Project

Mixed-use Development, Castleforbes, Sheriff St Upper, Dublin 1

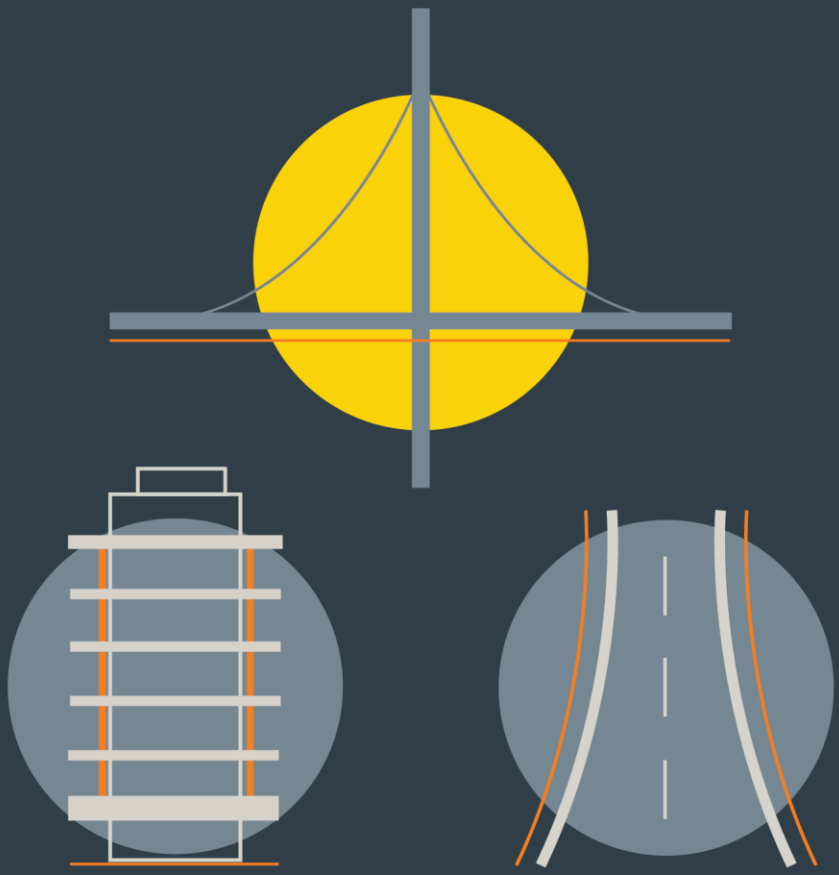
Report Title

Infrastructure Design Report

Client

Glenveagh Living PLC

INFRASTRUCTURE



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1.0 INTRODUCTION

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for the proposed mixed-use development on a site which forms part of the Castleforbes Business Park, Sheriff St Upper, Dublin 1.

1.2 Location & Topography

The proposed site is located in Dublin 1, in the North Docklands area of Dublin City, approximately 1.4km north-east of the City Centre as shown in *Figure 1-1*. The site is approximately 2.02Ha which forms part of the Castleforbes Business Park, Sheriff Street Upper, Dublin 1 (D01 VX48). The site is currently occupied by several warehouses and associated yards.

The site is bound by East Road to the west, an Irish Water pump station and CIE lands to the north, and Sheriff Street Upper to the south.

As per Dublin City Councils development plan, the site has been zoned Z14, to seek the social, economic and physical development and/or rejuvenation of an area with *mixed use, of which residential and "Z6" would be the predominant uses.*

Generally, the site is relatively flat with a slight fall from the south to north of the site. The topographical survey has been included in appendix D.

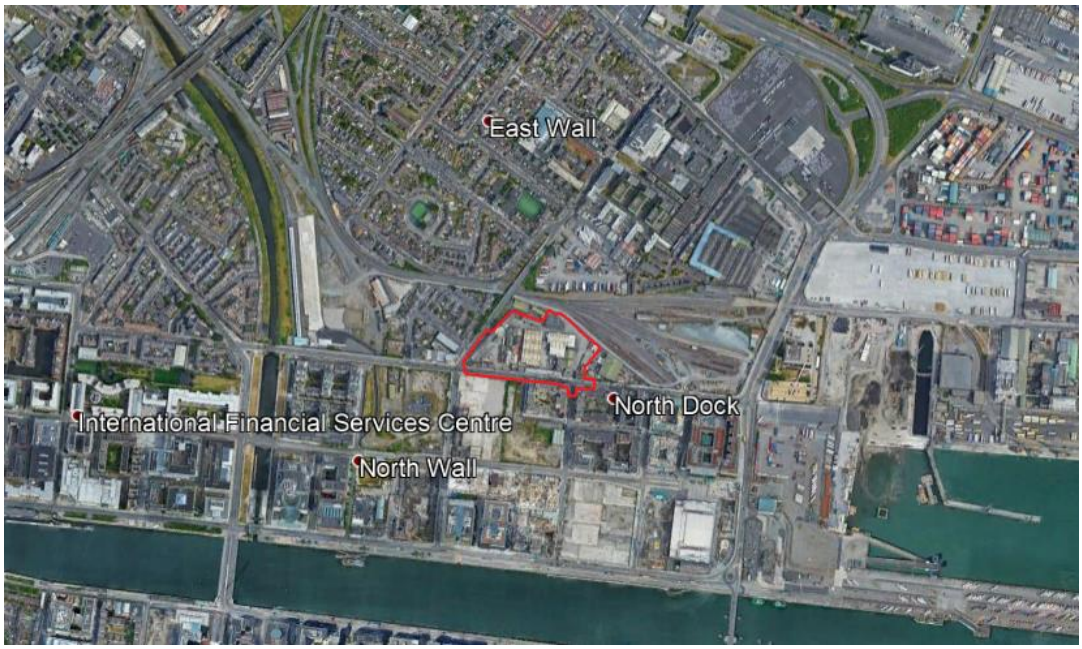


Figure 1-1: *Site Location (Site Boundary Indicative Only)*

1.3 Existing Ground Conditions

A ground investigation was undertaken by Ground Investigations Ireland and this revealed that the strata encountered consisted mainly of surfacing on made ground to approximately 1.80m-6.10m BGL on Granular and Cohesive deposits of fine to medium or fine to coarse SAND and brown sandy gravelly CLAY.

Rock was encountered within the Rock Cores between 29.30m and 34.50m and consisted of Weak to medium strong black fine thinly laminated Limestone.

Groundwater was noted at depths between 2.4m and 2.8m BGL which indicates a relatively normal groundwater table.

1.4 Proposed Development

The development will consist of the demolition of all structures on the site and the construction of a mixed use development set out in 9 no. blocks, ranging in height from 1 to 18 storeys, above part basement/upper ground level, to accommodate 702 no. residential units (comprising 100 studios, 406 no. 1 bed units, 169 no. 2 bed units, 15 no. 3 bed units, 8 no. duplex units and 4 no. live/work units), retail, creche, cultural space and residential tenant amenity. The site will accommodate car parking spaces, bicycle parking, storage, services and plant areas. The residential buildings are arranged around a central open space (at ground level) and raised residential courtyards at upper ground level over part basement level. Ground floor level uses located onto Sheriff Street and into the central open space include a cultural building and live/work office space. Two vehicular access points are proposed along Sheriff Street, and the part basement car parking is split into two areas accordingly, accommodating 1,040 bicycle parking spaces (including 30 no. disable spaces), 179 car parking spaces, plant, storage areas and other associated facilities. The main pedestrian access is located centrally along Sheriff Street with additional access points from East Rd and from the eastern end of Sheriff Street. The application also includes for a pocket park on the corner of Sheriff Street and East Rd to be provided as a temporary development prior to additional future development on this part of the site.

2.0 Flood Risk

Based on a review of the Eastern Catchment Flood Risk Assessment and Management (CFRAM) study, it is noted that the development lands are located within Flood Zone C for fluvial flooding. Dublin City Council's Strategic Flood Risk Assessment (SFRA) places the development lands within Flood Zone A, however it must be noted that it is in an area that benefits from flood defences. The Irish Coastal Protection Strategy Study (ICPSS) places the site located within the coastal flood extent for the 0.5% AEP event, however the ICPSS flood extent maps do not consider the existing flood defences that defend this area.

The mitigation measure used to decrease the risk of coastal flooding for site users was to ensure that all 'highly vulnerable' finished floor levels are located above the 0.1% AEP flood level, in addition to a climate change allowance and a conservative freeboard, giving a minimum FFL for this type of development of 4.08m.

Possible flood risk associated with the surcharging or blockage of the development's drainage system will be mitigated by suitable design of the drainage network, regular maintenance and inspection of the network and establishment of exceedance overland flow routes.

Flood risk has been assessed in a Site Specific Flood Risk Assessment (SSFRA). Please refer to DBFL report 180189-Rep-102 – SSFRA.

3.0 SITE ACCESS AND ROAD LAYOUT

3.1 Existing Access

The proposed development site has a two vehicular entry points on Sheriff Street Upper; one opposite the existing Sheriff St Upper/Castleforbes Road priority junction to the southeast corner of the subject site and the other at the southwest corner via a gated entrance as shown in Figure 3-1.

Figure 3-1: *Existing access into the site*

3.2 Proposed Access

3.2.1 Vehicular and Cycle Access

The proposed access to the residential development for vehicles and cycles will be via two entrances on Sheriff Street Upper (shown in Figure 3-2), at the south western and south eastern ends, which will lead into two separate basement/undercroft parking lots. The accesses will be 6m wide and will consist of a ramp leading from the ground floor level down to the basement level where vehicular parking and cycle storage spaces will be provided. Cycle access to pedestrian plazas and open space will also be available at various points around the development as per figure 3-2.

3.2.2 Pedestrian Access

Pedestrians will access the site via 2 no. entrances which are located on East Road at the north western side of the development and on Sheriff Street Upper, at the southern and south eastern side of the development. These entrances will be linked by the development's courtyard allowing for movement of pedestrians between East Road and Sheriff Street Upper through the development.

3.3 Servicing and Refuse

A single entrance for fire tender vehicles will be provided on Sheriff Street Upper at the southern end of the proposed development (refer to *Figure 3-2*). These vehicles will enter the development at the ground floor level via a shared space and will be able to proceed to the north of the development. The management company of the development will enforce restrictions for this entrance to ensure the area is accessible only by maintenance and fire tender vehicles using removable bollards.

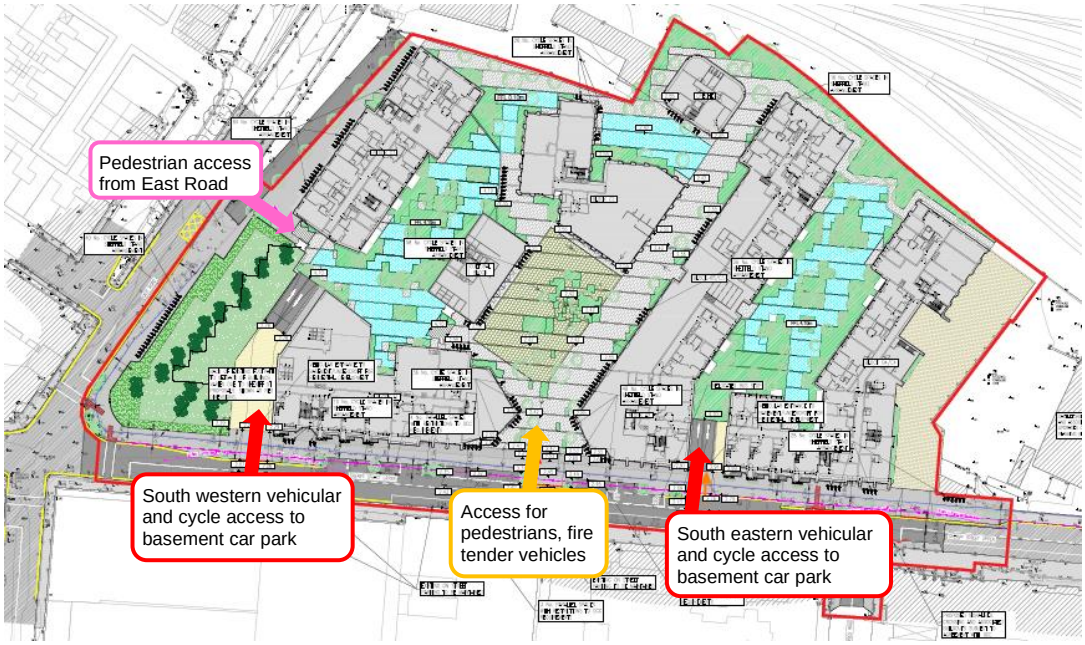


Figure 3-2: *Proposed Access to development*

3.4 Sheriff Street Upper Works

As part of the Castleforbes redevelopment, a Sheriff Street masterplan proposal has been created to give an overall concept of the full works along the northern side of the street. Elements of the proposals will be in separate planning applications, such as the granted Hotel and Office proposal directly to the east (Planning Ref 3433/19). As part of this proposal, the on-street car parking has been re-defined to take account of the various proposed developments vehicular accesses and respecting the associated sightlines.

In total over the northern side of Sheriff Street, a total of 14 no. on street car parking spaces have been proposed, 8 of these which are adjacent to this application boundary.

As part of these works, the footpath will be widened along the length of the application boundary, with the proposed buildings being set back to allow for an active street edge, with landscaped areas in accordance with the Design Manual for Urban Roads and Streets.

3.5 Sheriff Street Upper / Castleforbes Road Signalised Junction

In addition to the works stated in chapter 3.4, the development proposals also include for the upgrading the junction of Sheriff Street Upper / Castleforbes Road to a signalised junction in line with the Design Manual for Urban Road and Streets (DMURS) and the Traffic Management Guidelines. The proposed road layout and hard landscaping areas have been tracked to demonstrate that the proposed corner radii and turning heads will accommodate everyday vehicles.

As part of the junction pedestrian crossings will be included on Sheriff Street Upper at the proposed south eastern pedestrian entrance and Castleforbes Road.

3.6 Proposed Parking

Parking spaces for the residential development will be provided in the basement which will consist of 170 no. car parking spaces (of which 3 would be car share spaces), 9 no. disable parking bays, bike store areas to accommodate 1,040 no. residential bikes (including 30 no. disable bike spaces). A further 352 bicycle spaces will be provided at ground floor level.

As stated in chapter 3.4, 8 no. on-street parking spaces are being proposed on Sheriff St Upper as part of this application as part of the Sheriff St Upper masterplan.

3.7 Quality Audit

A quality audit, including a stage 1 road safety audit, was undertaken for the proposed development in which recommendations have been provided to help improve the quality of the design. As part of this process, DBFL provided feedback on the acceptance of the recommendations and alternative recommendations for implementations. These accepted amendments will be incorporated into the detailed design post planning in agreement with DCC.

4.0 EXISTING SERVICES AND UTILITIES

4.1 General

A comprehensive topographical survey was carried out for the subject site and existing drainage and utility records in the vicinity of the site obtained and surveyed in detail. A summary of the existing main services is provided below, and the Irish Water records can be found in appendix D.

4.2 Surface Water and Foul Drainage

Irish water records (refer to Figure 4-1) show that there is a 990mm combined brick sewer, to the south of the proposed development site, that drains from east to west along Sheriff Street Upper before turning north onto East Road and eventually discharges into the Irish Water pump station at the north western corner of the development site. The Irish Water pump station then discharges into a surface water gravity main, via a syphon overflow, that then drains south down Castleforbes Road.

The original rising main from the East Road Pumping Station, which is now disused cuts through the north eastern part of the site before turning south turning eastwards onto Sheriff St Upper.

Irish Water records also show a 1000mm combined brick sewer at the south eastern corner of the development site that drains south down Castleforbes Road.

4.3 Water Supply

The site is well served by watermains on Sheriff Street Upper as shown on Figure 4-1. There are two connections to the existing building off this watermain to the south of the development site, which will be re-used if practical and subject to Irish Water approval.

Existing Fire hydrants are also present at the south eastern and south western corners of the site.

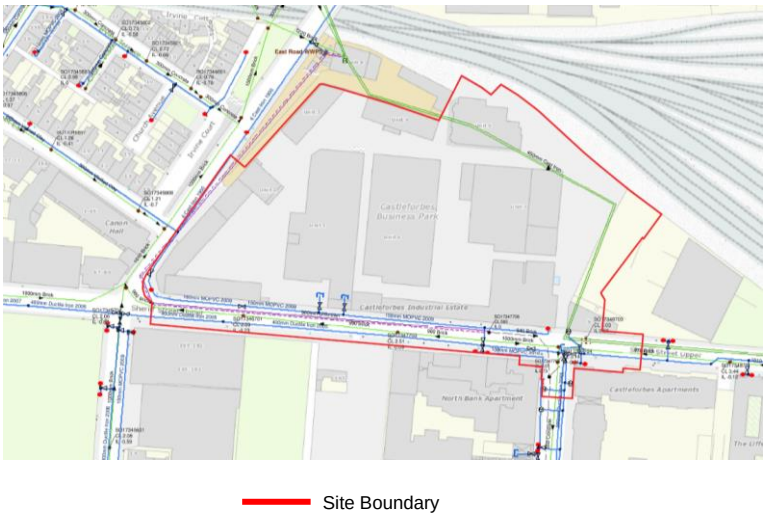


Figure 4-1: *Existing watermain and sewer records (Boundary indicative only)*

5.0 PROPOSED SURFACE WATER DRAINAGE

5.1 Surface Water Policy

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the Greater Dublin Strategic Drainage Study (GDSDS) and with the requirements of Dublin City Council. The guidelines require the following 4 main criteria to be provided by the design;

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment within the green roof, bio-retention/filter drains and green courtyard and garden.
- Criterion 2: River Regime Protection – satisfied by attenuating to greenfield run-off rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the development's surface water drainage design, planned flood routing, run-off contained within site, flood storage and highly vulnerable development set greater than 0.5m above 100-year flood level.
- Criterion 4: River flood protection – attenuation volume and discharge limit designed to greenfield run-off rates (long term storage not provided).

5.2 Surface Water Strategy

To meet the requirements of the surface water policy cited in section 5.1, the surface water strategy has been described in this section to give a clearer indication of how the design of the development has progressed to the submitted design. To give a clearer understanding of each SUDS element, the different stages of the treatment train has been explained in detail in the following section.

Infiltration techniques such as soakaways have been discounted as part of the development due to the groundwater table recorded during the site investigation and the potential presence of contaminated material within the site. Therefore, attenuation features at roof/terrace and ground level such as green roofs/build-up. Permeable paving, bioswales and rain gardens shall be implemented into the development to convey surface run-off via the drainage system to the larger attenuation tank while also providing treatment and ecological value.

Roof & Terrace Level:

As the first part of the treatment train, the SUDS features have been designed to prioritise, interception and reduction of flow rates. The features that will be incorporated into the design are:

- Green roof - this will be a mixture of intensive and extensive type with 80mm minimum construction depth. All necessary safety requirements will be designed and constructed to ensure safe maintenance can occur. The green roof will provide interception and reduction of flow rates at the beginning of the treatment train, providing source control for a large area of the development. After surface water has passed through the Green Roof medium, it will then drain to gullies located at the structural slab level and then conveyed to the below ground system via slung drainage.
- Planters will also be installed on the roof terraces locally acting to reduce run off and allowing an element of interception to occur.
- The hardstanding of the roof terraces will be constructed of permeable paving that allows the surface water to slowly percolate through the build-up before being discharged to the positive drainage system.

Podium Level (1st Floor):

- At podium level the subject development will implement permeable pavement and green landscaping (over Podium A and B). Refer to DBFL drawing 180159-2100 for extents.

  The green landscaped areas will constitute what is similar to an intensive Green Roof build-up, allowing surface water run-off to slowly percolate through the build-up medium, reducing the flows through the drainage network and also allowing vegetation to intercept run-off creating a reduction in run-off volumes.
- In areas of permeable paving, a free draining aggregate sub-base will be used between the permeable paving and the podium slabs allowing a reduction in flows within the drainage network.
- Once the rainwater has filtered through the various build-up mediums, run-off will drain to gullies located at the structural slab level and then conveyed to the below ground system via slung drainage.
- In addition to the above, smaller SUDS elements will also be located on podium such as Bio-swales, raised planters and rain gardens (refer to Figure 5-1). These will be specified in co-ordination with the landscape design to slow any areas of hardstanding that need to be drained and provide additional treatment and subsequent improvement of discharge quality.

Figure 5-1: *Examples of Urban Swales/Bio-swales – Various Sources*

Ground Floor:

- Permeable paving will be located around the ground floor of the development to again treat and reduce run-off at source. Figure 5-2 shows the proposed main areas where permeable paving is proposed, and the full extents can be seen on DBFL drawing 180159-2100. Impermeable strips have been included in the design to allow other services to be easily constructed and maintained. These areas still predominately drain to either the permeable paving or the proposed landscape features such as rain gardens.

- Tree pits and vegetation planters will also be connected to the surface water drainage and allow run-off to pass through planters and tree pits allowing interception of this vegetation, further reducing volume and flow rates within the drainage system. The use of smaller sustainable conveyance techniques will also be implemented where possible.

- The above source control SUDS measures being included within the design have been co-ordinated into the landscape design to ensure the surface water strategy is integral to the Landscape. This has reduced the sites reliance on attenuation tanks to reduce peak run-off flow rates. Although due to the design storm event, and the need to incorporate climate change within the design a certain volume is still required within an attenuation tank.

- The site requires one attenuation tank to provide the required volume to ensure the development does not flood in the 1 in 100-year storm event plus climate change. The main attenuation storage for the subject site will be in the pedestrian plaza of the development located centrally between the two basements.

- SUDS elements as described previously on ground floor will be also be connected to these attenuation tanks, decreasing the reliance on attenuation systems and using a co-ordinated multi element SUDS network to service the site.

The incorporation of the above SUDS elements will provide a sustainable approach to disperse surface water from the site and provide treatment of run-off and subsequent improvement of discharge quality.

5.3 Attenuation

Attenuation volumes have been calculated based on an allowable outflow / green field runoff rate of 3.2 l/s ($QBAR_{RURAL}$ calculated in accordance with Institute of Hydrology Report 124, see Appendix A). Refer to Appendix A for calculations sheets.

The drainage design uses SOIL type 2 for the site's QBar greenfield run-off calculations. To derive the soil type, table 4.5 of the Flood Studies Report was used as recommended by the GDSDS.

Run-off from the new development will be attenuated using various SUDS elements, although the main volume will be based in a geo-cellular attenuation tank which will work in parallel with a 'hydrobrake optimum' or similar approved as a flow control device.

The impermeable areas contributing to the attenuation volume have had the following reduction factors applied:

Roof Level:

- Green roofs, the proposed build-up will be a mix of intensive and extensive type with 80mm minimum construction depth. The soil build-up will primarily absorb some of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium. Therefore, a reduction of volume and flow rate will occur due to the presence of the green roof. Also, the green roof plant life will absorb a percentage of the run-off, further reducing volume that will drain to the surface water network. Therefore a 30% reduction factor has been applied.
- Flat impermeable roof and roads, a 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing (various sources recommend different reduction coefficients e.g. IS EN752 recommends Runoff Coefficient (C for the Rational Method) of 0.9 to 1.0 for impermeable areas and steeply sloping roofs. For flat roofs it recommends 0.5 to 1.0 depending on area).

Podium Level & Ground Floor:

- Green areas over podium, a reduction factor of 50% has been applied. The deep soil build-up will primarily absorb a substantial amount of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium.

- Permeable Paving on podium and ground will have a free draining material within the build-up and will reduce the flow rate from these areas. Rainfall will 'wet' the initial surface of the paving allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, as the run-off drains through the free draining aggregate, this build-up will also 'wet' giving another volume reduction due to evapotranspiration and natural storage within the SUDS feature. A reduction in velocity will also occur as the aggregate used will slow the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. A reduction factor of 30% has been applied for these reasons.
- Areas draining to Filter Drains and Bioswales and/or Treepits, a conservative reduction factor of 20% has been applied for these areas not located over podium. Firstly, rainfall will 'wet' the initial surface of the paving, allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, giving a reduction in volume. As run-off drains to these SUDS elements and through the build-up, the aggregate/soil surface area will also 'wet' giving another reduction of volume due to evapotranspiration and natural storage within the SUDS feature. There will also be a reduction of velocity as the aggregate/filter material used in the SUDS feature slows the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. The SUDS Manual outlines that they "can help reduce flow rates from a site by providing some attenuation storage and can reduce storage volume requirements where infiltration occurs".

Throughout the site, a geo-cellular storage system has been selected and designed to provide the required volume for the 100-year storm event (+20% climate change) using Micro Drainage source control software, refer to Appendix B for summary of results for various storm-water durations. Calculations indicate that 953m^3 of storage volume for the 100-year event (+20% climate change) is needed.

Surface water attenuation calculations can be found in Appendix B. Refer to DBFL drawings 180159-3101 and 180159-3112 for attenuation tank location and details.

5.4 Design Standards

Storm-water drainage has been designed in accordance with the Greater Dublin Code of Practice for Drainage Works. The following design parameters are applicable to the design:

- Time of entry: 4 minutes
- Pipe Friction (k_s): 0.6 mm
- Minimum Velocity: 1.0 m/s
- Standard Average Annual Rainfall: 693 mm
- M5-60: 16.2 mm
- Ratio r (M5-60/M5-2D): 0.28
- Attenuation Tank Storm Return Event: GDSDS Volume 2, p61, Criterion 3

  30 year no flooding on site.

  100 year check no internal property flooding. Flood routing plan. FFL freeboard above 100-year flood level. No flooding to adjacent areas.
- Climate Change: 20% for rainfall intensities, as GDSDS

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

The minimum pipe diameter for public surface water sewers is 225mm. Private drains comprise of diameters from 100mm.

5.5 Climate Change

Surface water calculations for the development made use of rainfall values for the Docklands area as provided by Met Eireann. Rainfall intensities were increased by a factor of 20% to take account of climate change, as required by the DCC for attenuation storage design.

5.6 Flooding Provision

In the case that that an exceedance storm event occurs, in excess of the 1% AEP. The development's layout is designed to ensure over-land flows are directed away from the buildings. In larger than the 100-year storm events, there will be additional volume within the surface water network which will be able to surcharge before flooding. When this tolerance has been exceeded the attenuation storage features will flood and overtop, with overland flows expected to pass from the site onto Sheriff Street Upper following the topography of the land as shown in Figure 5-2.

Figure 5-2: *Overland flow path*

5.7 Surface Water Quality Impact

The type of development is low risk i.e. it does not present a high risk of run-off contamination. The development's design and layout further reduce the risk of contaminants entering the surface water network as most of the site coverage will be roof/terrace/podium area with all of vehicle parking provided at basement level. Run-off from green areas of the roof will have a first stage of treatment by draining through green-roof medium which in turn drain to a slung system which in turn drain via the attenuation storage system. The courtyard areas will drain via their build-ups to the attenuation storage system.

The highest risk of contaminated surface water run-off from the site would be from the entrances to the car park which are relatively small areas.

All incidental drainage from the car park is discharged separately via a Class 2 oil separator to the foul sewer. In this way it is considered that the development provides treatment of collected run-off, and is low risk of pollutants.

The proposed surface water system has therefore been designed to incorporate SUDS techniques which naturally reduce pollutants and improve water quality.

5.8 Interceptance

The GDSDS recommends that no run-off should pass directly to a river for rainfall depths of 5mm and up to 10mm if possible, i.e. interception. The development's drainage design allows for collection of most of the site's run-off via SUDS features e.g. green roofs and filter drains, providing interception at source. In turn resulting runoff is conveyed to attenuation storage system provide a level of further interception. Calculations in accordance with the GDSDS recommendations can be found in appendix A and indicate a minimum of 128.9m^3 of interception volume should be provided. This interception will occur within elements such as the green roof, green podium and permeable paving.

6.0 PROPOSED FOUL DRAINAGE

6.1 Proposed Foul Layout

The proposed foul drainage for the development has been designed to drain to slung drainage systems in the basement parking areas which will then discharge into a subsurface foul sewer in the courtyard. The surface water drainage network will join into the last foul manhole before finally discharging the into the 1200mm diameter Irish Water combined sewer on Sheriff Street Upper to the south of the proposed development. The foul drainage network can be found on DBFL drawing 180159-3100.

An Irish Water Statement of Design Acceptance and the Confirmation of Feasibility can be found in appendix E.

6.2 Design Calculations

Minimum gradients and pipe diameters for gravity collector and main sewers are designed in accordance with the Building Regulations and Irish Water's Code of Practice for wastewater infrastructure and Standard Details for wastewater infrastructure.

The sewer network is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Wastewater Infrastructure, IS EN 752 (2008), IS EN12056: Part 2 and Building Regulations Part H.

Foul sewer design criteria are as follows:

Pipe Roughness Coefficient	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing)
Maximum Velocity	3.0 m/s

Estimated peak foul loading generated by the proposed development is provided in *Table 6-1* and *Table 6-2*.

Table 6-1: *Estimated Foul Loading for residential development*

RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Loading (G) (l/day/person)***	**Daily Loading (PG) (l/day)**	**Daily Loading (l/s)**
Residential	702	2.7 people/dwelling	1,893	150	284,310	3.29
					Daily Loading	**3.29**
					Growth factor	1.00
					Infiltration @ 10% (as CoP Appendix B – 2.2.4)	0.33
					Dry Weather Flow (l/s)	**3.62**
					Residential Peaking Factor (as CoP Appendix B – 2.2.5)	3.00
					Design Foul Flow (l/s)	**10.85**
					Surface Water allowance SW @ 1.5 (as CoP Appendix B – 2.2.11)	0.20
					Design Flow (l/s)	**11.05**
***Flow rates extracted from IW CoP for Wastewater Infrastructure - Appendix D**						

Table 6-2: *Estimated Foul Loading for commercial development*

COMMERCIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Use Type	**Floor Space (m^2)**	**Occupancy Rate**	**Population (P)**	**Loading (G) (l/day/person)***	**Daily Loading (PG) (l/day)**	**Daily Loading (l/s)****
Cultural	2,860	1 per 50 m^2	57	20	1,144	0.01
Live/Work	1,154	1 per 15 m^2	77	100	7,695	0.09
Creche	470	1 per 20 m^2	23	90	2,113	0.02
					Daily Loading	**0.13**
					Growth factor	1.00
					Infiltration @ 10% (as CoP Appendix B - 2.2.4)	0.01
					Dry Weather Flow (l/s)	**0.14**
					Commercial Peaking Factor (as CoP Appendix B - 2.2.7)	3
					Design Foul Flow (l/s)	**0.42**
					Surface Water allowance SW_E @ 1.5 (as CoP Appendix B - 2.2.11)	0.20
					Design Flow (l/s)	**0.62**
***Flow rates extracted from IW CoP for Wastewater Infrastructure - Appendix D** ****For commercial premises, a working day is assumed to be over 12 hours**						

Overall design flows from the development are calculated using IW CoP for Wastewater Infrastructure Appendix C, as outlined below:

Dry Weather Flow = PG + I + E

Design Foul Flow = [Pf_{Dom} X PG] + [$Pf_{Dom, Ind}$ X $P_E G_E$] + I +[Pf_{Trade} X E] (Eqn1)

Design Flow = Eqn 1 + [SW + SW_E]

The type of proposed use is mixed-use comprising residential and commercial; therefore, no industrial flow has been assumed. For commercial premises a working day is assumed to be over 12 hours when flows will be contributing to the public sewer network. Growth rates are not assumed as the proposed application is for a fixed quantum of development (G = 1).

Total Dry Weather Flow = 3.62 l/s (residential) + 0.14 l/s (commercial) = **3.76 l/s**

Total Foul Flow = 10.85 l/s (residential) + 0.42 l/s (commercial) = **11.27 l/s**

Total Flow = 11.05 l/s (residential) + 0.62 l/s (commercial) = **11.67 l/s**

6.3 Proposed Diversion

Irish Water's East Road Pumping Station is currently located to the north of the site which is accessed via East Road. From this pumping station an existing 450mm diameter rising main currently runs from west to east through the north eastern part of the site, turning south towards Sheriff Street upper where the rising main then turns eastwards and runs in the footpath of Sheriff St Upper (refer to Figure 6-1).

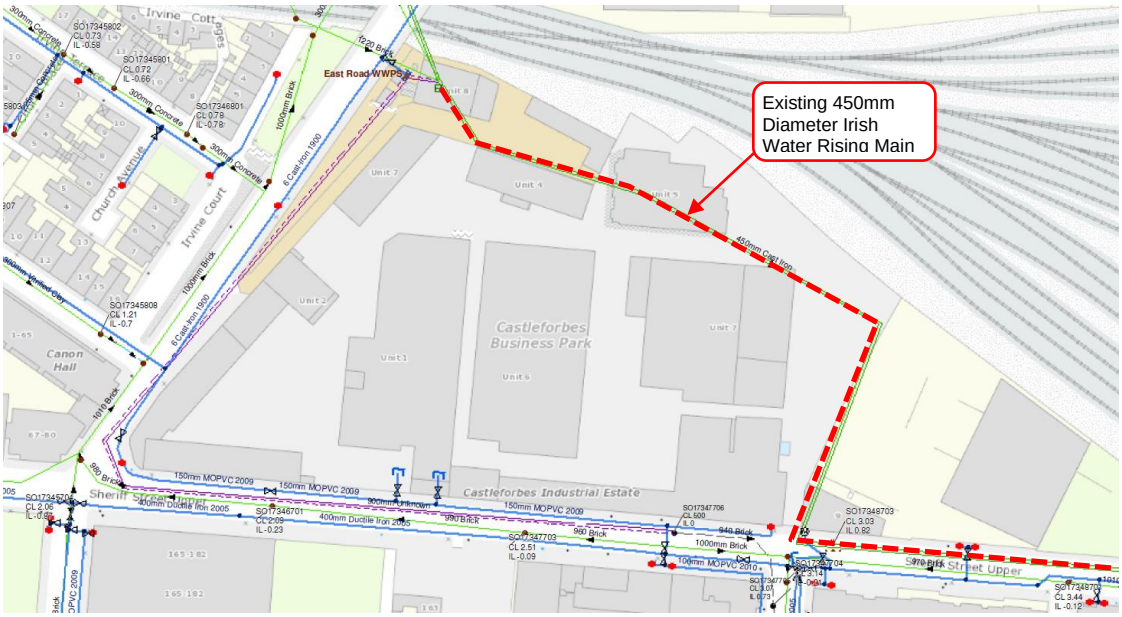


Figure 6-1: Irish Water Records

Due to the layout of the blocks and basement location, it is proposed to divert the rising main through the site which will allow 5m either side of the centreline of the sewer as shown on Figure 6-2.

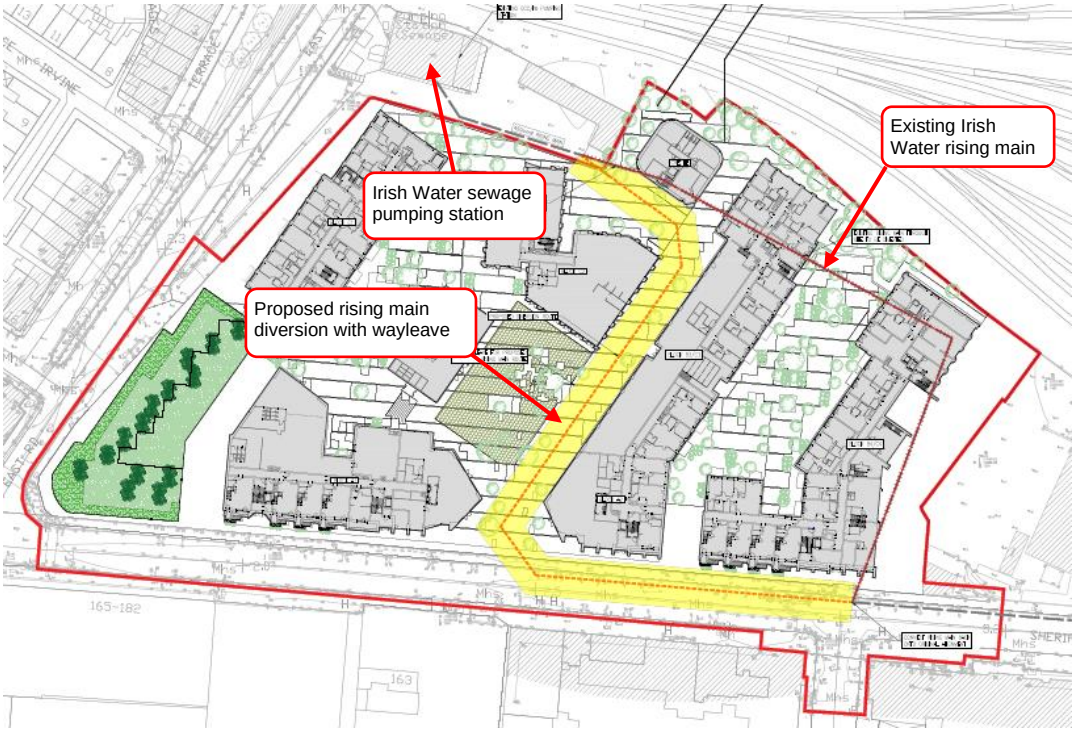


Figure 6-2: Proposed Irish Water rising main diversion

The proposed diversion will then run-down Sheriff Street Upper and connect into the existing rising main to complete the diversion.

The proposals have been submitted to Irish Water's Diversion team to progress the diversion and contact has also been sent to DCC Wastewater Services for their comments.

However, DCC do not use the rising main and this has been recommended to Irish Water for decommission. If this recommendation is accepted, there will be no need for the diversion and the rising main will be removed as part of the development works.

7.0 WATER SUPPLY AND DISTRIBUTION

7.1 Proposed Water main and Supply

As part of the development proposals the existing connection to the water main on Sheriff Street Upper will be used.

7.2 Water main Standards and Details

The water main layout and details including valves, hydrants, metering etc. will be in accordance with Irish Water's Code of Practice and Standard Details for water infrastructure.

7.3 Hydrants

As stated previously, there are existing fire hydrants along Sheriff Street Upper at the south eastern and south western corners of the site. These will be maintained to cater for any fire at the proposed development.

Hydrants shall comply with the requirements of BS 750:2012 and shall be installed in accordance with Irish Water's Code of Practice and Standard Details.

7.4 Design Calculations

The water demand is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Water Infrastructure Connections and Developer Services Design & Construction Requirements for Self-Lay Developments December 2017:

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

Per-capita consumption	150l/person/day
Average day/week demand factor	1.25
Peak demand factor	5.0

Average daily domestic demand = Total occupancy * Per-capita consumption

Average day/peak week demand = Average daily domestic demand * Average day/week demand factor

Peak hour water demand = Average day/peak week demand * Peak demand factor

Estimated water demand for the proposed development is provided in *Table 7-1* and *Table 7-2*. The total peak hour water demand for the combined commercial and residential use will be 21.90 l/s.

Table 7-1: *Estimated Water Demand for Residential Development*

RESIDENTIAL WATER DEMAND							
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Average daily domestic demand (l/day)**	**Average daily domestic demand (l/s)**	**Average day/peak week demand (l/s)**	**Peak hour water demand (l/s)**
Residential	702	2.7 persons/dwelling	1,893	284,310	3.29	4.11	20.54
						Peak hour water demand (l/s)	**20.54**

Table 7-2: *Estimated Water Demand for Commercial Development*

COMMERCIAL WATER DEMAND							
Use Type	**Floor Space (m^2)**	**Occupancy Rate**	**Population (P)**	**Average daily domestic demand (l/day)**	**Average daily domestic demand (l/s)***	**Average day/peak week demand (l/s)**	**Peak hour water demand (l/s)**
Cultural	2,860	1 per 50 m^2	57	150	0.10	0.13	0.65
Retail	1,154	1 per 15 m^2	77	150	0.13	0.16	0.80
Creche	470	1 per 20 m^2	23	150	0.04	0.05	0.25
						Peak hour water demand (l/s)	**1.71**
For commercial premises, a working day is assumed to be over 12 hours							

Appendix A

PERMISSIBLE OUTFLOW CALCULATIONS

PROJECT			JOB REF.
Castleforbes Development - SHD			p180159
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Permissible Site Discharge (Impermeable Area draining to Attenuation Tank)			1
Drawing ref.	**Calculations by**	**Checked by**	**Date**
180159-3100	PCC	NJF	19-Nov-20

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area? **1.75** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

Catchment (This refers to the entire site area)	0.3	
Area	1.75	Hectares (ha)
Drainage Group	1	Class
Depth to Impermeable Layers	1	Class
Permeability Group above Impermeable Layers	3	Class
Slope [o]	2	Class
SOIL Type	2	
[1]SOIL Index	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? No

What is the overall site area for catchment? 1.75 Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff.	Effective Area (m^2)
Roofs - Draining to gullies	3374.800	0.95	3206.060
Roofs - Green	6120.000	0.70	4284.000
Road and Footpaths - Draining to Gullies	0.000	0.95	0.000
Road and Footpaths - Draining to SuDS Features	0.000	0.80	0.000
Paved Areas - Draining to Gullies	1470.000	0.90	1323.000
Paved Areas - Draining to Suds features	4620.000	0.80	3696.000
Grassed Areas	1000.000	0.00	0.000

Include Public Open Space in Effective Catchment Area? Yes

Effective Catchment Area **12509.060** m^2

Effective Catchment Runoff Coefficient **0.75**

Long-Term Storage

Is long-term Storage provided? No

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 693.0 mm From Met Eireann, Co-ordinates N320000, E226000

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 3.20 Litres/sec

[7]Site Discharge = **3.20** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{ac} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

Appendix B

ATTENUATION AND SURFACE WATER NETWORK CALCULATIONS

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

Half Drain Time : 2951 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.631	0.281	0.0	2.6	2.6	191.2	O K
30 min Summer	0.745	0.395	0.0	2.6	2.6	268.5	O K
60 min Summer	0.879	0.529	0.0	2.6	2.6	359.4	O K
120 min Summer	1.033	0.683	0.0	2.6	2.6	464.7	O K
180 min Summer	1.130	0.780	0.0	2.6	2.6	530.3	O K
240 min Summer	1.197	0.847	0.0	2.6	2.6	576.2	O K
360 min Summer	1.287	0.937	0.0	2.6	2.6	637.0	O K
480 min Summer	1.351	1.001	0.0	2.6	2.6	680.9	O K
600 min Summer	1.400	1.050	0.0	2.6	2.6	714.0	O K
720 min Summer	1.438	1.088	0.0	2.6	2.6	739.6	O K
960 min Summer	1.492	1.142	0.0	2.7	2.7	776.4	O K
1440 min Summer	1.550	1.200	0.0	2.7	2.7	815.7	O K
2160 min Summer	1.575	1.225	0.0	2.8	2.8	831.4	O K
2880 min Summer	1.569	1.219	0.0	2.8	2.8	828.1	O K
4320 min Summer	1.542	1.192	0.0	2.7	2.7	810.3	O K
5760 min Summer	1.509	1.159	0.0	2.7	2.7	787.9	O K
7200 min Summer	1.476	1.126	0.0	2.7	2.7	765.5	O K
8640 min Summer	1.442	1.092	0.0	2.6	2.6	742.4	O K
10080 min Summer	1.408	1.058	0.0	2.6	2.6	719.6	O K
15 min Winter	0.665	0.315	0.0	2.6	2.6	214.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.445	0.0	169.5	34
30 min Summer	57.921	0.0	213.4	48
60 min Summer	38.927	0.0	350.5	78
120 min Summer	25.369	0.0	420.3	138
180 min Summer	19.466	0.0	415.4	196
240 min Summer	16.008	0.0	407.7	256
360 min Summer	12.013	0.0	398.3	374
480 min Summer	9.800	0.0	394.2	492
600 min Summer	8.359	0.0	393.4	612
720 min Summer	7.335	0.0	395.5	730
960 min Summer	5.961	0.0	404.0	968
1440 min Summer	4.439	0.0	410.8	1444
2160 min Summer	3.295	0.0	814.4	2160
2880 min Summer	2.662	0.0	802.0	2484
4320 min Summer	1.966	0.0	783.2	3248
5760 min Summer	1.584	0.0	1426.2	4048
7200 min Summer	1.342	0.0	1491.7	4904
8640 min Summer	1.171	0.0	1457.6	5720
10080 min Summer	1.045	0.0	1376.9	6560
15 min Winter	82.445	0.0	186.7	34

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	0.793	0.443	0.0	2.6	2.6	301.3	O K
60 min Winter	0.944	0.594	0.0	2.6	2.6	403.6	O K
120 min Winter	1.118	0.768	0.0	2.6	2.6	522.2	O K
180 min Winter	1.227	0.877	0.0	2.6	2.6	596.1	O K
240 min Winter	1.303	0.953	0.0	2.6	2.6	648.1	O K
360 min Winter	1.405	1.055	0.0	2.6	2.6	717.7	O K
480 min Winter	1.480	1.130	0.0	2.7	2.7	768.6	O K
600 min Winter	1.537	1.187	0.0	2.7	2.7	807.2	O K
720 min Winter	1.588	1.238	0.0	2.8	2.8	837.6	O K
960 min Winter	1.758	1.408	0.0	3.0	3.0	881.6	O K
1440 min Winter	1.981	1.631	0.0	3.2	3.2	929.3	O K
2160 min Winter	2.089	1.739	0.0	3.3	3.3	952.6	O K
2880 min Winter	2.076	1.726	0.0	3.2	3.2	949.7	O K
4320 min Winter	1.985	1.635	0.0	3.2	3.2	930.2	O K
5760 min Winter	1.854	1.504	0.0	3.0	3.0	902.2	O K
7200 min Winter	1.709	1.359	0.0	2.9	2.9	871.1	O K
8640 min Winter	1.586	1.236	0.0	2.8	2.8	836.7	O K
10080 min Winter	1.527	1.177	0.0	2.7	2.7	800.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	57.921	0.0	219.3	48
60 min Winter	38.927	0.0	387.4	76
120 min Winter	25.369	0.0	418.6	134
180 min Winter	19.466	0.0	408.4	192
240 min Winter	16.008	0.0	402.3	252
360 min Winter	12.013	0.0	398.8	368
480 min Winter	9.800	0.0	402.1	484
600 min Winter	8.359	0.0	410.3	602
720 min Winter	7.335	0.0	417.7	718
960 min Winter	5.961	0.0	428.1	950
1440 min Winter	4.439	0.0	439.3	1406
2160 min Winter	3.295	0.0	854.3	2064
2880 min Winter	2.662	0.0	861.9	2672
4320 min Winter	1.966	0.0	846.7	3336
5760 min Winter	1.584	0.0	1588.2	4280
7200 min Winter	1.342	0.0	1592.8	5264
8640 min Winter	1.171	0.0	1527.2	6224
10080 min Winter	1.045	0.0	1460.0	7080

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.200	Shortest Storm (mins)	15
Ratio R	0.279	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.260

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.280	8	12	0.280	16	20	0.170
4	8	0.280	12	16	0.250			

Model Details

Storage is Online Cover Level (m) 2.550

Cellular Storage Structure

Invert Level (m) 0.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	680.0	0.0	1.300	214.0	0.0
0.100	680.0	0.0	1.400	214.0	0.0
0.200	680.0	0.0	1.500	214.0	0.0
0.300	680.0	0.0	1.600	214.0	0.0
0.400	680.0	0.0	1.700	214.0	0.0
0.500	680.0	0.0	1.800	214.0	0.0
0.600	680.0	0.0	1.900	214.0	0.0
0.700	680.0	0.0	2.000	0.0	0.0
0.800	680.0	0.0	2.100	0.0	0.0
0.900	680.0	0.0	2.200	0.0	0.0
1.000	680.0	0.0	2.300	0.0	0.0
1.100	680.0	0.0	2.400	0.0	0.0
1.200	680.0	0.0	2.500	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0076-3400-1900-3400
Design Head (m)	1.900
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	0.350
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	3.4
Flush-Flo™	0.330	2.6
Kick-Flo®	0.676	2.1
Mean Flow over Head Range	-	2.6

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.2	7.000	6.2
0.200	2.5	1.400	2.9	3.500	4.5	7.500	6.4
0.300	2.6	1.600	3.1	4.000	4.8	8.000	6.6
0.400	2.6	1.800	3.3	4.500	5.1	8.500	6.8
0.500	2.5	2.000	3.5	5.000	5.3	9.000	7.0
0.600	2.4	2.200	3.6	5.500	5.6	9.500	7.2
0.800	2.3	2.400	3.8	6.000	5.8		
1.000	2.5	2.600	3.9	6.500	6.0		

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	20.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.280
Region	Scotland and Ireland	Cv (Summer)	1.000
M5-60 (mm)	16.200	Cv (Winter)	0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S1	4320 Summer	100	+20%	30/15 Summer	100/960 Summer		
1.001	S2	8640 Summer	100	+20%	30/1440 Summer	100/8640 Summer		
1.002	S3	2880 Summer	100	+20%	30/15 Summer	100/960 Summer		
2.000	S9	4320 Summer	100	+20%	1/960 Summer	100/960 Summer		
2.001	S10	2880 Summer	100	+20%	1/600 Summer	100/960 Summer		
1.003	S4	8640 Summer	100	+20%				
1.004	S5	8640 Summer	100	+20%	1/60 Summer			
1.005	S6	10080 Summer	100	+20%				
1.006	S7	2880 Summer	100	+20%				

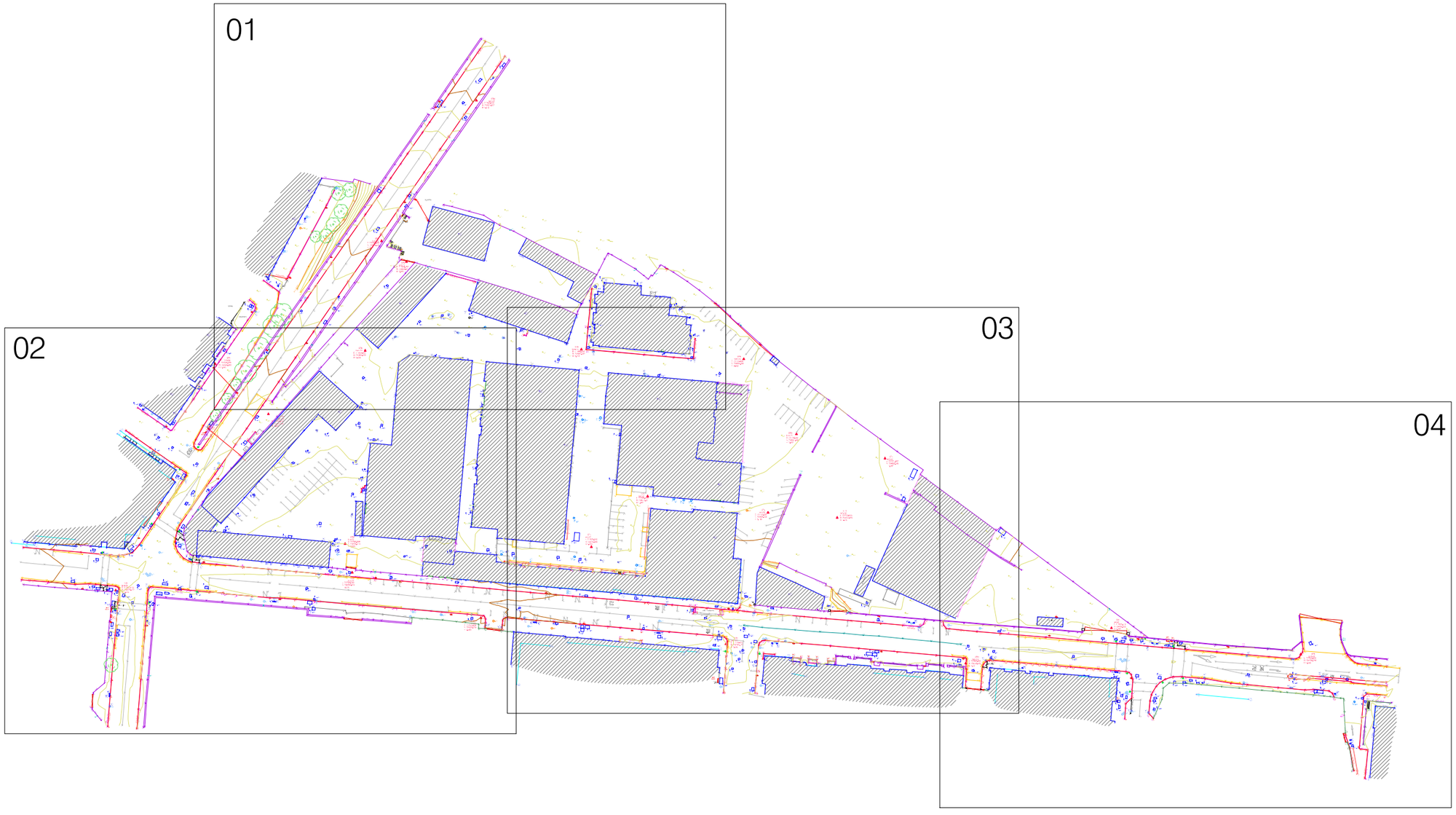
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	2.439	0.511	40.464	0.14		15.0	FLOOD	9

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	S2	2.620	0.761	1.400	0.05		9.1	FLOOD	1
1.002	S3	2.463	1.033	45.292	0.14		19.4	FLOOD	9
2.000	S9	2.455	1.375	56.250	0.14		14.6	FLOOD	9
2.001	S10	2.460	1.450	41.616	0.12		19.4	FLOOD	9
1.003	S4	2.574	-0.304	0.000	0.01		17.4	OK	
1.004	S5	2.577	1.887	0.000	0.04		3.6	SURCHARGED	
1.005	S6	-0.023	-0.249	0.000	0.07		3.6	OK	
1.006	S7	-0.290	-0.260	0.000	0.04		3.6	OK	

Appendix C

TOPOGRAPHICAL SURVEY



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Tram Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Bus Stop
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manhole
- Surface Water MH
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
- Eircom Inspection Cover
- Rodding Eye
- Road Sign
- Kiosk
- Gully
- Waste Bin
- Hydrant
- Fire Hydrant
- ESB Box
- ESB Inspection Cover
- Traffic Control Box
- LUAS Technical Cubicle
- Ticket Vending Machine
- Water Meter Cover
- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
- Washout
- Phone Box
- Bench Seat
- Gas Cover
- C P Box
- UIG Car Park Vent
- Duct

Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
- Top of Slope
- Ditch
- Water Edge / Lake / Pond
- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
- Water Level
- Crown Level
- Invert level
- Bed Level
- Soilheight
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- Top of Tree

Built Features

Roads & Road Markings

- Building
- Edge of Road
- Kerb Bottom
- Kerb Top
- Bridge Abutment
- Bridge Deck
- Bridge Parapet
- Building Façade
- Footpath / Platform Train & Tram
- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Fence
- Gate
- Road Centreline
- Top of Wall
- Hoarding
- Property Line
- Road Scar
- Top of Fence
- Wall / Retaining Wall
- Railway / Tram Rail / Grating / Ramp
- Building Canopy / Roof / Overhang
- Floor Level
- Apex Height
- Eaves Height
- Parapet Height
- Soffit Elevation
- Step Level
- Concrete Pad
- Track

Murphy Surveys Ltd. Disclaimer

The user or recipient of this survey data understands and acknowledges this data may be inaccurate or contain errors or omissions and the user or recipient assumes full responsibility for any risks or damages resulting from, arising from, or in connection with any use of or reliance upon data displayed herein. Although significant care has been exercised to produce surveys that satisfy survey accuracy standards, these surveys are only as accurate as the source data from which they were compiled. Although all reasonable steps have been taken to locate all features visible at the time of the survey, there is no guarantee that all will be shown on the drawing, as some above ground features may have obstructed the survey. Wherever possible, areas unable to be surveyed will be labelled as 'UTS'.

The Company shall not be liable for any inaccuracy of the data provided beyond the specified scale or accuracy, or for any matters resulting from their use for purposes other than that stated in the Contract. No liability shall attach to the Surveyor in respect of any consequential loss or damages suffered by the Client.

The Client must promptly notify the Company of any errors in mapping of which it becomes aware. If misleading, inaccurate or otherwise inappropriate information is brought to the Company's attention or the Company itself identifies any such imprecision or error in a survey, it shall use its reasonable endeavours to fix or remove it and if necessary in certain instances, the Company being on notice of any such misleading, inaccurate or otherwise inappropriate information, it will re-conduct the survey and reproduce the data to within the specified scale or accuracy.

North

Site Location

Map Sheet Layout:

01 02 03 04

Map Sheet 0000

Surveyed by :	MC
Drawn by :	SF
Checked by :	AM
Date:	October 2018
Date:	October 2018
Date:	18.10.2018
Datum	Malin Head
Grid System:	Irish National Grid ☐ ITM ■

Revisions

No.	Date	Description
01	18.10.2018	First Drawing

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Kildare Cork Belfast Glasgow London

Head Office
Global House
Kilcullen Business Campus
Kilcullen Co. Kildare
Ireland

Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

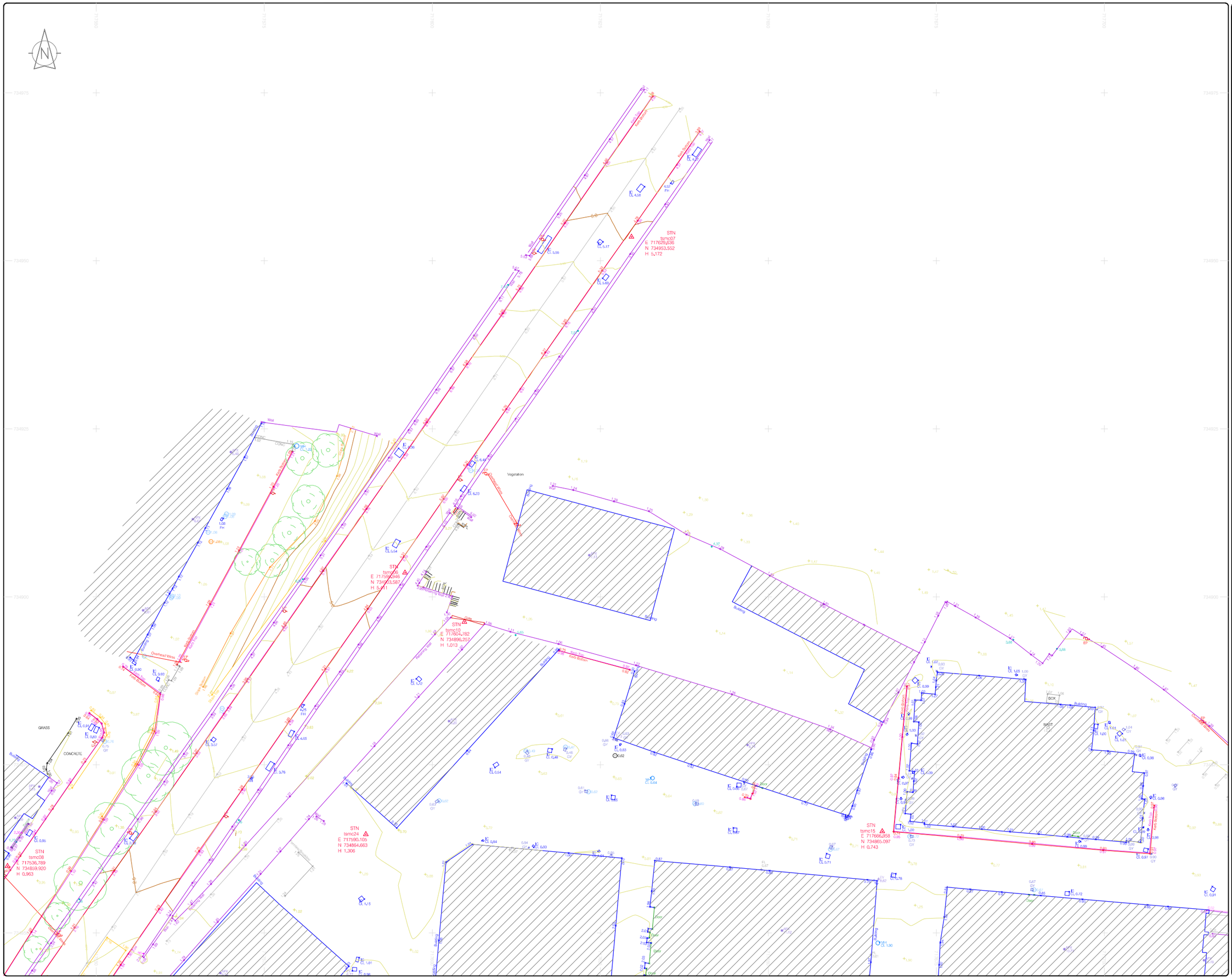
Client : DBFL Consulting Engineers

Project : 180159 Castleforbes Development Survey & GPR Quote

Date : 18.10.2018 **Scale :** NSC@A1

Description : Topographical Survey

Drawing Number : MSL27361_T_ITM_Rev0_00



LEGEND

Street furniture & Services

- Over Head Wires (LUAS) - Pylon ESB
- Flowerbed
- Pipe
- Lift
- Barrier
- Pump
- Trial Pit
- Bus/Tram Shelter
- Postbox
- Valve - General
- Water Valve
- Gas Valve
- Sluice Valve
- Air Valve
- Stop Cock
- C P Post
- Marker Post
- Traffic light
- Parking Meter
- Plane Aerial Mark
- Smart Card Validator
- Unknown Valve
- Bus Stop
- Bollard
- Beacon
- Coalhole Cover
- Bore Hole
- Electricity Pole
- Telegraph pole
- OCS Pole
- CCTV Camera Pole
- Lamp Post
- Foul Manhole
- Surface Water MH
- Manholes
- Air Conditioning Vents
- Services Inspection Cover
- Traffic Inspection Cover
- Cable TV Inspection Cover
- ESAT Inspection Cover
- NTL Inspection Cover
- Eircom Inspection Cover
- Rodding Eye
- Road Sign
- Kiosk
- Gully
- Waste Bin
- Hydrant
- Fire Hydrant
- ESB Box
- ESB Inspection Cover
- Traffic Control Box
- LUAS Technical Cubicle
- Ticket Vending Machine
- Water Meter Cover
- Telecom Inspection Cover
- Monument / Toilets
- Tank Storage
- Basement: MH, Cover & Pipe
- Dished Aerial Mark
- Stay for pole
- Pipe Protection
- Washout
- Phone Box
- Duct
- Gas Cover
- C P Box
- UIG Car Park Vent

Natural Features

- Surface Change
- Land Drain
- Bottom of Slope
- Top of Slope
- Ditch
- Water Edge / Lake / Pond
- Hedge / Trees Drip Line / Vegetation
- Tree Coniferous
- Water Level
- Crown Level
- Invert level
- Bed Level
- Spotheight
- Tree Deciduous

Golf

- Fair Way
- Green
- Tee Box

Other

- Survey Station
- Photo point
- Top of Tree

Built Features

Roads & Road Markings

- Building
- Edge of Road
- Kerb Bottom
- Kerb Top
- Bridge Abutment
- Bridge Deck
- Bridge Parapet
- Building Façade
- Fence
- Gate
- Road Centreline
- Top of Wall
- Hoarding
- Property Line
- Road Scar
- Top of Fence
- Footpath / Platform Train & Tram
- Damp Proof Course / Verge
- Bridge Pier / Wall & Gate Pillar / LUAS Trackbed
- Cycleway / Private Landing Area
- Floor Level
- Apex Height
- Eaves Height
- Parapet Height
- Soffit Elevation
- Step Level
- Concrete Pad
- Track
- Wall / Retaining Wall
- Railway / Tram Rail / Grating / Ramp
- Building Canopy / Roof / Overhang

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North

Site Location

Map Sheet Layout

01 02 03 04

Map Sheet 0000

Surveyed by : MC	Date: October 2018	Datum:	Malin Head
Drawn by : SF	Date: October 2018	Grid System:	Irish National Grid ☐ ITM ■
Checked by : AM	Date: 18.10.2018		

Revisions

No	Date	Description
0	18.10.2018	First Drawing

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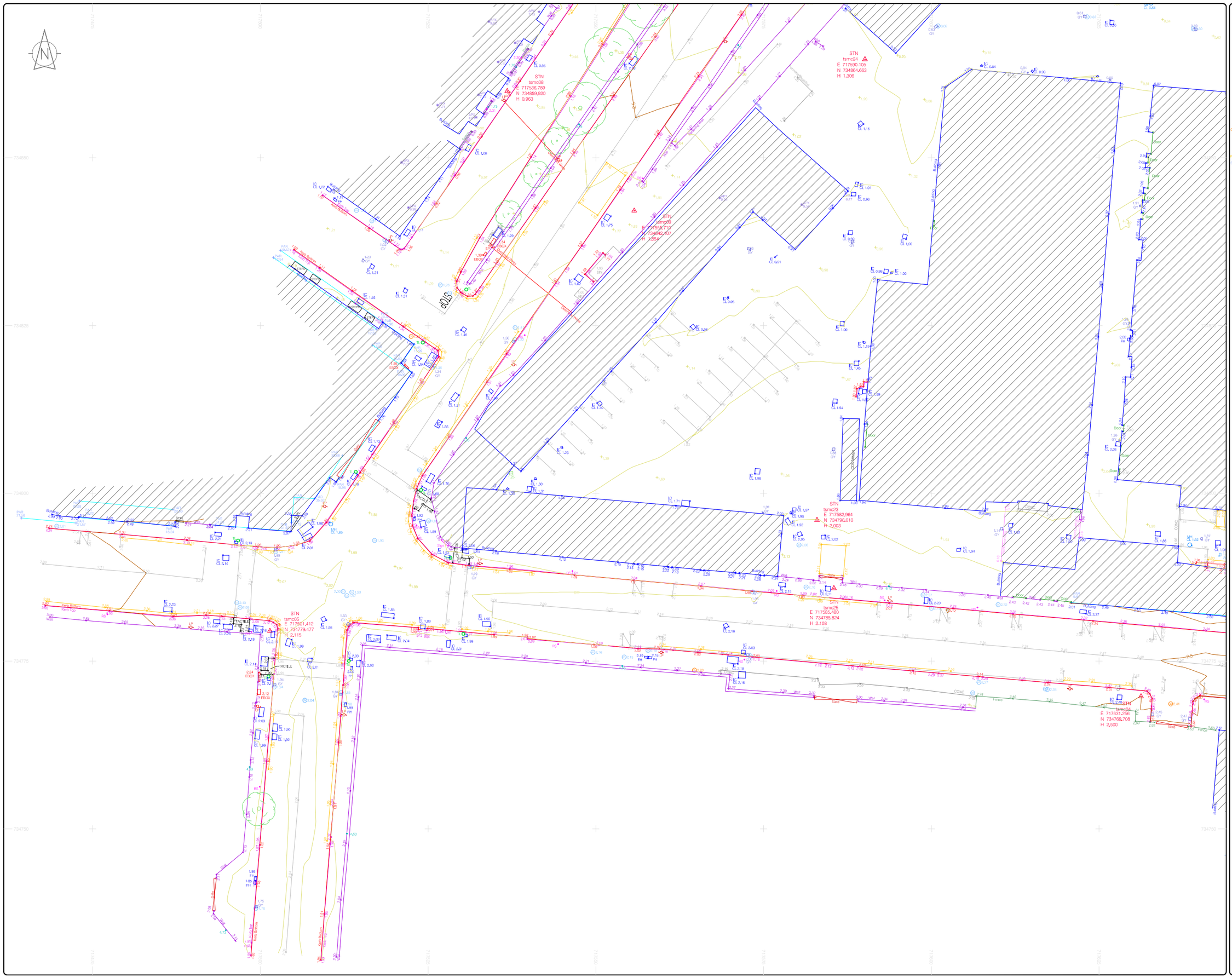
Client :	DBFL Consulting Engineers
Project :	180159 Castleforbes Development Survey & GPR Quote
Date : 18.10.2018	**Scale :** 1:250@A1
Description :	Topographical Survey
Drawing Number :	**MSL27361_T_ITM_Rev0_01**



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Tree Deciduous
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North

Site Location

Map Sheet Layout:

01 02 03 04

Map Sheet 0000

Surveyed by : MC	Date: October 2018	Datum:	Main Head
Drawn by : SF	Date: October 2018	Grid System:	
Checked by : AM	Date: 18.10.2018	Irish National Grid ☐ ITM ■	

Revisions

No.	Date	Description
0	18.10.2018	First Drawing

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Client :	DBFL Consulting Engineers
Project :	180159 Castleforbes Development Survey & GPR Quote
Date : 18.10.2018	**Scale :** 1:250@A1
Description :	Topographical Survey
Drawing Number :	**MSL27361_T_ITM_Rev0_02**

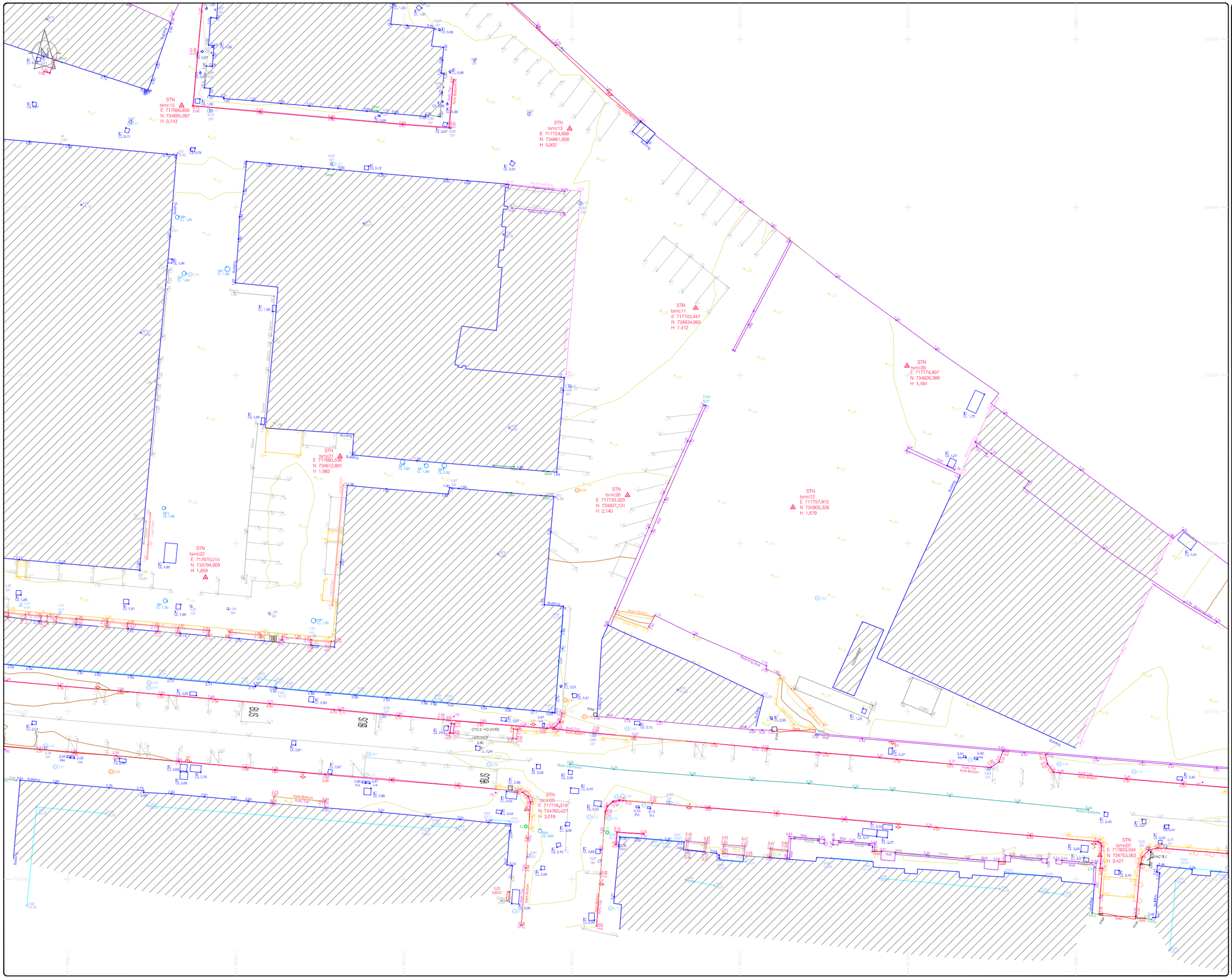

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Photo point
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Map Sheet 0000

Surveyed by : MC	Date: October 2018	Datum	Malin Head
Drawn by : SF	Date: October 2018	Grid System:	Irish National Grid ☐ ITM ■
Checked by : AM	Date: 18.10.2018		

Revisions

No	Date	Description
1	18.10.2018	First Drawing

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European GPR Association
RICS
The Survey Association Full Member

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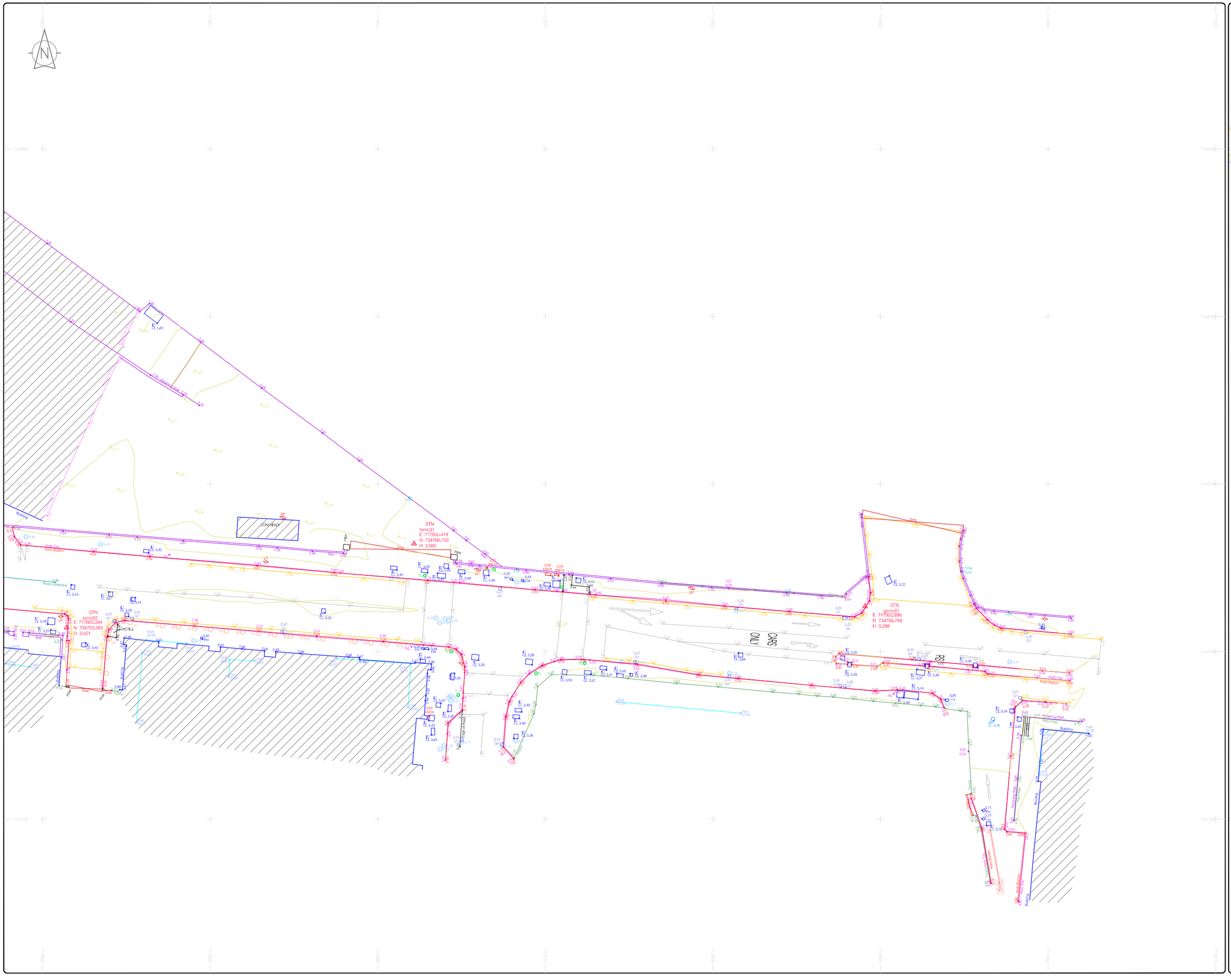
Description :	Topographical Survey
Drawing Number :	**MSL27361_T_ITM_Rev0_03**



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- Fair Way
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Other

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Built Features

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Site Location

Map Sheet Layout:

01 02 03 04

Map Sheet 0000

Surveyed by: MC	Date: October 2018	Datum: Main Head	
Drawn by: SF	Date: October 2018	Grid System:	
Checked by: AM	Date: 18.10.2018	Irish National Grid ☐ ITM ■	

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Project : 180159 Castleforbes Development Survey & GPR Quote

Date : 18.10.2018 **Scale :** 1:250@A1

Description : Topographical Survey

Drawing Number : MSL27361_T_ITM_Rev0_04

Appendix D

IRISH WATER RECORDS

UISCE ÉIREANN : IRISH WATER

Legend

- Boundary Meter
- Check Meter
- Unknown Meter ; Other Meter
- PRV
- Sluice Valve Open
- Sluice Valve Closed
- Butterfly Valve Open
- Sluice Valve Closed
- Scour Valves
- Double Air Control Valve

Water Hydrants

Hydrant Function

- Fire Hydrant
- Telemetry Kiosk
- Cap
- Other Fittings

Water Distribution Mains

Owned By

- Irish Water
- Irish Water
- Water Abandoned Lines

Sewer Manholes

Manhole Type

- Standard
- Hatchbox
- Lamphole

Sewer Discharge Points

Discharge Type

- Other; Unknown
- Pump Station

Sewer Inlets

Inlet Type

- Catchpit
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Pumping - Combined
- Pumping - Foul
- Syphon - Overflow

Storm Manholes

Manhole Type

- Standard
- Surface Gravity Mains
- Surface Gravity Mains Private

Surface Fittings

Fitting Type

- Other; Unknown

1:1,000 at A0

Last edited: 13/04/2018

Metres

0 25 50 100

Appendix E

IRISH WATER CONFIRMATION OF FEASBILITY AND STATEMENT OF DESIGN ACCEPTANCE

Thomas Carrigg
Ormond House,
Upper Ormond Quay
Dublin

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

10 December 2019

Dear Thomas Carrigg,

Re: Connection Reference No CDS19003355 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 764 units at Castleforbes Rd, North Inner City, Dublin.

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Castleforbes Rd,, North Inner City,, Dublin.

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

Water:

- The Development with reduced peak hour demand of 15.9 l/s can be supplied from the existing 400 mm ID Ductile Iron main in Sheriff Street. Therefore adequate onsite balancing storage tank is required to ensure that the peak hour flow is not exceeded.
- Also, 24 hour water onsite storage tanks, for both domestic and non-domestic units, are required.
- The connection should include installation of a bulk meter with associated telemetry system and control valve.

Wastewater:

- There are storm and combine sewer in Sheriff Street Upper adjacent to the site. Separate storm and foul water connection services should be provided for the Development.
- New connection of foul water to the existing combine sewer network is feasible without upgrade. Storm water connection arrangement should be agreed with Dublin City County Council Drainage Division.
- The proposed Development indicates that an important Irish Water infrastructure is present on the site. The Developer will be required to survey the site to determine the exact location of the infrastructure. Any trial investigations shall be carried out with the agreement and in the presence of Dublin City Council Inspector.
- You are advised that structures or works over or in close proximity to Irish Water infrastructure that will inhibit access for maintenance or endanger structural or functional integrity of the infrastructure are not allowed.

- Diversion of the infrastructure is required. The diversion will be subject to customer entering diversion agreement with Irish Water. A wayleave in favour of Irish Water, will be required over all Infrastructure that is not located within the Public Space.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

- In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.
- All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details.
- You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

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

If you have any further questions, please contact Marina Zivanovic Byrne from the design team on 01 89 25991 or email mzbyrne@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Thomas Carrigg
Ormond House,
Upper Ormond Quay
Dublin

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

9 November 2020

Re: Design Submission for Castleforbes Rd,, North Inner City,, Dublin (the "Development")
(the "Design Submission") / Connection Reference No: CDS19003355

Dear Thomas Carrigg,

Many thanks for your recent Design Submission.

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

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

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

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

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

180159-3101 Drainage Layout
180159-3104 Watermain Layout
180159-3120 Foul Long Sections

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

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