainage features. Signage shall be erected to clearly identify the wash-out areas. Sufficient wash-out areas shall be provided to cater for all vehicles at peak delivery times.

On-site batching of concrete is not envisaged, but ready to use mortar silos are often used for housing developments. These systems involve the delivery and storage of dry cement and aggregates in silos, water is added at the point of delivery to make mortar or plaster. The following controls shall be put in place for the on-site batching of concrete, mortar and render:

- The plant shall be maintained in good condition,
- Delivery of cement shall be means of a sealed system to prevent escape of cement,
- The plant shall be situated on a paved area at least 20m from any temporary or permanent drainage features,
- Emergency procedures shall be in place to deal with accidental spillages of cement or mortar.

Figure 6 - Concrete Truck Washout Area with Impermeable Liner

3.2.4. Accidental Leaks or Spills

No bulk chemicals will be stored within the active construction areas. Temporary oil and fuel storage tanks may be kept in the material storage area in suitable containers and will be stored on appropriately bunded spill pallets as required. Any fuel and oil stored on site shall be stored on bunded spill pallets (approved under BS EN 1992-3:2006). All bunds will be impermeable and capable of retaining a volume of equal to or

greater than 1.1 times (>110%) capacity of the containers stored on them. In the event of a spillage, excess oil or fuel will be collected in the bund.

Refuelling of vehicles and the addition of hydraulic oils or lubricants to vehicles will be undertaken off site where possible. Where this is not possible, filling and maintenance will take place in a designated material storage compound, which is located at least 10 metres from any temporary or permanent drainage features. Spill protection equipment such as absorbent mats, socks and sand will be available in clearly marked bins/silos and in construction vehicles to be used in the event of an accidental release during refuelling. Training will be given to site workers in how to manage a spill event.

The following mitigation measures will be taken at the construction site to prevent any spillages to ground of fuels during machinery activities and prevent any resulting soil and/or groundwater quality impacts:

- Refuelling will be undertaken off site where possible,
- Where mobile fuel bowsers are used the following measures will be taken:

1. Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use.
2. Any pump or valve will be fitted with a lock and will be secured when not in use.
3. All bowsers to carry a spill kit and operatives must have spill response training; and
4. Portable generators or similar fuel containing equipment will be placed on suitable drip trays.
5. Weekly checks of spill kits will be carried out to ensure they are sufficiently stocked.

3.2.5. Monitoring

Daily checks will be carried out and recorded in a Surface Water Management Log to ensure surface water drains are not blocked by silt, or other items, and that all storage is located the required distance from surface water receptors. A daily log of inspections will be maintained, and any significant blockage or spill incidents will be recorded for root cause investigation purposes and updating procedures to ensure incidents do not reoccur.

3.3. Noise Vibration & Dust Control

Construction of the development has the potential to create significantly increased noise and dust levels locally unless adequate controls are put in place. Earthworks operations will involve the use of heavy construction plant. Stockpiles of material and haul roads could become dusty in dry weather. Road and housing construction are also potential sources of noise and dust.

3.3.1. Noise Control

Specific noise abatement measures shall comply with the recommendations of BS5228-1 2009. These measures will include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise,
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations,
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract,
- Compressors and generators will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers,

- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use,
- Any plant, such as generators or pumps, required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen,
- Location of plant shall consider the likely noise propagation to nearby sensitive receptors.

The earthworks will generate typical construction activity related noise and vibration sources from use of a variety of plant and machinery such as rock breakers (where required), excavators, lifting equipment, dumper trucks, compressors and generators. The noise levels shall comply with the mitigation measures and any planning conditions.

A designated noise liaison will be appointed to site during construction works. Any complaints will be logged and followed up in a prompt fashion. In addition, prior to particularly noisy construction activity, e.g., excavation close to a property, etc., the site contact will inform the nearest noise sensitive locations of the time and expected duration of the works.

All works on site shall comply with BS 5228 2009+ A1 2014 (Parts 1 & 2) which gives detailed guidance on the control of noise and vibration from construction activities. In general, the contractor shall implement the following mitigation measures during the proposed infrastructure works:

- Avoid unnecessary revving of engines and switch off equipment when not required,
- Keep internal haul roads well maintained and avoid steep gradients,
- Minimise drop height of materials,
- Start-up plant sequentially rather than all together.

3.3.2. Vibration Control

Vibration limits to be applied for the infrastructure works will be those specified in the TII document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII, Revision 1, 2004).

Allowable Vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration shall comply with the mitigation measures and any planning conditions.

3.3.3. Dust Control

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design, planning and effective control strategies. The siting of construction activities and soil stockpiles will take note of the location of sensitive receptors and prevailing wind directions to minimise the potential for significant dust nuisance. In addition, good site management will include the ability to respond to adverse weather conditions by either restricting operations onsite or using effective control measures quickly before the potential for nuisance occurs.

- During working hours, technical staff (e.g., Environmental Manager/ECoW) will be available to monitor dust levels as appropriate; and
- At all times, the dust management procedures put in place will be strictly monitored and assessed.

The dust minimisation measures will be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust generation. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed,

and procedures implemented to rectify the problem. Dust levels shall comply with the mitigation measures and any planning conditions.

Specific dust control measures to be employed shall be as follows:

Site Routes

Site access routes (particularly unpaved areas) can be a significant source of fugitive dust from construction sites if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions.

- A speed restriction of 15 km/hr will be applied as an effective control measure for dust for onsite vehicles or delivery vehicles within the vicinity of the site.
- Bowsers will be available during periods of dry weather throughout the construction period, with water sourced from the mains supply. The bowser will operate during dry periods to ensure that unpaved areas are kept moist. The required application frequency will vary according to soil type, weather conditions and vehicular use.
- Any hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced areas shall be restricted to essential site traffic only.

Demolition/Excavation

Demolition and excavation work during periods of high winds and dry weather conditions can be a significant source of dust.

- During dry and windy periods, and when there is a likelihood of dust nuisance, watering shall be conducted to ensure moisture content of materials being moved is high enough to increase the stability of the soil and thus suppress dust,
- During periods of very high winds (gales), activities likely to generate significant dust emissions will be postponed until the gale has subsided. The movement of truck containing materials with a potential for dust generation to an off-site location will be enclosed or covered.

Stockpiling

The location and moisture content of stockpiles are important factors which determine their potential for dust emissions. The following measures will be put in place:

- Overburden material will be protected from exposure to wind by storing the material in sheltered parts of the site, where possible,
- Regular watering will take place during dry/windy periods to ensure the moisture content is high enough to increase the stability of the soil and suppress dust,
- Permanent or long-term stockpiles of topsoil shall be seeded to limit dust emission.

3.4. Construction Traffic Management

It shall be the responsibility of the Developer and their appointed PSCS to implement and oversee a Construction Site Traffic Management Plan (CSTMP). The following list is a preliminary estimation of the daily traffic movements that will be generated by construction on the site:

- **Construction Workers / Site Staff -** Maximum number 60/day, generating 140 traffic movements,
- **Net Importation of fill material -** As required, less than 20 loads /day, generating 40 truck movements,

- **General Construction materials delivery (truck/ Van) -** On average 15 number/day, generating 30 traffic movements,
- **Construction Waste Removal -** When required, less than 40 loads/day, generating 80 truck movements.

It is recommended that the PSCS follow the guidance provided by the HSA in preparing the CSTMP. The HSA guidance document (Figure 3) and online fillable forms provide a framework of 6 main headings around which a full and detailed CSTMP can be formed. The headings are as follows:

1. **Information** – general site and responsible personnel information,
2. **Training** – proof of training or provision of training for relevant staff,
3. **Temporary Works** – Details of all temporary works relating to site traffic,
4. **Hazards** – Identification of hazards and risk assessments for same,
5. **Controls** – actions taken to mitigate risks identified,
6. **Resources** – equipment required to implement the plan i.e., hoarding, barriers, lighting signs etc.

Figure 7: HSA Construction Site Traffic Management Plan Guidance

The CSTMP shall outline issues which are relevant to the project and to provide solutions which are satisfactory to all concerned. The issues which we believe to be important are as follows:

- Proposed Traffic Routes – Planning and Management of same,
- Construction traffic logistics,
- Planning and management of expected traffic flow rates,
- Planning and management of delivery times,
- Site access and egress,
- Maintenance of public roads,
- Communication with local authorities and neighbours.

There are specific traffic management issues which the applicant can control. These are listed as follows:

- Extensive and thorough site rules for site traffic. This is issued to all sub-contractors at pre-appointment stage and shall ensure that they are contractually bound,
- Detailed delivery routes and times as a part of the rules which are in accordance with this traffic management plan – the options for delivery routes are limited by the fact that there will only be one entrance to the development site and traffic will approach on St. Joseph's Road (L-1220-0) and the Aldworth Heights Estate Road,
- Gated access and egress will be established at the entrance to the development site allowing in only authorised traffic which has arrived at the appointed time and by the appointed route,
- Approved contractor parking for all construction related personnel – this will be provided internally within the secured development site area.

The rules regarding access routes, clearways, minimum road width, parking near hydrants, etc. will be relayed to all site staff. Any driver who breaches the rules will be noted and reported to their employer and any driver who consistently or knowingly breaks the rules will be refused further access to the site.

Signage will be erected along emergency vehicle routes, and critical areas such as assembly points and means of escape will be kept clear.

To ameliorate/mitigate impacts on the surrounding area and, to mitigate noise levels emanating from the site, all site development and building works will be carried out only during those hours stipulated by the County Council in conditions attached to the planning grant. Any deviation from these times shall be submitted to Cork County Council for approval.

3.4.1. Planning and Management of Delivery Times

In relation to deliveries to the site, all large deliveries will have to be notified to site management at least 24 hours in advance. No large deliveries will be allowed to the site during peak traffic times for the area. All deliveries must enter the site at the designated entrance and report to the site security man who in turn will contact the relevant persons to take charge of unloading, etc.

3.4.2. Site Access and Egress

Access and egress to the site will be controlled by the developer and their appointed main contractor. The access for construction traffic for the development will have to be via the single entrance. As development progresses and dwellings are occupied the traffic management plan and the location of the site compound will need to be continuously reviewed in order to minimise disruption to residents. The developer will provide information on the requirements of the site traffic access rules to all stakeholders, which will include the following:

- The prescribed access routes. The route identified shall be monitored and updated as required by construction sequencing and shall be followed at all times by drivers entering and exiting the site,
- No site access before the permitted start times,
- No site access after the permitted finish times,
- Strictly no parking on any access road to the site,
- Minimise disruption to any developed/occupied phases,
- No vehicle may park on or around any footpaths in the adjoining areas,
- Caution must be exercised entering and leaving the site,

- All vehicles must stop at the security barrier,
- All instructions from the developer or development staff must be obeyed,
- Vehicles leaving the site must do so only at an appropriate break in the traffic, and must not force their way into traffic,
- Only vehicles with specific business on the site can enter the site, once permission has been granted by the developer and/or his staff,
- Heavy vehicle drivers must check their tyres for lodged stones, and remove them prior to returning to the public roads,
- Site speed limit proposed is 15 kph.

3.4.3. Maintenance of the Public Road

For the duration of the construction period there will be a power washer and wheel wash located inside the main entrance to the site. This will wash the wheels and undercarriages of all vehicles leaving the site to ensure no debris leaves the site on vehicles. Adequate provision will be made on site for drainage of this area. All truck drivers must also inspect their vehicles before they leave the site for stones caught in their tyres or any other debris.

There will be parking spaces at the site compound, reserved for staff, clients, and visitors. This will be located adjacent to the site compound. On street parking will not be acceptable under any circumstances.

Unauthorised entry will not be permitted and will be prevented by a security system which will be in operation during construction.

The wastewater sewer, potable water supply and electrical and telecoms ducting shall require connections to existing infrastructure in the public realm. Works within public areas will be given priority, in terms of available staff and traffic management, to ensure that this component of the overall development is completed as expeditiously as possible, to minimise disruption. As part of any works (i.e., provision of services) within public roads/areas in the vicinity of the site, it will be ensured that these roads/areas will be re-instated to the satisfaction of Cork County Council.

3.5. Local Stakeholder Involvement

The Developer will, as required, liaise with owners of local properties in advance of works commencing onsite and coordinate works to have minimum impact on the operation of local properties. All signage used will meet the requirements of the Safety, Health & Welfare at Work (General Applications) Regulations 2007 and Chapter 8 Traffic Signs Manual.

3.6. Waste Management

This section outlines the measures that will be undertaken to minimise the quantity of waste produced at the site and the measures to handle the waste in such a manner as to minimise the effects on the environment. A site-specific Construction Waste Management Plan (WMP) has been prepared and will be employed to ensure sustainable and effective waste management throughout the construction and demolition phases of the project. Adherence to the WMP prepared for the construction works will ensure that the management of waste arising is dealt with in compliance with the provisions of the Waste Management Acts 1996 – 2015 and amendments. The waste management hierarchy to be adopted will be as follows:

1. Prevention and Minimisation,
2. Reuse of Waste,
3. Recycling of Waste,
4. Disposal.

Typical waste materials that will be generated from the demolition and construction works will include:

- Soil and Stones,
- Concrete, bricks, tiles and ceramics,
- Wood, glass and plastics,
- Metals,
- Gypsum-based construction material,
- Paper and cardboard,
- Mixed C&D Waste,
- Chemicals (Solvents, paints, adhesives, detergents etc.)

The management of all hazardous waste arisings, if they occur, shall be coordinated in liaison with health and safety management.

3.6.1. Waste Minimisation

Waste minimisation measures proposed are summarised as follows (and are described in more detail in the CWMP):

- Materials will be ordered on an 'as needed' basis to prevent over supply,
- Materials will be correctly stored and handled to minimise the generation of damaged materials,
- Materials will be ordered in appropriate sequence to minimise materials stored on site,
- A waste tracking log will be established,
- Sub-contractors will be responsible for similarly managing their wastes,
- All wood waste generated by site works will be inspected and examined and will be segregated as re-useable wood and scrap wood waste.

3.6.2. Waste Storage

The main waste storage area will be situated in the site compound A dedicated and secure area containing bins, and/or skips, and storage areas, into which all waste materials generated by construction site activities, will be established within the development.

Waste materials generated will be segregated at the site compound, where it is practical to do so. Where the on-site segregation of certain waste types is not practical, offsite segregation will be carried out. There will be skips and receptacles provided to facilitate segregation at source. All waste receptacles leaving site will be covered or enclosed. The appointed waste contractor will collect and transfer the wastes as receptacles are filled.

The site Construction Manager will ensure that all staff are informed of the requirements for segregation of waste materials by means of clear signage and verbal instruction. Appointed employees will be made responsible for ensuring good site housekeeping.

3.7. Invasive Species

No evidence of invasive plant species was discovered on the works site during initial surveys. Should some trace of an invasive species be identified during site clearance, the following measures are proposed to prevent the inadvertent spread of any invasive plant species:

1. The Contractor will prepare an Invasive Alien Species (IAS) Management Plan for the works. The Plan must be clearly communicated to all site staff and must be adhered to if it is to be implemented successfully,
2. Prior to the development and landscaping works an updated survey by an appropriately experienced ecologist will be carried out to establish the full extents of the invasive plant species within the proposed development site boundary,
3. In accordance with the Tii guidance this survey will produce accurate 1:5000 scale mapping for the precise location of invasive species. The pre-construction surveys will be undertaken by suitable ecologists with competence in identifying the species concerned having regard to any seasonal constraint,
4. Areas of invasive species will be fenced off and signage installed where no works will take place within this area until such time as they can be eradicated/managed,
5. The invasive species will be appropriately managed (aiming for eradication) prior to any vegetation clearance works occurring where these species were identified.

For the best available methods of control and eradication refer to the NRA Guidelines (2010) and Fennell *et al*. (2018). It is recommended that a suitably experienced contractor is employed to undertake the invasive species eradication programme at the site. Several approaches are available for the control of invasive plant species consisting of chemical control, physical control, or a combination of both. For example, manual control may only work for small, new infestations such as young Buddleia shrubs, but a combination of manual and chemical control may be required to ensure the complete eradication of more established shrubs. The specialist contractor will advise/finalise the best approach based on their knowledge of the species in question.

4.0 Roles and Responsibilities

4.1. Construction Manager

The Construction Manager will have overall responsibility for the site during the construction phase. This will include implementation of the CEMP. The Construction Manager shall:

- Manage all construction staff and subcontractors to ensure the requirements of the CEMP, planning permission and all legislative requirements are complied with,
- Cooperate with the Environmental Manager to ensure that the works do not pose an environmental risk,
- Ensure all monitoring plans are maintained throughout the construction phase,
- Be responsible for implementing all response plans and notifying relevant bodies of any incidents.

4.2. Environmental Manager or Ecological Clerk of Works (ECoW)

The Environmental Manager will be responsible for all environmental monitoring during the construction phase. The duties of the Environmental Manager are summarised as follows:

- Carry out (or manage) all environmental monitoring and maintain auditable logs of all environmental requirements,
- Liaise with statutory bodies in relation to environmental issues,
- Prepare regular environmental reports and maintain the CEMP,
- Carry out environmental site audits to ensure the works are carried out in accordance with the CEMP. Advise the Construction Manager of non-conformances and areas for improvement.
- Review the Contractor's method statements with respect to environmental issues.
- Monitor compliance with the mitigation measures and any planning conditions relating to the environment.
- Assist the Construction Manager in the notification and investigation of all environmental incidents.
- Act as a point of contact to allow all site staff to take responsibility for and report environmental issues.
- Provide education and toolbox talks for all site staff and maintain an Environmental Notice Board.

5.0 Conclusion

This planning stage CEMP sets out the overall management strategy for construction works for the proposed development. The CEMP aims to ensure the management of construction activity is carried out in a planned, structured, and considerate manner which minimises the impacts of the works on the local environment, residents, and commercial activities in the vicinity of the site. Due to the nature of construction works, there may be unforeseen events which occur at the site and the project team will actively manage any changes and discuss with the relevant authorities, where required. The project stakeholders are committed to ensuring that the construction activities to be carried out are actively managed to minimise potential issues.