Appendix 3-3

Engineering Planning Report

PUNCH
consulting engineers

183106 - Crown Square Development Phase 2, Galway City

Engineering Planning Report Stage 3

July 2019

Document Control

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PL0	Stage 2 Issue	13/03/2019	F. Timlin	D. Gallery	R. Stokes
PL1	Stage 3 Issue	23/05/2019	F. Timlin	D. Gallery	R. Stokes
PL2	Stage 3 Issue	09/07/2019	F. Timlin	D. Gallery	C. O'Brien

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1 Introduction

This report was prepared to accompany a planning application for a proposed development on a site located at the junction of the Monivea & Joyce's Road, Mervue, Galway City. This report deals specifically with the surface water drainage, foul water drainage, watermain design and flood protection measures for this application.

The planning application has been divided into two phases. Phase 1, which relates to the office and hotel development on the western half of the site, was submitted to Galway City Council in November 2018. Phase 2, which relates to the residential development at the eastern half of the site, is the subject of this report, and this report forms part of the SHD application for Phase 2.

The Phase 2 development will consist of a residential scheme comprising 288 no. apartments and amenity accommodation with a gross floor area of circa 32,379 sqm; a commercial scheme with a cumulative gross floor area of 4,096 sqm; public realm and landscaping works, including pedestrian and cyclist linkages; and a double basement with pedestrian, cyclist and vehicular access.

Following discussions with Galway City Council, it was agreed that best approach to take to describe the engineering design – traffic, roads, drainage, water and flooding - would be to describe the design for the entire development. Therefore, the figures used in this report relating to the drainage and water design are based on the total load to be carried from the entire development, with the figures broken down into their contributing parts for clarity.

The mixed-use development project commenced on site in 2008. In late 2008, it was halted during the construction phase due to the sharp downturn in the economy and has remained in a partially-constructed phase since that time.

The site has been stripped to create a double basement area over the entire site footprint, and this has been partially infilled with a two-storey concrete frame in one area of the site adjacent to Monivea Road. This existing structure is a significant element. There are also a large number of foundations poured in other areas of the site, and sections of basement slab.

The development has a plan area of approximately 5.117 hectares in total. Access to the development will be via the Monivea Road and Joyce's Road. Figure 1 below indicates the proposed development within the surrounding development.

Figure 1 - Site Location of the Proposed Development

The Layout of the proposed scheme is detailed in the series of planning drawings by Henry J Lyons Architects accompanying this planning submission.

In preparation of this report and design of the development, PUNCH Consulting Engineers have liaised with the following parties:

1. Frank Clancy, Senior Executive Engineer, Water services, Galway City Council
2. John Sheehan, Executive Technician, Water services, Galway City Council
3. Brian Day, Senior Design Engineer, Irish Water
4. James O'Malley, Design Engineer, Irish Water

2 Foul Water Drainage Design

2.1 Existing Foul Water Drainage

On the basis of available records, the following foul water drainage exists adjacent to the site of the proposed development.

- A 675mm Concrete sewer is located on the Monivea Road, which falls in a south-westerly direction.
- A 225mm Concrete sewer is located on the Tuam Road, which falls in a south-westerly direction.

It should be noted that diversion works of the 675mm concrete sewer on the Monivea Road were undertaken in 2008, please refer to Figure 2 below and Appendix A for illustration of the existing sewer network.

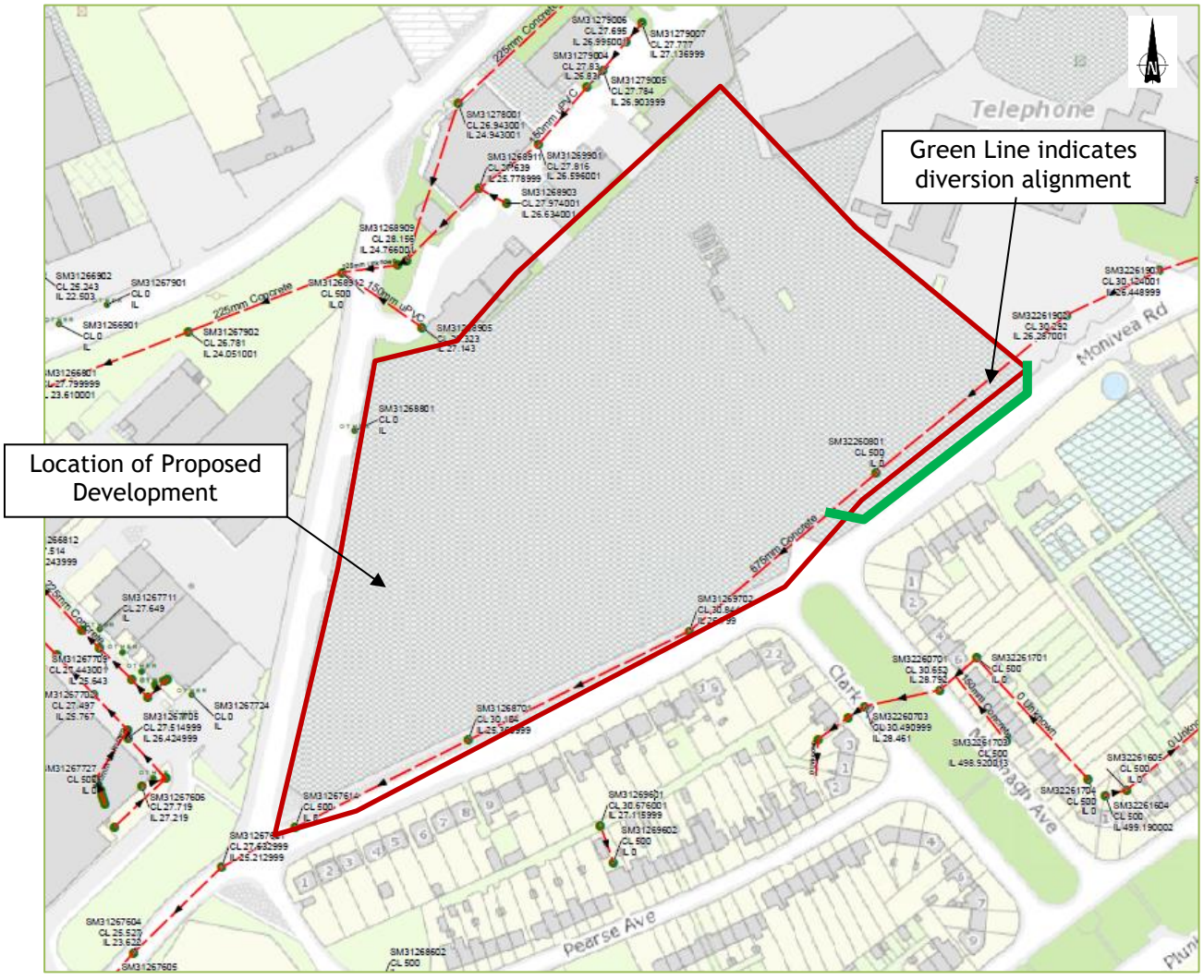


Figure 2 – Existing Foul Drainage Surrounding Site (Source: Irish Water Record Drawing)

2.2 Proposed Foul Water Drainage

Foul water drainage has been designed using WinDes Microdrainage software with reference to the following documentation:

1. "*Recommendations for Site Development Works for Housing Areas*" published by DOE
2. "*Code of Practice for Wastewater Infrastructure*" published by *Irish Water - particularly Appendix D - Wastewater Flow Rates for Design*
3. "Wastewater Engineers Treatment & Reuse" by Metcaff & Eddy

On the basis of the documentation referenced above, the following wastewater characteristics have been taken:

1. 165 litres/ person/ day for residential units
2. 250 litres/ guest/ day for hotel rooms (assuming 2 no. guests per room)
3. 300 litres/100sq.m/day for hotel amenity area
4. 300 litres/100sq.m/day for retail area
5. 300 litres/100sq.m/day for fitness/ leisure area
6. 300 litres/100sq.m/day for restaurant/ coffee shop area
7. 300 litres/100sq.m/day for medical centre/ pharmacy/ other area
8. 400 litres/100sq.m/day for convenience store area
9. 750 litres/100sq.m/day for ancillary residential accommodation (Concierge, Games Room, Movie Room etc.)
10. 750 litres/100sq.m/day for office area

Table 1 below shows the foul flows for the development, indicating proposed dry weather flow, as well as the peak flows. The total increase in dry weather flow (DWF) associated with the site was calculated as 6.74 l/s with an increase in peak flow of 40.44 l/s. The daily foul loading is 582.177m^3. The sewers will be designed for the peak flow.

Table 1: Calculation of Peak Daily Foul Flow

Building Use	Quantity	Rate per day	Daily Foul Loading (l/day)	DWF (l/s)	Design Flow (6DWF) (l/s)
Total Commercial Floor Area	39,445 m^2	750l/100m^2	295,838	3.42	20.52
Total Residential Units	288 units/1030 persons	165l/person	169,950	1.97	11.82
Total Hotel Rooms	175 rooms	500l/room	87,500	1.01	6.06
Total Hotel Amenities Area	2,490 m^2	300l/100m^2	7,470	0.09	0.54
Total Ancillary Residential Accommodation	1,275 m^2	750l/100m^2	9,563	0.11	0.66

Total Fitness/Leisure Area	1,140 m^2	300l/100m^2	3,420	0.04	0.24
Total Medical /Pharmacy/Other Area	1,962 m^2	300l/100m^2	5,886	0.07	0.42
Total Restaurant/Coffee Shop Area	550 m^2	300l/100m^2	1,650	0.02	0.12
Total Convenience Store Area	225 m^2	400l/100m^2	900	0.01	0.06
TOTAL			**582,177**	**6.74**	**40.44**

The general approach taken for the design of the proposed foul water drainage system is to collect all foul water from ground level upwards and discharge to the public foul water sewer network by gravity via an external below ground drainage system. This will minimise the volume of foul water which will need to be pumped from the development and, furthermore, reduce the volume of emergency storage required in the pumping station.

It is proposed to make two connections to the public foul water sewer system on the 675mm diameter concrete foul sewer on the Monivea Road, one at the West of the site and one to the East.

2.2.1 Foul Water Reduction Measures

It is noted that the development will incorporate water conservation measures in the sanitary facilities. These will include low flow dual flush toilets, and monobloc low volume push taps. These will reduce the foul discharge from the development.

2.2.2 External Foul Water Drainage System

A below ground drainage system will be provided for the site. This will deal with foul water from both the residential/commercial developments and the suspended drainage system in the basement. It is proposed to connect this drainage system to the 675mm diameter public foul water sewer located in the Monivea Road.

2.2.3 Proposed Foul Water Drainage System

The proposed foul sewers have been designed using MicroDrainage software in accordance with the "Irish Water Code of Practice for Wastewater Infrastructure" design guide. Please refer to Appendix B for details of Foul Water Calculations.

In the basement, it is proposed that a pumping station will be provided to pump effluent from showers and toilets being provided for staff that walk or cycle to the proposed development. The effluent will be pumped to a decompression manhole in the courtyard and flow by gravity to the proposed foul drainage network.

In accordance with the GDSDS, any surface water that is generated within the -1 & -2 basement will run through a bypass interceptor prior to being pumped to the foul water system, this figure is estimated at 0.04l/s based upon approximately 1600 parking bays (Refer to Architects site layout drawings for more details) at 2l/ bay/ day, in accordance with the "Design Recommendations for Multi Storey and Underground Car Parks" published by the Institute of Structural Engineers.

A pre-connection enquiry form was issued to Irish Water and a response was received stating "subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network can be facilitated." Please refer to Appendix C for details of the letter of feasibility from Irish Water.

Please refer to Appendix D for "Statement of Design Acceptance" issued by Irish Water.

2.2.4 Foul Water Drainage Suspended from Underside of Ground Floor Slab

Vertical stacks collecting foul water from the above storeys will enter the basement level at service riser locations. These will be connected to drainage pipes suspended from the underside of the ground floor slab and where necessary, strapped to the basement wall. These will penetrate the basement wall at various locations and connect to the external drainage system. Adequate protection will be provided to all drainage strapped to the basement wall face to ensure damage is not caused from moving vehicles.

2.3 Phasing

It is proposed that the residential units are to be constructed concurrently. The number of units and the total wastewater demand for the residential units is outlined below.

Table 2: Wastewater demand

Item	No. units	Total design demand
Total residential units	288	11.82 l/s

3 Surface Water Drainage Design

3.1 Existing Surface Water Drainage

On the basis of available records, the following public surface water drainage exists adjacent to the development site:

- A 450mm Concrete sewer is located on the Monivea Road, which falls in a south-westerly direction.
- A 600mm Concrete sewer is located on the Tuam Road, which falls in a south-westerly direction.

The existing site is currently impermeable with significant excavation works having been previously undertaken. Refer to Figure 3 below and Appendix A for illustration of the existing sewer network.

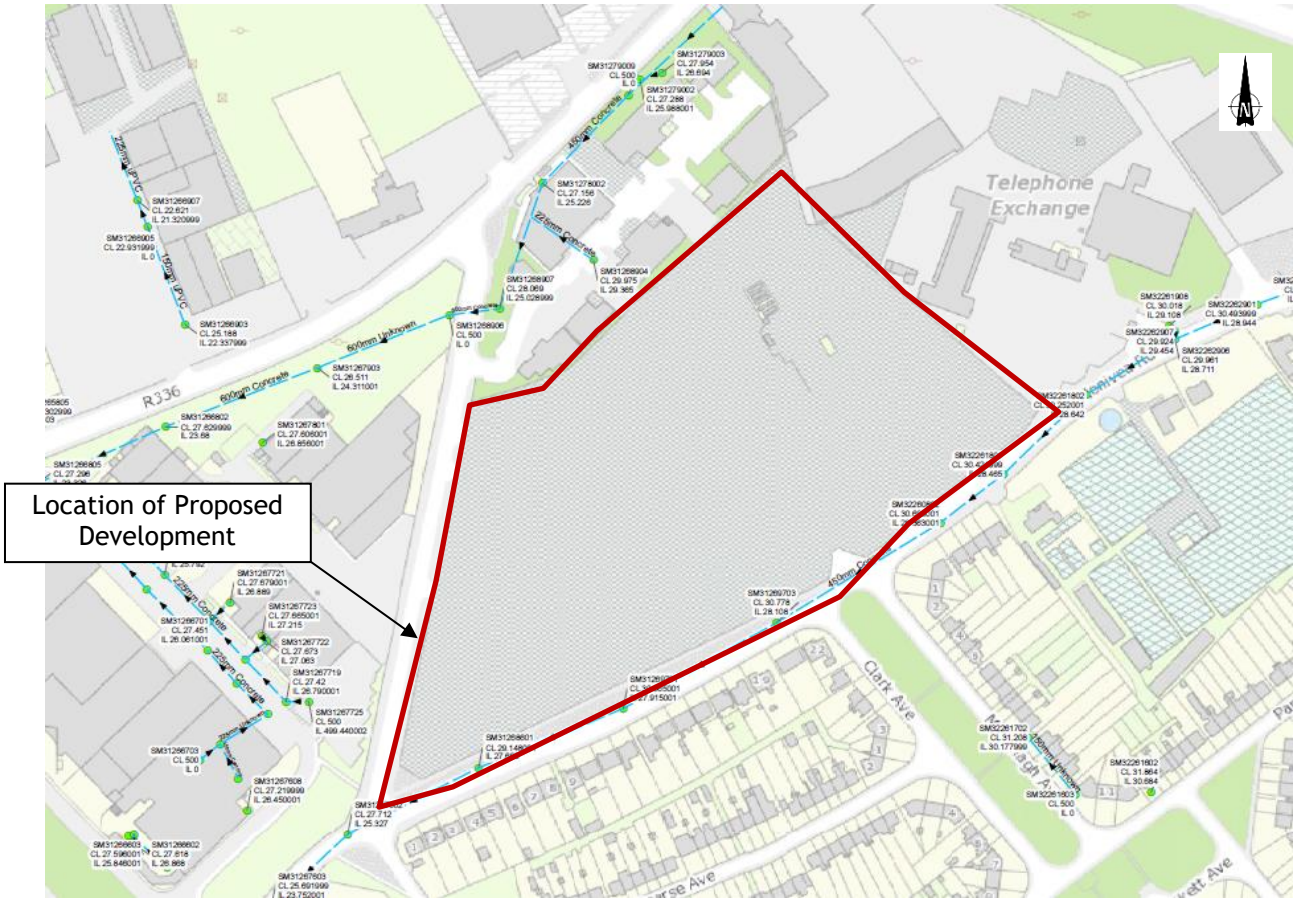


Figure 3 – Existing Storm Drainage Surrounding Site (Source: Irish Water Record Drawing)

3.2 Existing Site

The existing permitted development commenced construction in 2008. However, due to the economic downturn it was abandoned in late 2008. Currently there is a large excavation with parts of the impermeable concrete frame car park installed on site. The general Topography of the site excluding the excavation is largely flat with a gentle slope falling towards the West of the site. Levels vary on Joyce's Rd from 28-29mAOD, and rise to approx. 30mAOD on Monivea Road at the eastern extremity of the site. The excavated site area has been reduced to formation level for the original basement which was at an FFL of 23.3mAOD. The proposed basement level under this planning application is also to be at 23.3AOD.

3.3 Proposed Surface Water Drainage

The proposed surface water drainage system has been designed with reference to the following documents:

1. "*Recommendations for Site Development Works for Housing Areas*" - DOE
2. "*Greater Dublin Strategic Drainage Study*" (GDSDS)
3. CIRIA Publications C753 - "*The SuDS Manual*"
4. Galway City Development Plan 2017-2023

The drainage system has been designed with the aim of providing a sustainable drainage solution ensuring, in so far as feasible, that the development has a minimal impact on the existing public surface water sewer system. This is achieved with the incorporation of Sustainable urban Drainage Systems (SuDS).

The Galway City Development Plan 2017-2023 in conjunction with the Greater Dublin Strategic Drainage Study (GDSDS) requires that the site discharge is reduced. The runoff is to be reduced for the 1% AEP (1:100-year storm return period), with an additional 10% to be added to rainfall to allow for climate change.

Similar to the design of foul water drainage, the general approach taken for the design of the proposed surface water drainage system is to collect all surface water from ground level upwards and discharge to the public surface water sewer network by gravity via an external below ground drainage system. This will minimise the volume of surface water which will need to be pumped from the development, hence reducing the whole life cost and impact for the development.

3.3.1 Proposed Development Drainage Network

The proposed development has been designed using MicroDrainage software.

An M5-60 of 17.5mm and a Ratio (R) of 0.300 was utilised in the model.

The model has analysed a range of storms at the 1% AEP (1 in 100-year return period storm), with a 10% additional rainfall to allow for climate change.

A value for the SAAR for the site has been obtained from the HR Wallingford website. This value is 1281mm. A copy of these results is included in Appendix E.

The surface water runoff from the proposed development is to be entirely separate from the development's foul sewerage network development drainage.

All surface water run-off from roof areas and hardstanding areas shall be collected in the gravity pipe network. The surface water from any open deck parking areas or pavements shall be collected via a series of gullies and channels.

Any surface water that is generated within the -1 & -2 basement will run through a bypass interceptor prior to being pumped to the foul water system, this figure is estimated at 0.04l/s based upon approximately 1600 parking bays at 2l/ bay/ day.

New surface water connections will be designed to connect by gravity to the existing public drainage network, with 70% of limited forward flow discharging to the Tuam Road located north of the site and the remainder discharging to the Monivea Road located south of the development.

A detailed utility survey is currently being undertaken, to ascertain which services could be utilised as part of the new network.

On the eastern half of the site, a portion of the external podium level drops down to Basement -1 level. Therefore, it will not be possible to discharge surface water from this area by gravity to the public sewer. Surface water from the proposed reduced podium area on site will be attenuated and then pumped via rising main to the North of the site where it will connect into the main line of the proposed surface water drainage network.

Please refer to Appendix F for MicroDrainage calculations related to proposed surface water drainage.

3.3.2 General

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS).

Please note discussions have being held with Galway City Council Water services Department as regards the surface water strategy. Please refer to Appendix G for memorandum in regard to discussions.

3.3.3 Attenuation Tanks

The proposed attenuation tanks will be sized to reduce the runoff from the site to 2l/ha/s for the 1% AEP (1:100 year storm return period) storm, with 10% additional rainfall to allow for climate change in accordance with the recommendations set out in the Greater Dublin Strategic Drainage Study. The result of this analysis requires 4 no. Attenuation tanks with a combined liquid storage of 2056 cu.m. Most of the attenuation tanks will be located outside the footprint of the basement structure.

Gullies and linear drainage channels will be provided as required to prevent surface water ponding on site and to ensure that no surface water discharges on to the public road and footpath surface.

3.3.4 Rainwater Harvesting

It is proposed to utilise rainwater recovered from the apartment rooftops for flushing of toilets, wash down of car park and bin stores, watering of green areas, and perhaps topping up of the sprinkler tanks which are all a waste of potable water.

The grey-water recovered on the site would normally go directly to the storm water drain. By recycling this rain water, less drawdown will occur from the existing watermains and has the added benefit of limiting rainwater entering the storm sewer.

3.3.5 Green Roofs

It is proposed to provide a large extent of extensive green roofs within the proposed development. This shall be provided at roof level and at podium level. Green roofs are widely recognised as an effective SuDS solution and an important tool in mitigating the adverse effects of development on rainfall run-off and for managing urban flood risk.

Research in the UK by Kellagher and Lauchlan (2005)1 and CIRIA C753 (The SuDS Manual) indicates that green roofs are effective in providing both attenuation and volume reduction in runoff for minor rainfall events.

3.3.6 Bypass Separators

All surface water generated by the development will be passed through a class 1 bypass separator to capture and remove harmful material before the surface water discharges into the attenuation tanks.

Any surface water that is generated within the -1 & -2 basement will run through a bypass interceptor prior to being pumped to the foul water system, this figure is estimated at 0.04l/s based upon approximately 1600 parking bays at 2l/ bay/ day.

3.3.7 Green Areas

The proposed development will include several planted areas. These will be installed to reduce the surface water runoff on the site and to act as a SUDS measure for the development.

3.4 Compliance with the GDSDS

There are 4 sub criteria for level of services as set out in the GDSDS-RDP Volume 2 Section 6.3.4 (table 6.3).

1) No flooding on site, except where planned (30-year high estimated rainfall).
2) No internal property flooding (100-year high intensity rainfall event).
3) No internal flooding (100-year river event and critical duration for site).
4) No flooding off site except where specifically planned (100-year high intensity rainfall event).

The mitigation measures proposed as part of the surface water network and the treatment train as outlined above will allow the development to comply with the items, 1 - 4 noted above with regards to compliance with the GDSDS.

4 Watermain Design

4.1 Existing Water Infrastructure

The following existing public watermain infrastructure exists adjacent to the development

- 9 inch nominal diameter asbestos watermain located on Joyce's Road with a 150mm diameter Cast Iron connection to the proposed development.
- 300mm nominal diameter asbestos watermain located on Monivea Road.
- 300mm nominal diameter asbestos watermain located on the Tuam Road.

Refer to Figure 4 below and Appendix A for illustration of the existing sewer network.

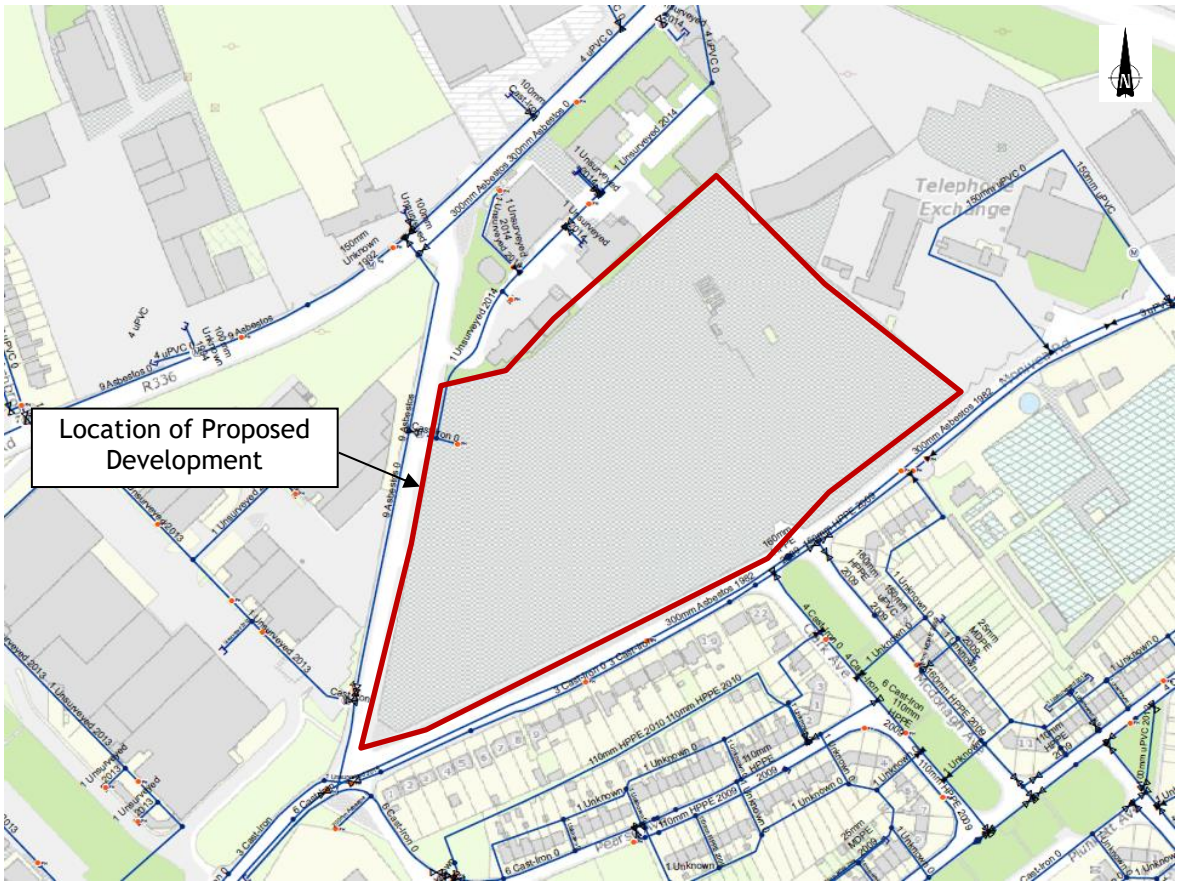


Figure 4 - Existing Watermain Surrounding Site (Source: Irish Water Record Drawing)

4.2 Proposed Water Infrastructure

4.2.1 Water Supply Demand

The existing water supply connection is to be retained. The extent of the existing connection within the site is not known. This is intended to be confirmed through a utility survey currently being undertaken.

The residential units will be constructed concurrently, as such, the demand will be as outlined below.

4.2.2 Water Supply Demand

The design loading for foul drainage is used to evaluate an approximation of the water demand on the site, without additional flow to allow for surface water infiltration. On the basis of this, the following flow rates are to be used:

1. 150 litres/ unit/ day for residential units
2. 250 litres/ guest/ day for hotel rooms (assuming 2 no. guests per room)
3. 300 litres/100sq.m/day for hotel amenity area
4. 300 litres/100sq.m/day for retail area
5. 300 litres/100sq.m/day for fitness/ leisure area
6. 300 litres/100sq.m/day for restaurant/ coffee shop area
7. 300 litres/100sq.m/day for medical centre/ pharmacy/ other area
8. 400 litres/100sq.m/day for convenience store area
9. 750 litres/100sq.m/day for ancillary residential accommodation (Concierge, Games Room, Movie Room etc.)
10. 750 litres/100sq.m/day for office area

With reference to Irish Water's "Water Code of Practice," the average daily flow is calculated as the number of persons multiplied by the flow rate per person. The average day peak week flow is taken to be 1.25 x the average flow, and the peak demand is taken to be the average day peak week flow multiplied by a peaking factor of 5.

This is demonstrated in Table 3 below. On the basis of this table, the development will have an average day peak drawdown of 8.18l/s and a peak demand flow of 41.01l/s.

Table 3: Water Average Day Peak Flow

Component	Quantity	Rate per Day	Dry Weather Flow	Design Flow (5 DWF) (l/s)
Total Commercial Floor Area	39,445 m^2	750l/100sqm	**369.80 cu.m/day or 4.28 l/s**	**21.40**
Total Residential Units	288 units/1030 persons	150l/person	**193.13 cu.m/day or 2.24 l/s**	**11.20**
Total Hotel Rooms	175 Rooms	500l/room	**109.4 cu.m/day or 1.27 l/s**	**6.35**
Total Hotel Amenities Area	2,490 m^2	300l/100sqm	**9.34 cu.m/day or 0.11 l/s**	**0.55**
Total Ancillary Residential Accommodation	1,275 m^2	750l/100m2	**9.56 cu.m/day or 0.11 l/s**	**0.66**

Total Fitness/Leisure Area	1,140 m^2	300l/100sqm	**4.28 cu.m/day or 0.05l/s**	**0.25**
Total Medical/ Pharmacy/ Other Area	1,962 m^2	300l/100sqm	**7.36 cu.m/day or 0.09 l/s**	**0.45**
Total Restaurant/ Coffee Shop Area	550 m^2	300l/100sqm	**2.06 cu.m/day or 0.02 l/s**	**0.10**
Total Convenience Store Area	225 m^2	400l/100sqm	**1.13 cu.m/day or 0.01 l/s**	**0.05**
Total			**8.18 l/s**	**41.01 l/s**

A pre-connection enquiry form was issued to Irish Water and a response was received stating "subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network can be facilitated. Please refer to Appendix C for details of the letter of feasibility from Irish Water.

Please refer to Appendix D for "Statement of Design Acceptance" issued by Irish Water.

4.2.3 Water demand Reduction Measures

To further reduce the water demand on Irish Water, water supplies and to reduce the foul discharge from the development, water conservation measures will be incorporated in the sanitary facilities throughout the development, e.g. dual flush toilets, Monobloc low volume push taps and waterless urinals.

4.3 Phasing

It is proposed that the residential units are to be constructed concurrently. The number of units and the total water demand for the residential units is outlined below.

Table 4: Water demand

Item	No. units	Total design demand
Total residential units	288	11.20 l/s

5 Flood Risk Assessment

A Flood Risk Assessment has been undertaken by PUNCH Consulting Engineers for the development which accompanies this planning submission.

6 Traffic and Transportation Assessment

The Traffic and Transport Assessment prepared for planning application 18/363 Crown Square included for the whole Crown Square development as envisaged at that date. As part of the design development, there have been minor amendments to the number of parking spaces and the various building areas and uses but the change in overall number of vehicle trips generated is inconsequential. The total car parking numbers is 1377, this is a small reduction of 25 no. parking spaces from those submitted with the Phase 1 planning application. Therefore, the TTA produced on 31/10/18 and previously submitted to GCC on 09/11/18 for Phase 1 is proposed to be included as part of the Phase 2 documentation with the updated parking numbers.

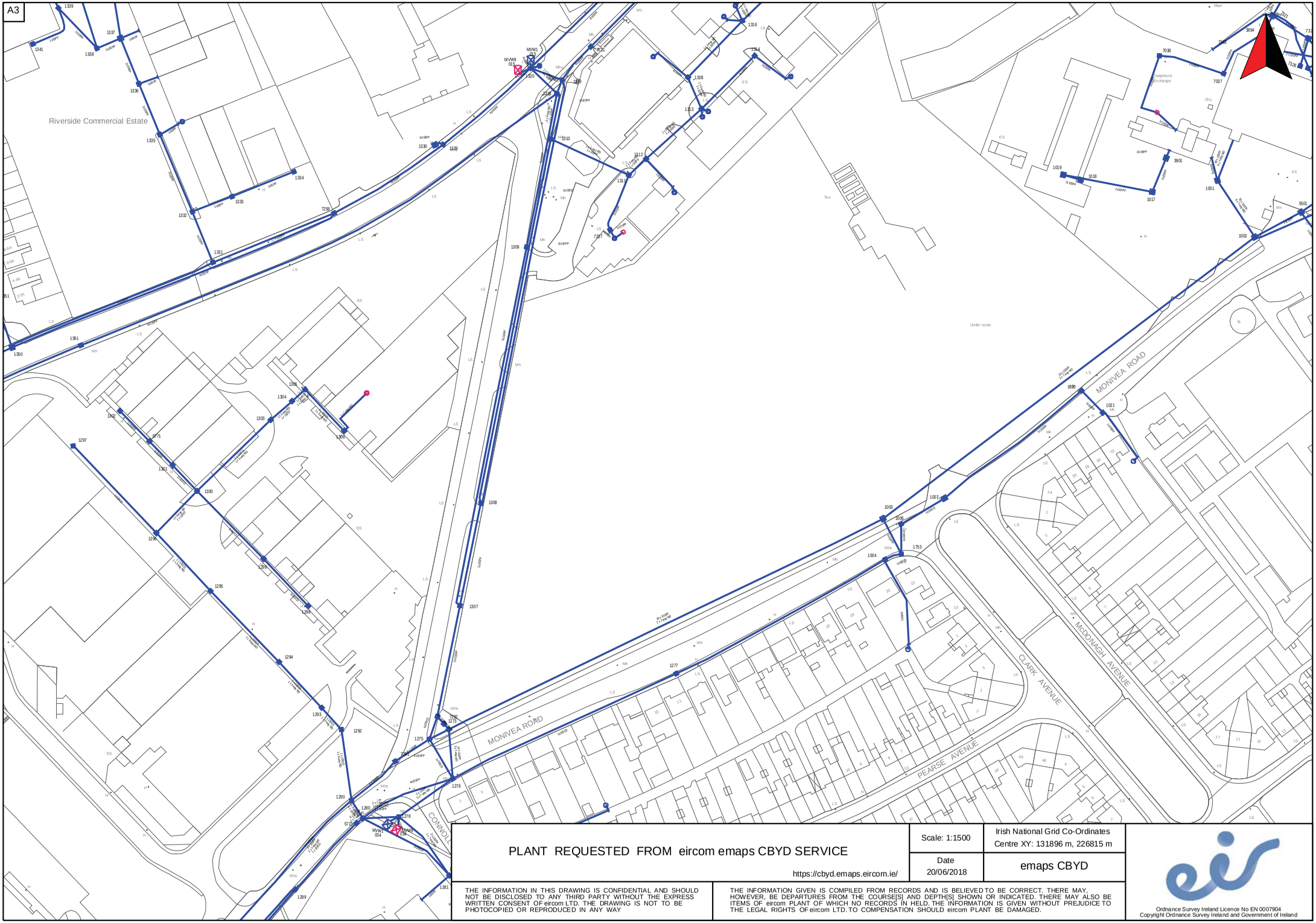
7 Road Safety Audit

A Road Safety Audit has been undertaken by CST Consulting Engineers for the development which accompanies this planning submission.

8 Mobility Management Plan

A Mobility Management Plan has been undertaken by PUNCH Consulting Engineers for the development which accompanies this planning submission. The Mobility Management Plan (MMP) prepared for planning application 18/363 Crown Square included for the whole Crown Square development as envisaged at that date. Following receipt of a further information (FI) request from Galway City Council on 11/01/19, the MMP was revised and resubmitted to GCC on 18/02/19. As part of the design development, there have been minor amendments to the number of parking spaces and various building areas and uses but the scope and content of the MMP is unchanged. The total car parking numbers submitted as part of the FI response have reduced slightly from those submitted with the Phase 1 planning application. Therefore, the revised MMP previously submitted to GCC on 18/02/19 is proposed to be included as part of the Phase 2 documentation with the updated parking numbers.

Appendix A - Existing Services Record Drawings



PLANT REQUESTED FROM eircom emaps CBYD SERVICE

https://cbyd.emaps.eircom.ie/

Scale: 1:1500	Irish National Grid Co-Ordinates Centre XY: 131896 m, 226815 m
Date 20/06/2018	emaps CBYD

ESB Networks

TITLE:

20180619-010_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: 19-Jun-2018

** SCALE: 1:1500

** SCALE WHEN PRINTED ON AN A0 PAGE
XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM

WARNING

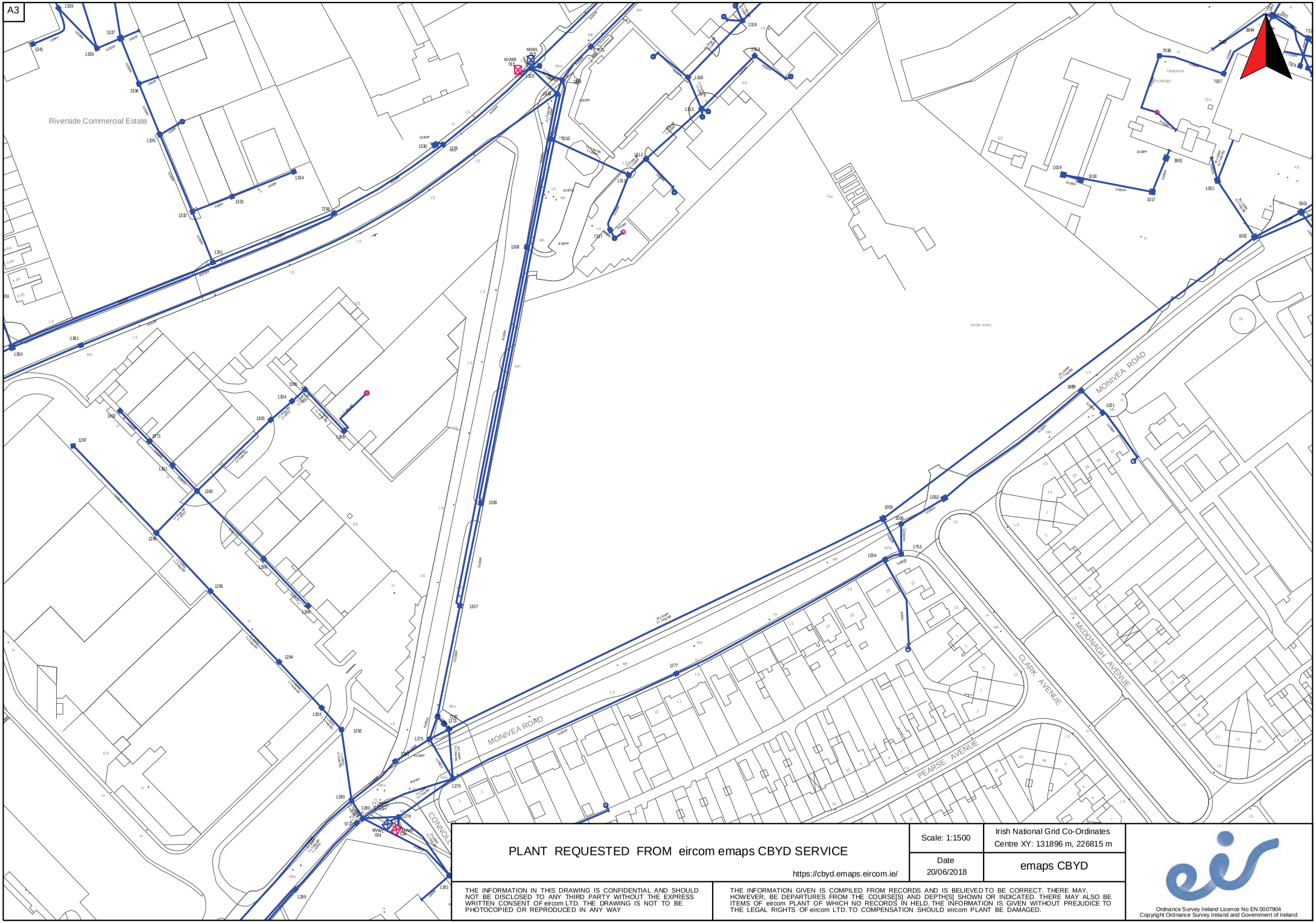
THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS 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 1850 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 'HSA 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.

X,Y: 131026, 227349

X,Y: 132766, 227349

X,Y: 132766, 226195

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



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XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM

WARNING

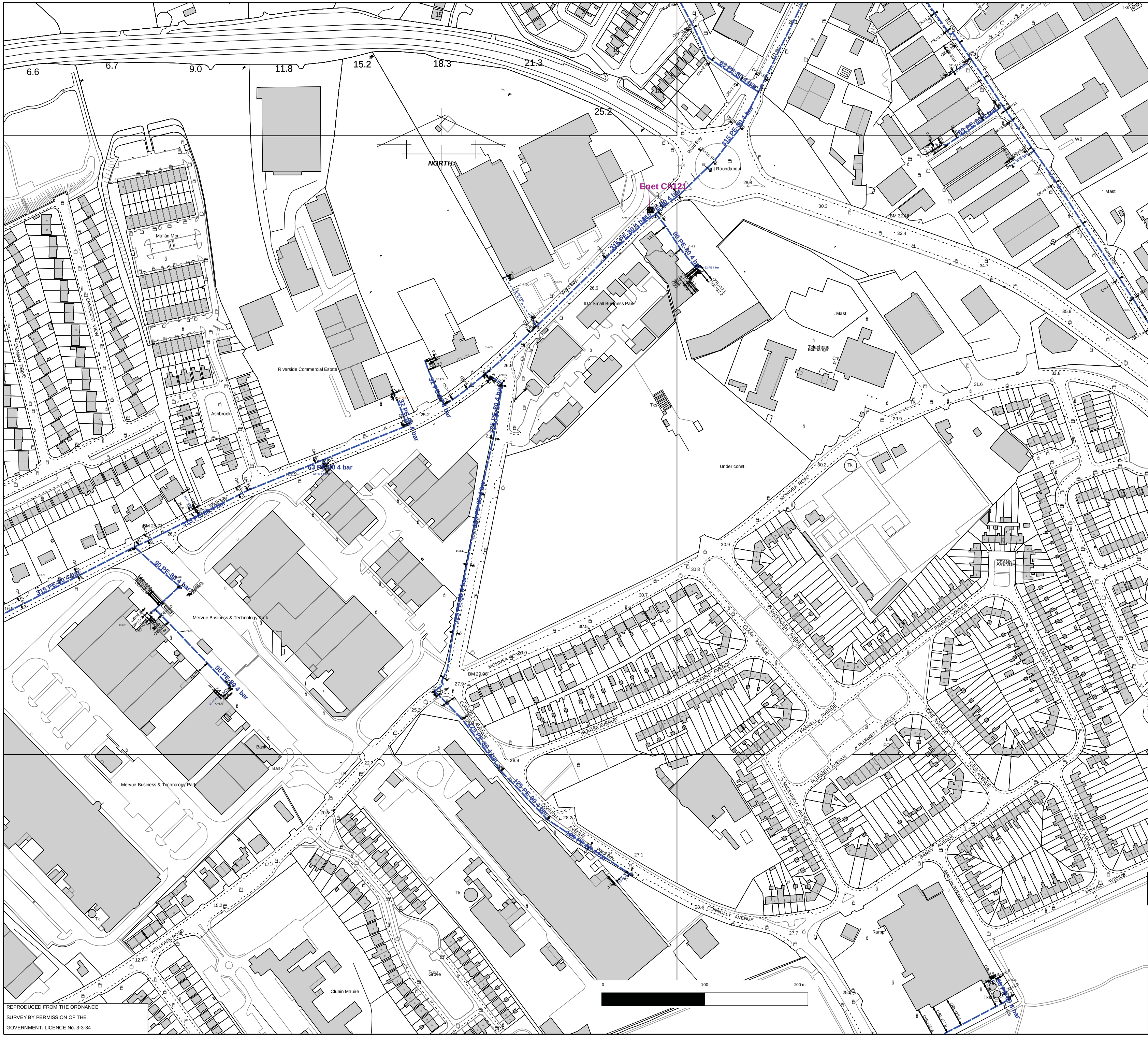
THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS 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 1850 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 'HSA 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.

X.Y: 131026, 227349

X.Y: 132766, 227349

X.Y: 132766, 226195

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



REPRODUCED FROM THE ORDNANCE SURVEY BY PERMISSION OF THE GOVERNMENT. LICENCE No. 3-3-34

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 1850 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 (1890 289 389) or can be downloaded at www.hsa.ie.

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

Contact Aurora Telecom on 1850-427-399 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=? Cover (depth in meters)	Pressure Monitor
CP Test Point	Protection (Sleeve)
End Cap	Protection (Slabbing)
Hot Tap	Reducer
Installation	Service Terminator
Valve	Tee
Mains Verification **	Transition

** Please contact GNI on 1850-427747 for specific information.

Design Department - DUBLIN

Gas Networks Ireland

GAS NETWORK INFORMATION

Issue:	Punch Consulting Engineers		
Location:	Monivea Rd, Mervue, Co. Galway		
Plot Date:	19/06/2018	Contact:	C Fallon
Plotted by:	KOC	Scale:	1:2500

Not Archived - Alternative : [Network Maintenance Dublin]2018_Plots Kevin

Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road

UISCE ÉIREANN : IRISH WATER

Legend

Sewer Gravity Mains (Irish Water owned)

Liquid Type

- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)

Liquid Type

- Combined
- Foul
- Overflow
- Unknown

Sewer Manholes

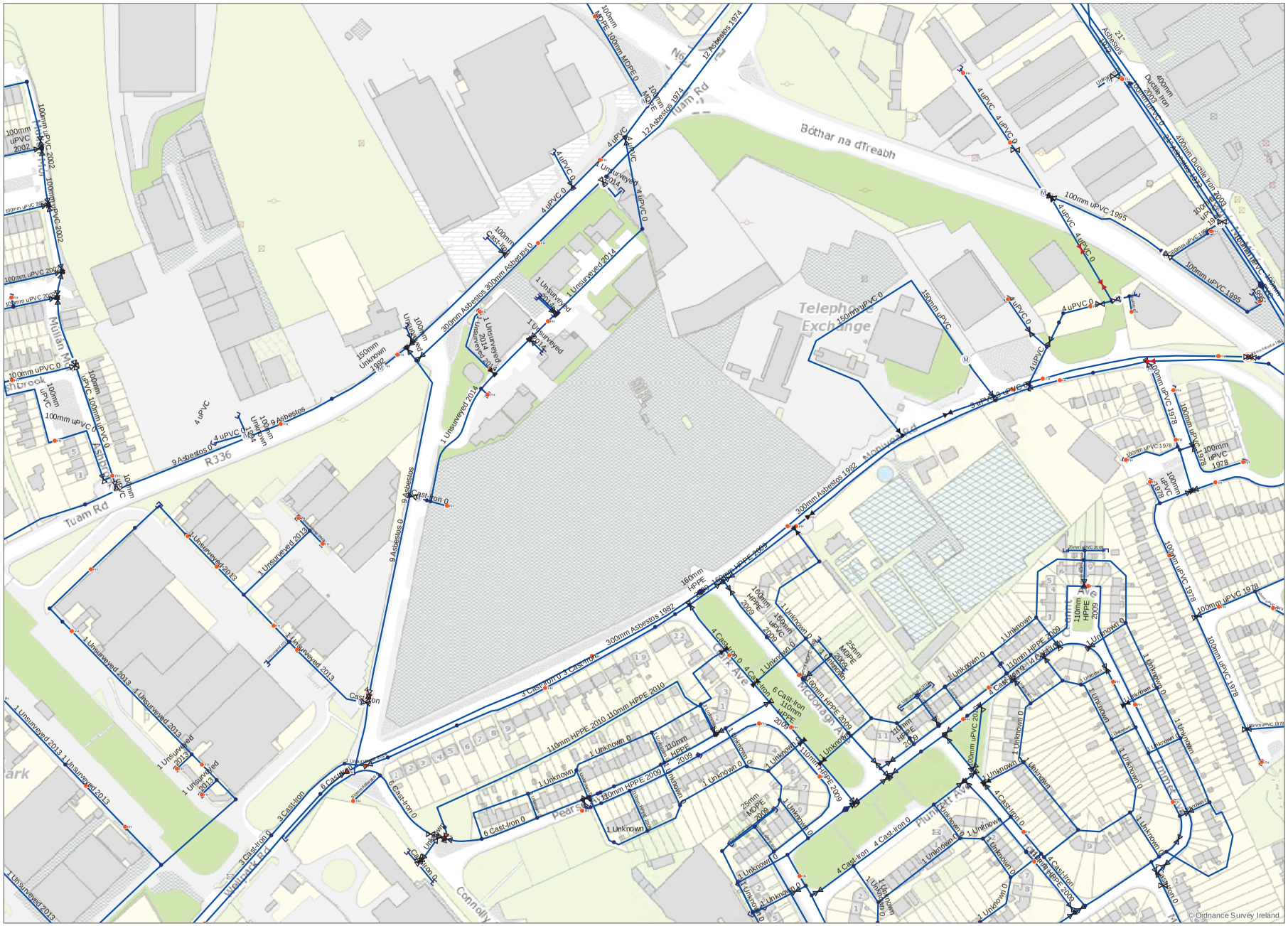
Manhole Type

- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	**1:2,000**
Drawing No.:	**Crown pe FW**
Drawn By:	**J Sheahan**
Checked By:	**.**
Approved By:	**.**
Drawn Date	**19/06/2018**
Checked Date:	**.**
Approved Date:	**.**



UISCE ÉIREANN : IRISH WATER

Legend

Water Mains(Irish Water Owned)

Liquid Type

- Untreated
- Potable Water

Water Mains(Non Irish Water Owned)

Liquid Type

- Untreated
- Potable Water

Boundary Valves

Valve Normal Position

- Open
- Closed
- Part Closed

Non Boundary Valves

Valve Normal Position

- Open
- Closed
- Part Closed

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	1:2,000
Drawing No.:	Crown pe W
Drawn By:	J Sheahan
Checked By:	.
Approved By:	.
Drawn Date	19/06/2018
Checked Date:	.
Approved Date:	.

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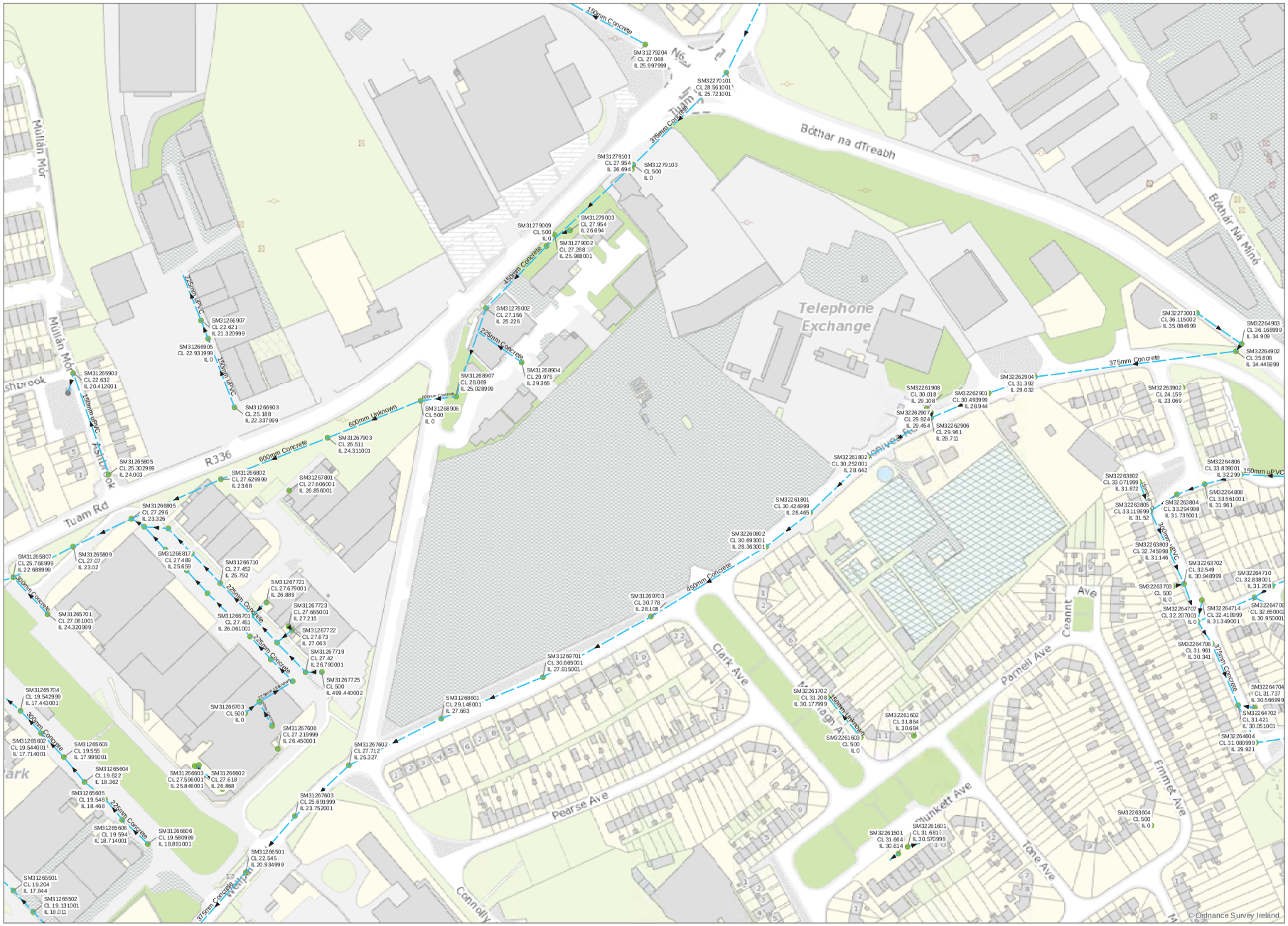
Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road



UISCE ÉIREANN : IRISH WATER

Legend

Liquid Type

Surface

Liquid Type

Surface

Storm Manholes

Manhole Type

- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	**1:2,000**
Drawing No.:	**Crown pe SW**
Drawn By:	**J Sheahan**
Checked By:	**.**
Approved By:	**.**
Drawn Date	**19/06/2018**
Checked Date:	**.**
Approved Date:	**.**

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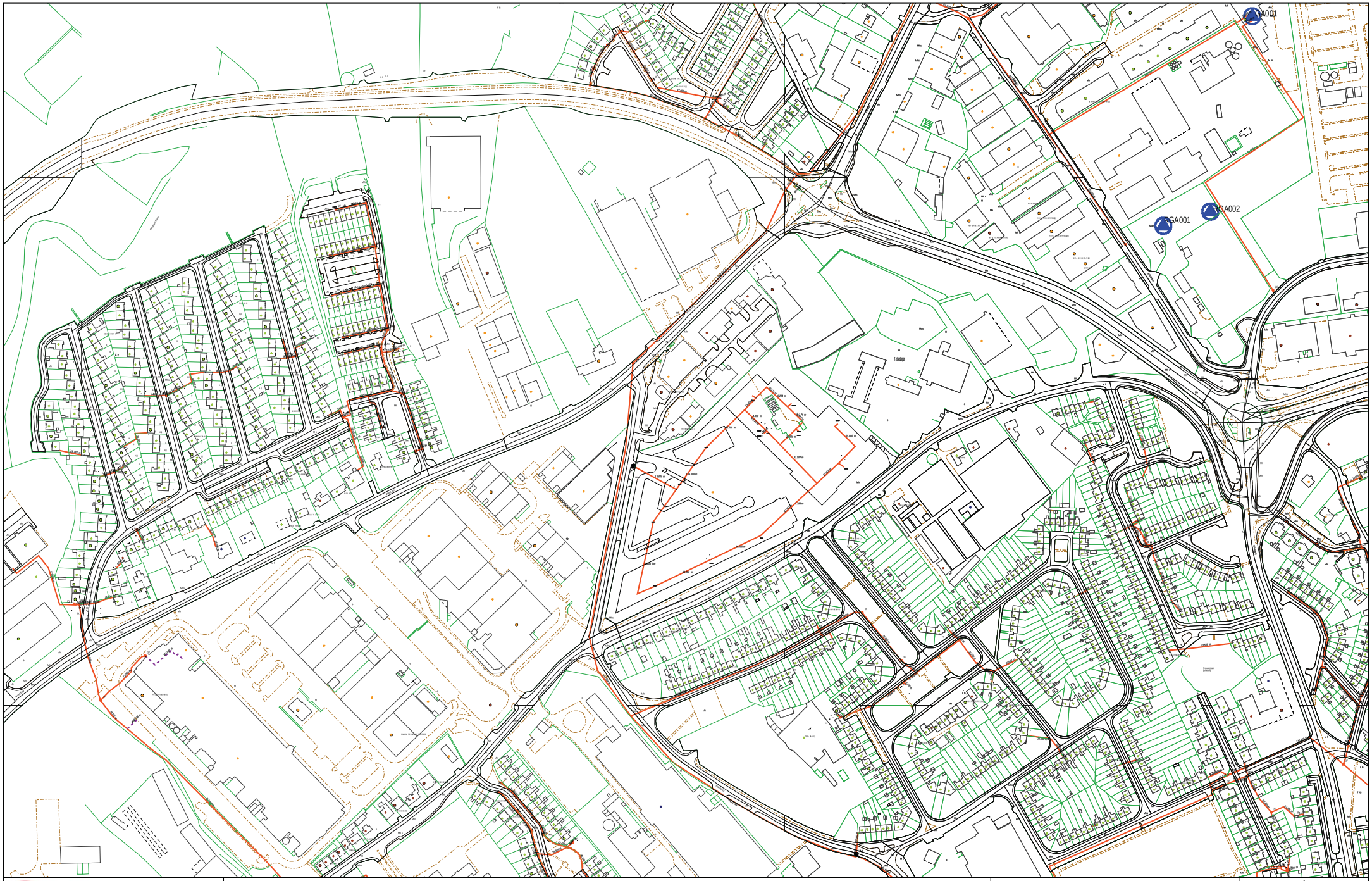
Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road



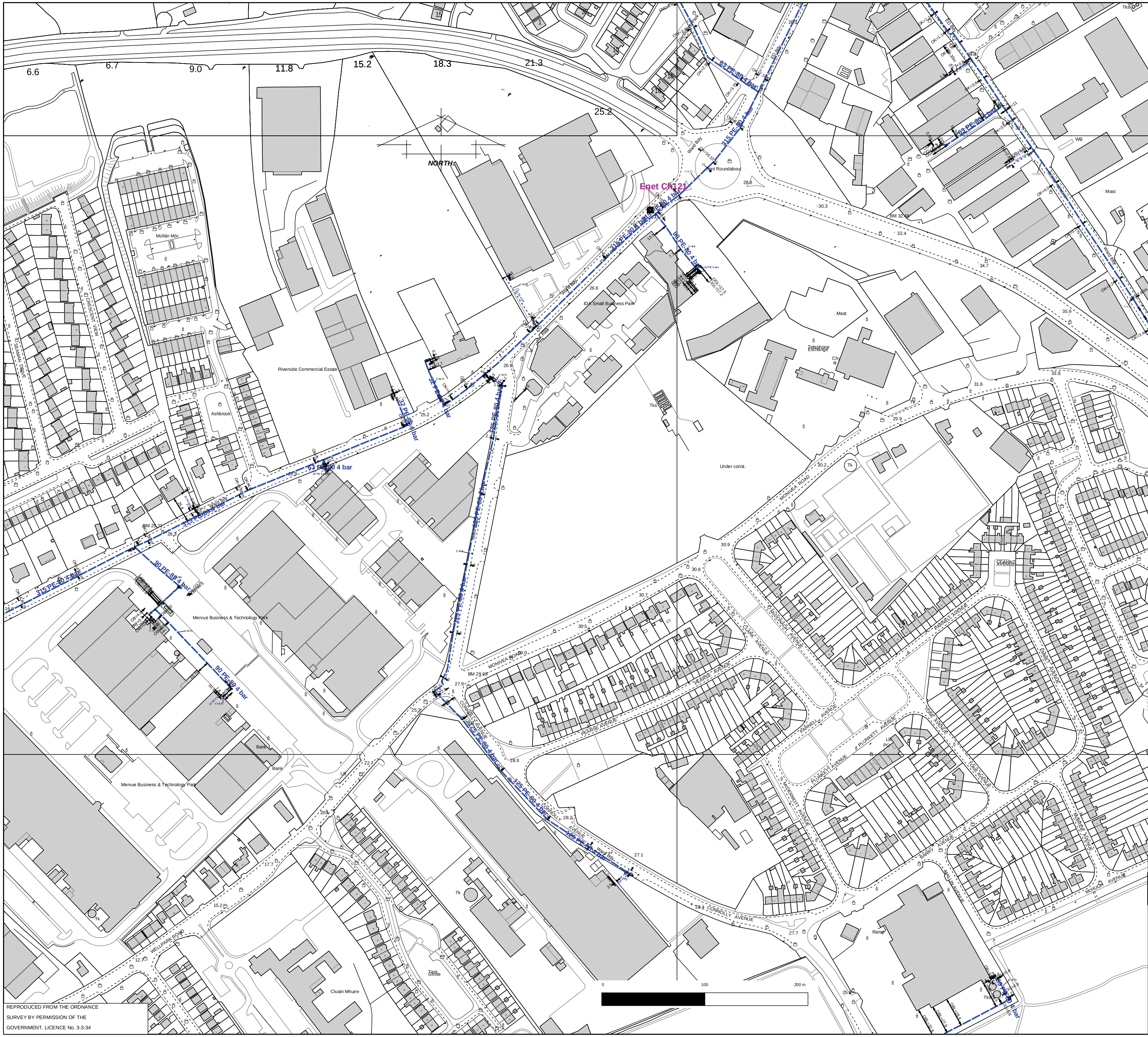
Virgin Media
Unit 6 & 7
Broomhill Business Park
Tallaght 24

PROJECT NAME

DESIGNED BY:

Produced on: 19/06/2018

@ A3



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CP Test Point	Protection (Sleeve)
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Hot Tap	Reducer
Installation	Service Terminator
Valve	Tee
Mains Verification **	Transition

** Please contact GNI on 1850-427747 for specific information.

Design Department - DUBLIN

Gas Networks Ireland

GAS NETWORK INFORMATION

Issue:	Punch Consulting Engineers		
Location:	Monivea Rd, Mervue, Co. Galway		
Plot Date:	19/06/2018	Contact:	C Fallon
Plotted by:	KOC	Scale:	1:2500

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

Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road

UISCE ÉIREANN : IRISH WATER

Legend

Sewer Gravity Mains (Irish Water owned)

Liquid Type

- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)

Liquid Type

- Combined
- Foul
- Overflow
- Unknown

Sewer Manholes

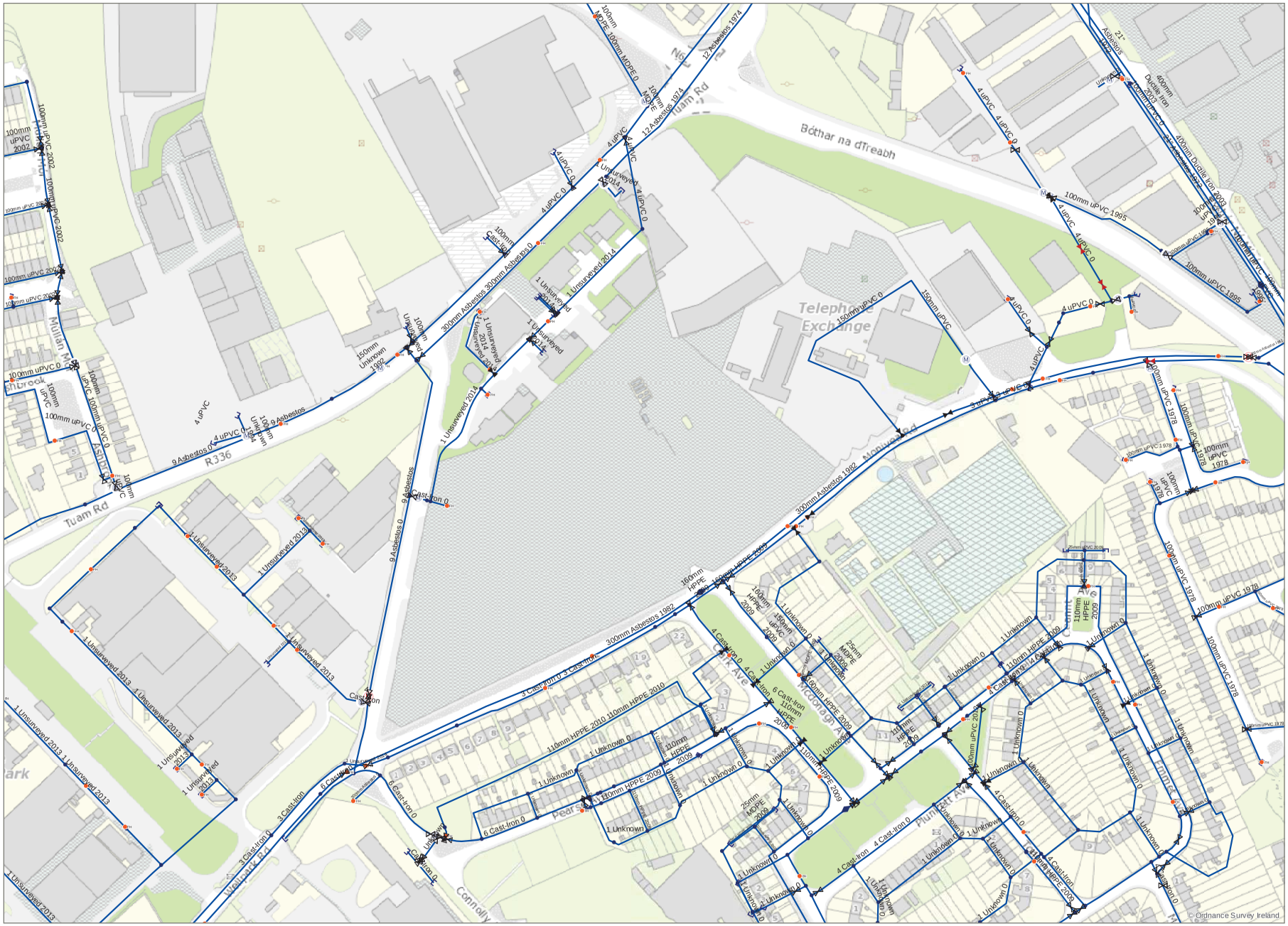
Manhole Type

- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	1:2,000
Drawing No.:	Crown pe FW
Drawn By:	J Sheahan
Checked By:	.
Approved By:	.
Drawn Date	19/06/2018
Checked Date:	.
Approved Date:	.



UISCE ÉIREANN : IRISH WATER

Legend

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- Untreated
- Potable Water

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Liquid Type

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- Potable Water

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Valve Normal Position

- Open
- Closed
- Part Closed

Non Boundary Valves

Valve Normal Position

- Open
- Closed
- Part Closed

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	1:2,000
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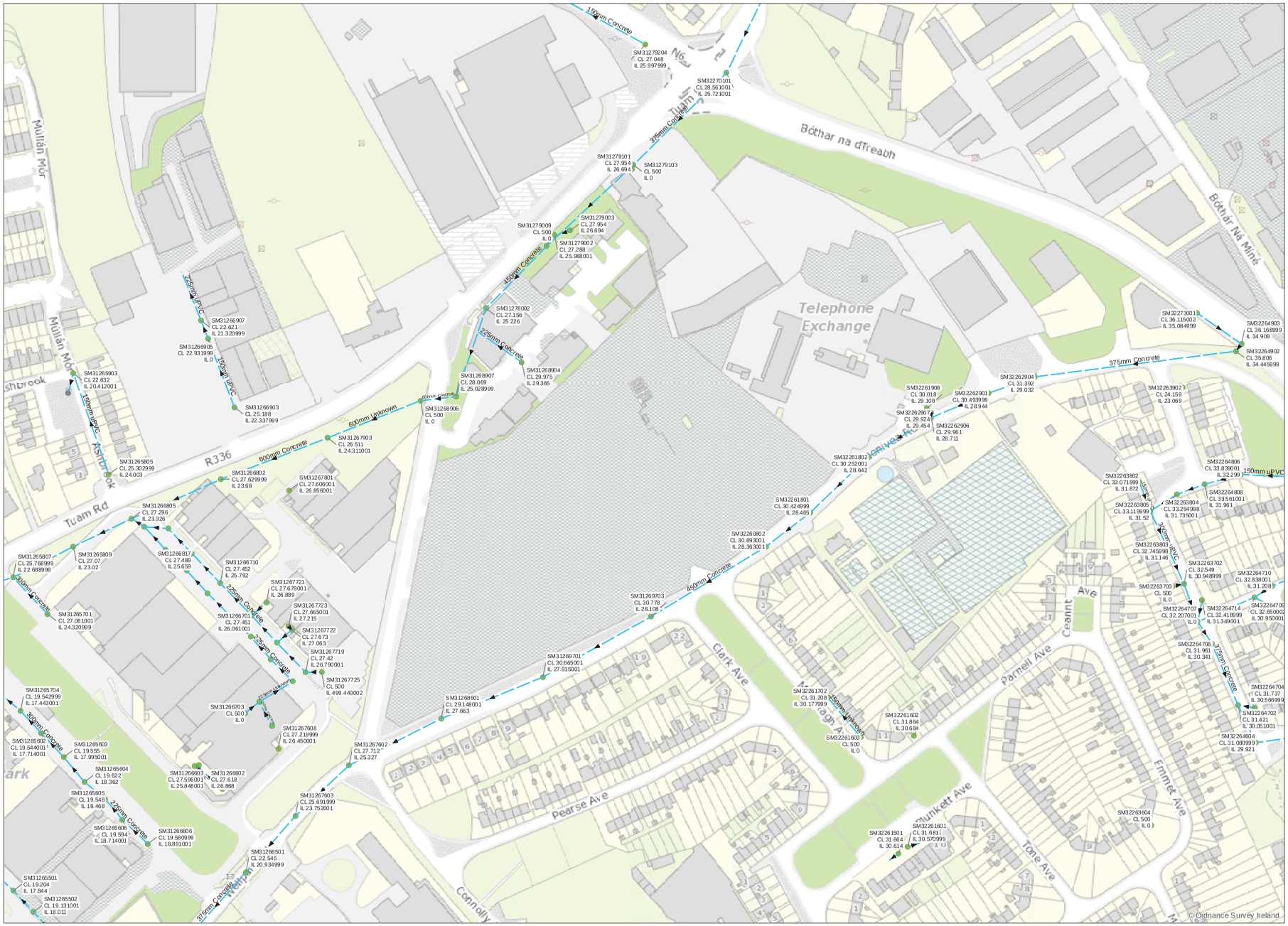
Drawn Date	19/06/2018
Checked Date:	.
Approved Date:	.

Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road



UISCE ÉIREANN : IRISH WATER

Legend

Liquid Type

Surface

Liquid Type

Surface

Storm Manholes

Manhole Type

- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

0 0.02 0.04 0.08 Km

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A2:	**1:2,000**
Drawing No.:	**Crown pe SW**
Drawn By:	**J Sheahan**
Checked By:	**.**
Approved By:	**.**
Drawn Date	**19/06/2018**
Checked Date:	**.**
Approved Date:	**.**

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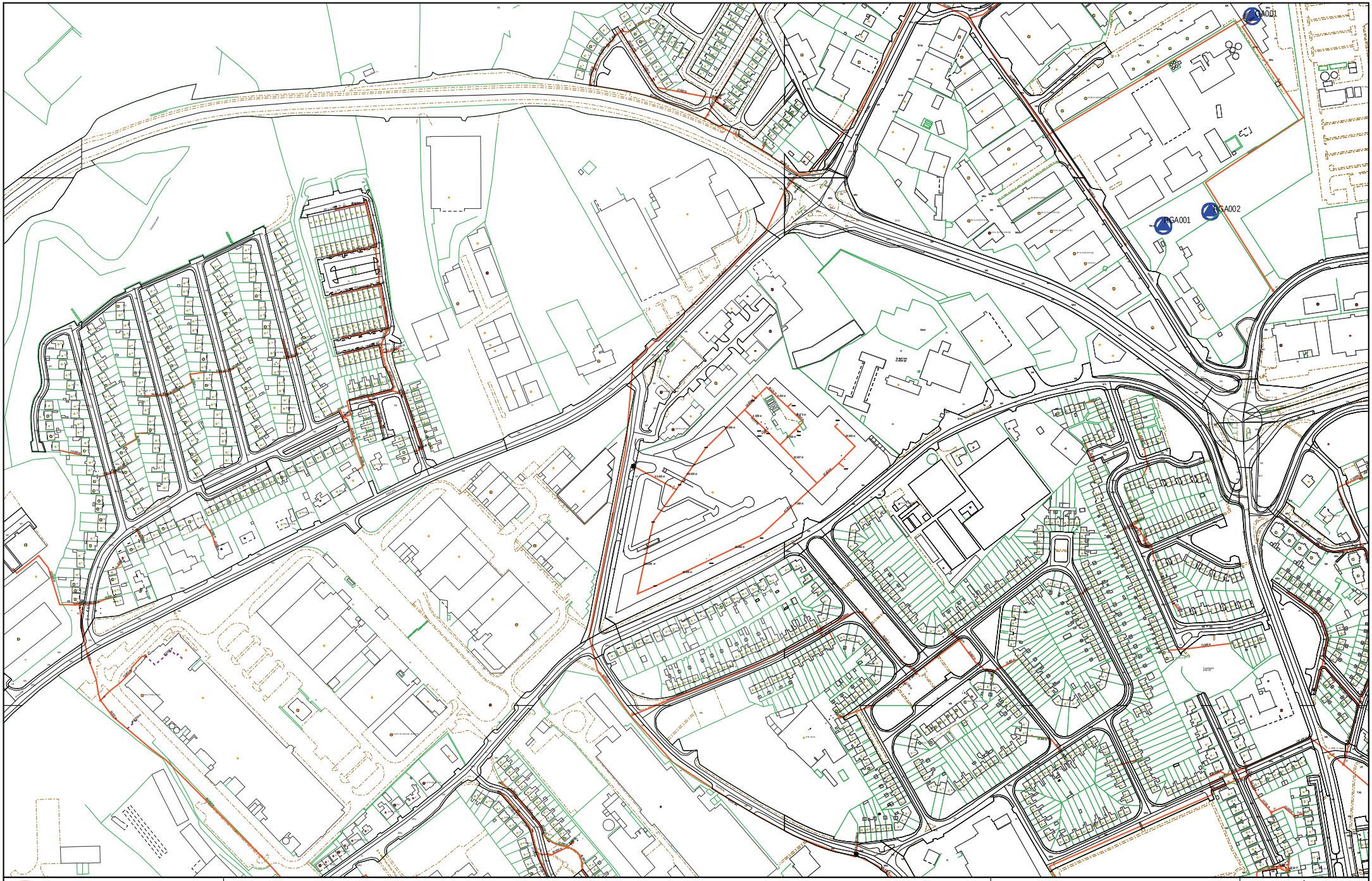
Map Template Design: kcarroll@water.ie

Water Services
Crown Site
Monivea Road



Virgin Media
Unit 6 & 7
Broomhill Business Park
Tallaght 24

PROJECT NAME

DESIGNED BY:

Produced on: 19/06/2018

@ A3

Appendix B – Foul Water Calculations – Micro Drainage

FOUL SEWERAGE DESIGN

Design Criteria for Foul Phase 1

Pipe Sizes Standard Manhole Sizes Standard

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	0.000
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Phase 1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
20.000	10.000	0.050	200.0	0.000	238	0.0	1.500	o	225	
20.001	64.381	0.322	200.0	0.000	0	0.0	1.500	o	225	
20.002	14.483	0.072	200.0	0.000	0	0.0	1.500	o	225	
20.003	22.874	0.114	200.6	0.000	0	0.0	1.500	o	225	
20.004	32.344	0.162	199.7	0.000	134	0.0	1.500	o	225	
20.005	5.870	0.029	202.4	0.000	0	0.0	1.500	o	225	
20.006	49.923	0.250	199.7	0.000	0	0.0	1.500	o	225	
20.007	5.689	0.028	203.2	0.000	0	0.0	1.500	o	225	
20.008	27.245	0.136	200.3	0.000	0	0.0	1.500	o	225	
20.009	12.851	0.064	200.8	0.000	0	0.0	1.500	o	225	
20.010	65.606	0.328	200.0	0.000	0	0.0	1.500	o	225	
21.000	43.074	0.215	200.3	0.000	109	0.0	1.500	o	225	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
20.000	29.800	0.000	0.0	238	0.0	73	0.66	0.81	32.2	7.4
20.001	29.750	0.000	0.0	238	0.0	73	0.66	0.81	32.2	7.4
20.002	29.428	0.000	0.0	238	0.0	73	0.66	0.81	32.2	7.4
20.003	29.356	0.000	0.0	238	0.0	73	0.66	0.81	32.2	7.4
20.004	29.242	0.000	0.0	372	0.0	93	0.74	0.81	32.2	11.5
20.005	29.080	0.000	0.0	372	0.0	93	0.74	0.81	32.0	11.5
20.006	29.051	0.000	0.0	372	0.0	93	0.74	0.81	32.2	11.5
20.007	28.801	0.000	0.0	372	0.0	93	0.74	0.80	32.0	11.5
20.008	28.773	0.000	0.0	372	0.0	93	0.74	0.81	32.2	11.5
20.009	28.637	0.000	0.0	372	0.0	93	0.74	0.81	32.1	11.5
20.010	28.573	0.000	0.0	372	0.0	93	0.74	0.81	32.2	11.5
21.000	29.675	0.000	0.0	109	0.0	49	0.52	0.81	32.2	3.4

Network Design Table for Foul Phase 1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
22.000	9.490	0.047	200.0	0.000	0	0.0	1.500	o	225	
22.001	4.566	0.023	198.5	0.000	103	0.0	1.500	o	225	
23.000	14.192	0.071	199.9	0.000	103	0.0	1.500	o	225	
22.002	9.491	0.047	201.9	0.000	0	0.0	1.500	o	225	
24.000	23.448	0.117	200.4	0.000	109	0.0	1.500	o	225	
25.000	23.649	0.118	200.0	0.000	0	0.0	1.500	o	225	
22.003	51.186	0.256	199.9	0.000	0	0.0	1.500	o	225	
21.001	39.470	0.197	200.0	0.000	0	0.0	1.500	o	225	
26.000	25.299	0.126	200.0	0.000	0	0.0	1.500	o	225	
26.001	51.453	0.257	200.0	0.000	0	0.0	1.500	o	225	
21.002	65.355	0.327	200.0	0.000	0	0.0	1.500	o	225	
21.003	12.814	0.064	200.0	0.000	0	0.0	1.500	o	225	
27.000	22.879	0.114	200.0	0.000	0	0.0	1.500	o	225	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
22.000	29.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
22.001	29.903	0.000	0.0	103	0.0	48	0.52	0.81	32.3	3.2
23.000	29.950	0.000	0.0	103	0.0	48	0.51	0.81	32.2	3.2
22.002	29.879	0.000	0.0	206	0.0	68	0.63	0.81	32.1	6.4
24.000	29.950	0.000	0.0	109	0.0	49	0.52	0.81	32.2	3.4
25.000	29.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
22.003	29.832	0.000	0.0	315	0.0	85	0.71	0.81	32.2	9.7
21.001	29.460	0.000	0.0	424	0.0	100	0.77	0.81	32.2	13.1
26.000	29.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
26.001	29.824	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
21.002	29.263	0.000	0.0	424	0.0	100	0.77	0.81	32.2	13.1
21.003	28.936	0.000	0.0	424	0.0	100	0.77	0.81	32.2	13.1
27.000	29.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0

Network Design Table for Foul Phase 1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
28.000	22.862	0.114	200.0	0.000	0	0.0	1.500	o	225	
27.001	52.955	0.265	200.0	0.000	0	0.0	1.500	o	225	
21.004	86.040	1.076	80.0	0.000	0	0.0	1.500	o	225	
20.011	18.924	0.237	79.8	0.000	0	0.0	1.500	o	225	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
28.000	29.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
27.001	29.836	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
21.004	27.860	0.000	0.0	424	0.0	78	1.08	1.28	51.1	13.1
20.011	26.785	0.000	0.0	796	0.0	110	1.27	1.29	51.1	24.6

Surcharged Outfall Details for Foul Phase 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
20.011	EX-F1	28.090	26.548	0.000	0	0

Input Hydrograph Type: User Defined

No Input Hydrograph data used for analysis due to offset specified.

Simulation Criteria for Foul Phase 1

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

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

Simulation Criteria for Foul Phase 1

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

FOUL SEWERAGE DESIGN

Design Criteria for Foul Phase 2

Pipe Sizes Standard Manhole Sizes Standard

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	0.000
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul Phase 2

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	21.138	0.106	200.0	0.000	96	0.0	1.500	o	225	
1.001	22.507	0.113	200.0	0.000	0	0.0	1.500	o	225	
1.002	23.985	0.120	200.0	0.000	0	0.0	1.500	o	225	
1.003	6.661	0.033	200.0	0.000	0	0.0	1.500	o	225	
1.004	39.338	0.197	200.0	0.000	0	0.0	1.500	o	225	
2.000	19.958	0.100	200.0	0.000	144	0.0	1.500	o	225	
2.001	22.106	0.111	199.2	0.000	0	0.0	1.500	o	225	
2.002	31.940	0.160	199.6	0.000	0	0.0	1.500	o	225	
1.005	44.160	0.221	200.0	0.000	0	0.0	1.500	o	225	
3.000	36.914	0.185	200.0	0.000	480	0.0	1.500	o	225	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	30.000	0.000	0.0	96	0.0	46	0.50	0.81	32.2	3.0
1.001	29.894	0.000	0.0	96	0.0	46	0.50	0.81	32.2	3.0
1.002	29.782	0.000	0.0	96	0.0	46	0.50	0.81	32.2	3.0
1.003	29.662	0.000	0.0	96	0.0	46	0.50	0.81	32.2	3.0
1.004	29.629	0.000	0.0	96	0.0	46	0.50	0.81	32.2	3.0
2.000	30.000	0.000	0.0	144	0.0	57	0.57	0.81	32.2	4.5
2.001	29.900	0.000	0.0	144	0.0	57	0.57	0.81	32.3	4.5
2.002	29.789	0.000	0.0	144	0.0	57	0.57	0.81	32.2	4.5
1.005	29.432	0.000	0.0	240	0.0	73	0.66	0.81	32.2	7.4
3.000	30.000	0.000	0.0	480	0.0	107	0.79	0.81	32.2	14.9

Network Design Table for Foul Phase 2

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.006	56.395	0.282	200.0	0.000	0	0.0	1.500	o	225	
4.000	24.844	0.124	200.0	0.000	120	0.0	1.500	o	225	
4.001	47.911	0.240	200.0	0.000	0	0.0	1.500	o	225	
1.007	5.342	0.027	200.0	0.000	0	0.0	1.500	o	225	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	29.211	0.000	0.0	720	0.0	138	0.87	0.81	32.2	22.3
4.000	29.970	0.000	0.0	120	0.0	52	0.54	0.81	32.2	3.7
4.001	29.846	0.000	0.0	120	0.0	52	0.54	0.81	32.2	3.7
1.007	28.929	0.000	0.0	840	0.0	153	0.90	0.81	32.2	26.0

Surcharged Outfall Details for Foul Phase 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	EX-F2	30.315	28.902	0.000	0	0

Input Hydrograph Type: User Defined

No Input Hydrograph data used for analysis due to offset specified.

Simulation Criteria for Foul Phase 2

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

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

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

Appendix C – Irish Water Letter of Feasibility

LUXOR INVESTMENTS LIMITED
C/O DONNAGH MURPHY

PUNCH CONSULTING, 97 HENRY STREET, LIMERICK

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

12th March 2019

Dear Sir/Madam,

Re: Customer Reference No 953699652 pre-connection enquiry - Subject to contract | Contract denied
Connection for mixed use development comprising of 300 residential units and ancillary residential accommodation, offices, hotel, retail units, medical centre, pharmacy and leisure centre

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at CROWN SQUARE DEVELOPMENT, MONIVEA ROAD, GALWAY.
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.

An existing Irish Water 675mm diameter wastewater sewer runs along the southern boundary of the development site. A connection can be facilitated to the Irish Water wastewater network. The structural integrity of the existing Irish Water sewer running to the south of the development site should not be comprimised during the course of any construction works. The proposed discharge may require a Trade Effluent to Sewer Discharge Licence to be in place prior to connection being made. The applicant is advised to visit https://www.water.ie/for-business/trade-effluent/ in this regard.

The existing Irish Water watermain network has capacity to cater for the proposed development. We understand that the development site has an existing watermain connection from the 9 inch AC watermain on Connolly Avenue. This is the preffered connection location. You will be responsible for assessing the suitability of this existing connection and the existing private side watermain network in catering for the proposed development demands. The existing water meter arrangement may require to be upgraded to ensure it satisfies IW requirements and that it is right sized to suit the development supply demands. This will be confirmed at connection application stage. Please note that the confirmation of feasibility to connect to the Irish Water water infrastructure does not extend to your fire flow requirements. To guarantee a flow to meet the Fire Authority requirements you should provide adequate fire storage capacity within your development.

Strategic Housing Development

Irish Water notes that the residential element of this development may dictate that this element 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. The water and wastewater layouts can be submitted to cdsdesignqa@water.

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 James O Malley from the design team at jomalley@water.ie. For further information, visit **www.water.ie/connections**

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

Appendix D – Statement of Design Acceptance

Luxor Investments Limited c/o Fergal Timlin,
Punch Consulting,
97 Henry Street,
Limerick

23 May 2019

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

Re: Design Submission for Housing Development at Crown Square Development, Monivea Road, Galway (the "Development") (the "Design Submission") / 953699652.

Dear Fergal,

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: James O'Malley
Email: jomalley@water.ie

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix A

Document Title & Revision

- 183-106-051-PL1 Proposed Ground Floor Drainage Layout – Phase 2
- 183-106-053-PL1 Basement Floor Drainage – Phase 2
- 183-106-054-PL1 Watermain Layout – Phase 2
- 183-106-057-PL0 Drainage Longitudinal Sections – Sheet 3 of 6
- 183-106-058-PL0 Drainage Longitudinal Sections – Sheet 4 of 6
- 183-106-060-PL0 Drainage Longitudinal Sections – Sheet 6 of 6

Standard Details/Code of Practice Exemption: N/A

*** Statement of Design Acceptance conditional that minimum cover to FC20-10 is increased to 500mm as per section 3.9.1 of the Wastewater Code of Practice**

*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.

NOTE

PROPOSED DRAINAGE TO BE IN ACCORDANCE WITH THE IRISH WATER CODE OF PRACTICE

IRISH WATER WASTEWATER DETAILS

Drawing No.	Drawing Title
STD-WW-01	Waste water service connection responsibility
STD-WW-02	Typical layout for sewer within new developments
STD-WW-03	Drain & service connection pipework
STD-WW-04	Typical sewer / service pipe connection
STD-WW-05	Typical service layout indicating separation distances
STD-WW-06	Restrictions on wastewater infrastructure adjacent to trees
STD-WW-06A	Restrictions on new trees/shrubs planting adjacent to sewers
STD-WW-07	Trench backfill & bedding
STD-WW-08	Concrete bed, haunch & surround to wastewater pipes
STD-WW-09	Blockwork manhole (>450mm dia.)
STD-WW-12	Backdrop manholes
STD-WW-13	Private side inspection chamber
STD-WW-34	Vent stack

PROPOSED WATERMAINS & SEWERS WITHIN THE "PRECAUTION AREA" ASSOCIATED WITH PROPOSED TREES TO BE FULLY PROTECTED WITH TERRAM ROOTGUARD OR SIMILAR APPROVED ROOT CONTROL BARRIER. THE "PRECAUTION AREA" IS AS SET OUT IN IRISH WATER STANDARD DETAIL STD-WW-06

DRAINAGE LEGEND

EXISTING FOUL - RECORD

EXISTING SURFACE WATER - RECORD

PROPOSED FOUL RISING MAIN

PROPOSED STORM RISING MAIN

PROPOSED FOUL — F1.000

PROPOSED SURFACE WATER — S1.000

PROPOSED ATTENUATION TANK

PROPOSED SUSPENDED FOUL — F1.000

PROPOSED SUSPENDED STORM — S1.000

PHASING LEGEND

PHASE 1 WORKS BOUNDARY

PHASE 2 WORKS BOUNDARY

SEWERS GENERAL:

1. ALL SEWERS SHALL COMPLY WITH SECTION 3.13 OF THE IRISH WATER WASTEWATER CODE OF PRACTICE AS DESCRIBED BELOW;
2. ALL FOUL SEWERS TO BE THERMOPLASTIC STRUCTURED WALL SEWER PIPE AND SHALL COMPLY WITH THE RELEVANT PROVISIONS OF WIS 4-35-01. (I.E.POLYSEWER BY POLYPIPE CIVILS OR EQUIVALENT APPROVED)
3. GRAVITY SEWER PIPE MATERIAL TYPES - THE TYPES AND FITTINGS OUTLINED HEREIN SHALL BE USED IN THE CONSTRUCTION OF THE GRAVITY SEWERS. PIPE MATERIAL SHOULD NOT CHANGE BETWEEN MANHOLES. THE LIST BELOW DOES NOT APPLY TO PIPES INSTALLED BY PIPE JACKING OR MICRO TUNNELING
4. CONCRETE; CONCRETE SEWER PIPES WITH SPIGOT AND SOCKET JOINTS AND RUBBER RING FITTINGS SHALL COMPLY WITH IS EN 1916 :2002+ A1 :2012, BS 5911, PART 1 (2002 + 2010) AND IS 6 (2004) OR EQUIVALENT STANDARD, STRENGTH CLASS Y20 WITH MINIMUM CRUSHING LOADS IN ACCORDANCE WITH TABLE B OF BS 5911-1 (2002: 2010). ALL PIPES AND FITTINGS SHALL HAVE GASKET TYPE JOINTS OF SPIGOT AND SOCKET OR REBATED FORM. (PIPE DIAMETERS 225mm AND ABOVE)
5. THERMOPLASTIC STRUCTURED WALL PIPES; THERMOPLASTIC STRUCTURED WALL PIPES SHALL COMPLY WITH THE PROVISIONS OF IS EN 13476 (2007/2009). PIPES TO BE OF STIFFNESS CLASS 8KN/M2 AND TO BE CAPABLE OF DEMONSTRATING A JETTING RESISTANCE OF 2,600 PSI (180 BAR) WITHOUT DAMAGE WHEN TESTED IN ACCORDANCE WITH SECTION 3.3 OF WIS 4-35-01 (2008). (SEWER DIAMETERS 150mm UP TO 450mm. SERVICE CONNECTIONS OF 100mm DIAMETER)
6. UNPLASTICISED PVC; UNPLASTICISED PVC PIPES AND FITTINGS SHALL COMPLY WITH THE PROVISIONS IS EN 1401 2009/2012. PIPES TO BE APPLICATION AREA CODE "UD", STIFFNESS CLASS 8KN/M2 . PROVISION FOR JETTING SHALL BE BASED ON THE WRC SEWER JETTING CODE OF PRACTICE. JUNE 1997. PIPES TO BE CAPABLE OF RESISTING A MAXIMUM JETTING PUMP PRESSURE OF 2,600PSI (180 BAR) WITHOUT DAMAGE. (SEWER DIAMETERS 150mm UP TO 450mm, SERVICE CONNECTIONS OF 100mm DIAMETER)
7. OTHER; THE USE OF ALTERNATIVE PIPE TYPES AND MATERIALS WILL REQUIRE THE PRIOR WRITTEN AGREEMENT OF IRISH WATER.
8. ALL RISING MAINS SHALL COMPLY WITH SECTION 3.14 OF THE IRISH WATER WASTEWATER CODE OF PRACTICE

DRAINAGE PLAN
SCALE 1:500

COLOUR DRAWING

Date Drawn: 2018-11-06
Drawn By: P.J. Mulcahy
Date Issued: 2019-03-13
Issued By: P.J. Mulcahy

Rev	Amendment	By	Date
PL0	ISSUED FOR PLANNING	PJM	2019-03-13
PL1	ISSUED FOR RFI - REVISED AS PER IRISH WATER COMMENTS	PJM	2019-05-15

Rev	Amendment	By	Date

Client:
CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: PROPOSED GROUND FLOOR DRAINAGE LAYOUT - PHASE 2

PUNCH consulting engineers
Dublin|Limerick|Cork|Galway|Glasgow
Carleycon House, Main Street, Oranmore, Co. Galway, H91 DVX4
IRL: +353 91 388 016 www.punchconsulting.com

Stage: PLANNING
Scale @ A0: 1:500
Technician Check: P.J. Mulcahy
Engineer Check: Fergal Timlin
Approved: Donal Gallery
Drawing No: 183-106-051
Rev: PL1

DRAINAGE LEGEND

PROPOSED FOUL — F1-0 — F1.000

PROPOSED SURFACE WATER — S1-0 — S1.000

PROPOSED ACO CHANNEL — ACO

PROPOSED GULLY — RG

TRAPPED FOUL GULLY TO SERVICE AREAS — F-GY

PROPOSED FOUL RISING MAIN — FS-RM

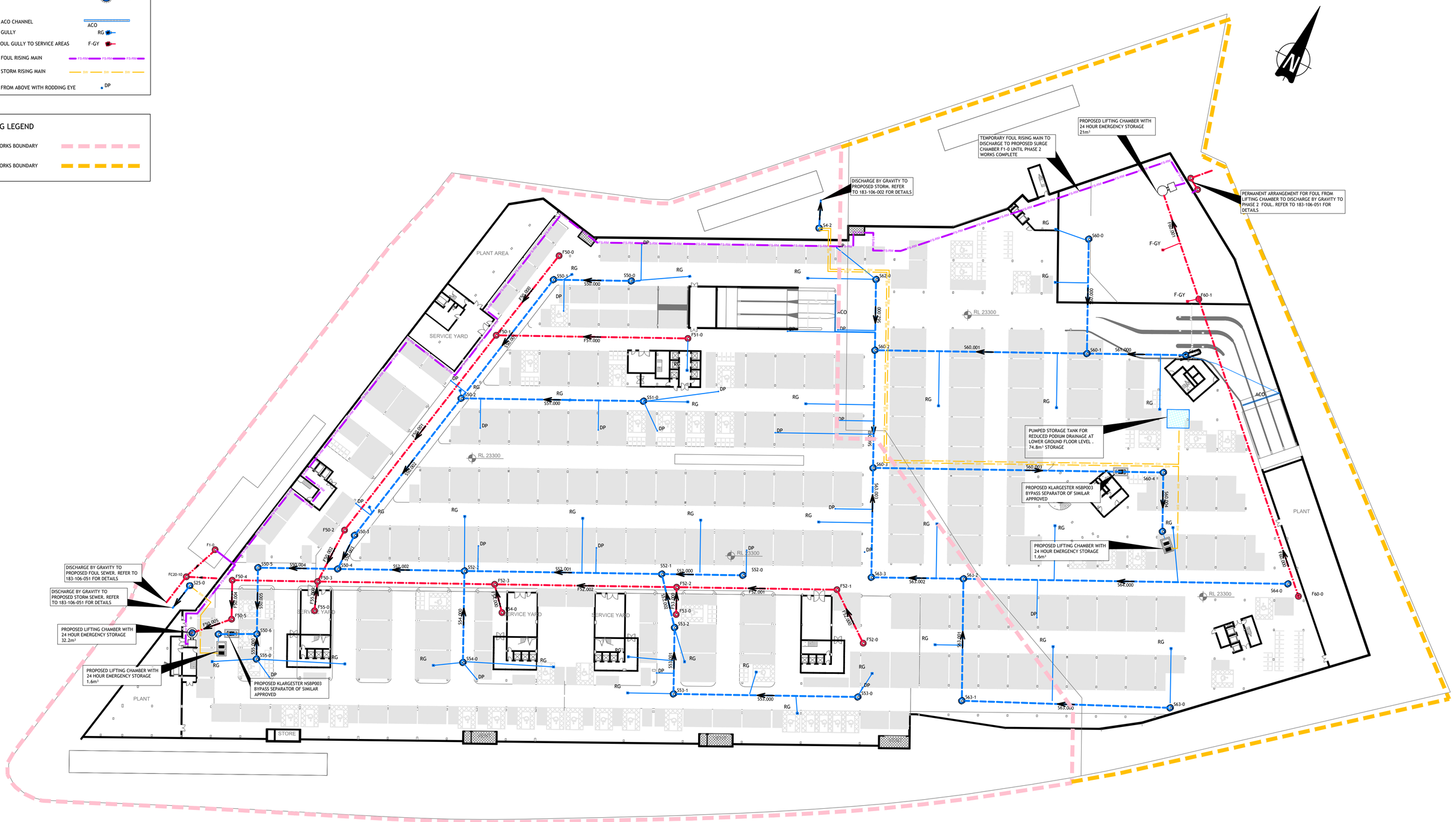
PROPOSED STORM RISING MAIN — SW

DROP PIPE FROM ABOVE WITH RODDING EYE — DP

PHASING LEGEND

PHASE 1 WORKS BOUNDARY

PHASE 2 WORKS BOUNDARY



Date Drawn: 2019-03-08
Drawn By: PJ Mulcahy
Date Issued: 2019-03-13
Issued By: PJMulcahy

Rev	Amendment	By	Date
PL0	ISSUED FOR PLANNING	PJM	2019-03-13
PL1	ISSUED FOR RFI - REVISED AS PER IRISH WATER COMMENTS	PJM	2019-05-15

Client: CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: BASEMENT FLOOR DRAINAGE - PHASE 2

PUNCH consulting engineers
Dublin|Limerick|Cork|Galway|Glasgow
Carleycon House, Main Street, Oranmore, Co. Galway H91 DVX4
IRL: +353 91 388 016 www.punchconsulting.com

Stage: PLANNING
Scale @ A1: 1:500
Technician Check: PJ Mulcahy
Engineer Check: FTimlin
Approved: DGallery
Drawing No: 183-106-053
Rev: PL1

IRISH WATER WATERMAIN DETAILS

Drawing No.	Drawing Title
STD-W-01	Water service connection responsibility
STD-W-02	Typical layout for water mains within developments
STD-W-03	Customer connection & boundary box
STD-W-04	General pipe connections (sheet 1 of 7)
STD-W-05	General pipe connections (sheet 2 of 7)
STD-W-06	General pipe connections (sheet 3 of 7)
STD-W-07	General pipe connections (sheet 4 of 7)
STD-W-08	General pipe connections (sheet 5 of 7)
STD-W-09	General pipe connections (sheet 6 of 7)
STD-W-11	Typical service layout indicating separation distances
STD-W-12	Restrictions on water infrastructure works adjacent to existing trees
STD-W-12A	Restrictions on new trees / shrubs planting adjacent to watermains
STD-W-13	Trench backfill & bedding
STD-W-15	Sluice valve for polyethylene (P.E.) pipe (<350mm dia.) (sheet 2 of 2)
STD-W-18	On-line hydrant for polyethylene (P.E.) pipe (sheet 3 of 4)
STD-W-19	Off-line hydrant for polyethylene (P.E.) pipe (sheet 4 of 4)
STD-W-22	On-line air valve for polyethylene (P.E.) pipe (sheet 3 of 4)
STD-W-26	Non mech meter chamber (40-250mm dia.)
STD-W-27	Marker posts / plates
STD-W-28	Water main thrust & support blocks
STD-W-30	Scour chamber & head wall arrangements

NOTE

PROPOSED WATERMAIN TO BE IN ACCORDANCE WITH THE IRISH WATER CODE OF PRACTICE

PROPOSED WATERMAINS & SEWERS WITHIN THE "PRECAUTION AREA" ASSOCIATED WITH PROPOSED TREES TO BE FULLY PROTECTED WITH TERRAM ROOTGUARD OR SIMILAR APPROVED ROOT CONTROL BARRIER.
THE "PRECAUTION AREA" IS AS SET OUT IN IRISH WATER STANDARD DETAIL STD-WW-06

SCOUR CHAMBER FITTED WITH FLAP VALVE (IW STD-W-30)

STORMWATER MANHOLE

PHASING OF DEVELOPMENT REQUIRES A TEMPORARY DEADEND AT THIS LOCATION IN ACCORDANCE WITH IW STD-W-05

PROPOSED CONNECTION TO EXISTING WATERMAIN

BOUNDARY BOX MANIFOLDS ARE SITUATED IN BASEMENT LEVEL B2. FOR FURTHER DETAILS OF BOUNDARY BOXES AND INTERNAL SUPPLY PIPEWORK REFER TO M&E CONSULTANTS DRAWINGS AND SPECIFICATION

SCOUR CHAMBER (IW STD-W-30)

STORMWATER MANHOLE

PHASING OF DEVELOPMENT REQUIRES A TEMPORARY DEADEND AT THIS LOCATION IN ACCORDANCE WITH IW STD-W-05

WATERMAIN LEGEND

- EXISTING WATERMAIN
- PROPOSED WATERMAIN (110mm OD PE100 SDR11 PIPE)
- PROPOSED SUSPENDED WATERMAIN (LEVEL B1) DN100 DUCTILE IRON
- PROPOSED SUSPENDED WATERMAIN (LEVEL B2) DN100 DUCTILE IRON
- PROPOSED FIRE HYDRANT — H
- PROPOSED SLUICE VALVE — SV
- PROPOSED SCOUR VALVE — ScV
- BOUNDARY BOX MANIFOLD (FOR MULTIPLE PROPERTIES) — BBM
- PROPERTY BOUNDARY BOX — BB
- EXISTING WATERMETER — WM
- AIR VALVE — AV

PHASING LEGEND

- PHASE 1 WORKS BOUNDARY
- PHASE 2 WORKS BOUNDARY

Date Drawn:	2019-03-08
Drawn By:	P.J. Mulcahy
Date Issued:	2019-03-13
Issued By:	P.J. Mulcahy

Rev	Amendment	By	Date
PL0	ISSUED FOR PLANNING	PJM	2019-03-13
PL1	ISSUED FOR RFI - REVISED AS PER IRISH WATER COMMENTS	PJM	2019-05-15

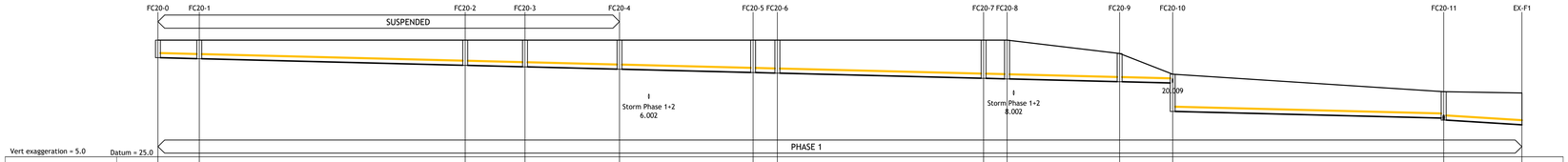
Client:

CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: WATERMAIN LAYOUT - PHASE 2

PUNCH consulting engineers
Dublin|Limerick|Cork|Galway|Glasgow
Carleycon House, Main Street, Oranmore, Co. Galway H91 DVX4
TEL: +353 91 388 016 www.punchconsulting.com

Stage:	PLANNING
Scale @ A1:	1:500
Technician Check:	P.J. Mulcahy
Engineer Check:	Fergal Timlin
Approved:	Donal Gallery
Drawing No:	183-106-054
Rev:	PL1



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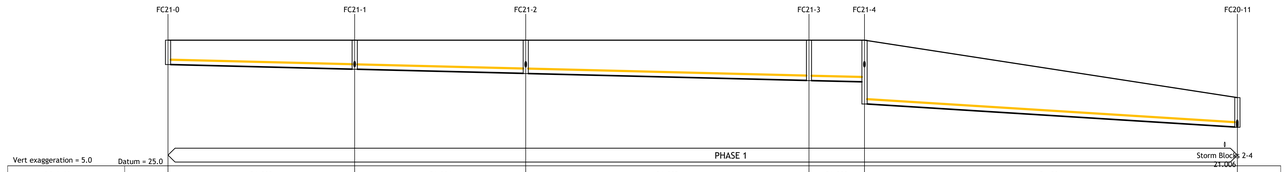
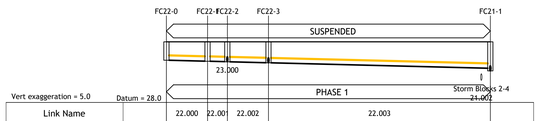
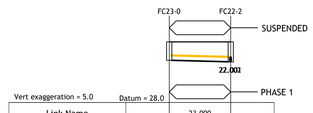
Slope		1:200.0	1:199.9	1:201.2	1:200.6	1:199.7	1:202.4	1:199.7	1:203.2	1:200.3	1:200.8	1:200.0	1:79.8
Cover Level		30.650	30.650	30.650	30.650	30.650	30.650	30.650	30.650	30.650	30.000	29.000	28.150 / 28.090
Invert Level		29.800	29.750 / 29.750	29.438 / 29.438	29.356 / 29.356	29.242 / 29.242	29.080 / 29.080	29.051 / 29.051	28.801 / 28.801	28.773 / 28.773	28.637 / 28.637	28.573 / 27.200	26.872 / 26.785 / 26.548
Length		10.000	64.381	14.483	22.874	32.344	5.870	49.923	5.689	27.245	12.851	65.606	18.924



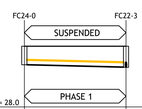
Link Name		21.000	21.001	21.002	21.003	21.004
Section Type		225mm	225mm	225mm	225mm	225mm
Slope		1:200.3	1:200.4	1:199.9	1:200.2	1:80.0
Cover Level		30.800	30.800	30.800	30.800	30.800 / 28.150
Invert Level		29.675	29.460 / 29.460	29.263 / 29.263	28.936 / 28.936	28.872 / 27.860 / 26.784
Length		43.074	39.470	65.355	12.814	86.040



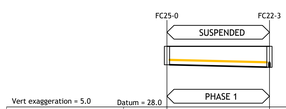
Link Name		22.000	22.001 / 22.002	22.003	
Section Type		225mm	225mm / 225mm	225mm	
Slope		1:201.9	1:198.5 / 1:201.9	1:199.9	
Cover Level		30.800	30.800 / 30.800	30.800	30.800
Invert Level		29.950	29.903 / 29.880 / 29.878	29.872 / 29.832	29.576
Length		9.490	4.566 / 9.491	51.186	



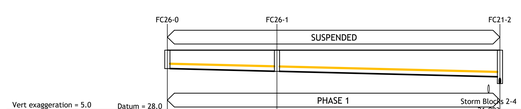
Link Name		23.000
Section Type		225mm
Slope		1:199.9
Cover Level		30.800 / 30.800
Invert Level		29.950 / 29.879
Length		14.192



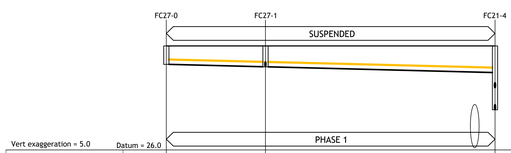
Link Name		24.000
Section Type		225mm
Slope		1:200.4
Cover Level		30.800 / 30.800
Invert Level		29.950 / 29.833
Length		23.448



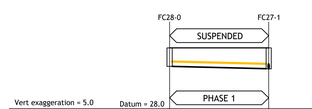
Link Name		25.000
Section Type		225mm
Slope		1:200.4
Cover Level		30.800 / 30.800
Invert Level		29.950 / 29.832
Length		23.649



Link Name		26.000	26.001
Section Type		225mm	225mm
Slope		1:200.8	1:200.2
Cover Level		30.800	30.800 / 30.800
Invert Level		29.950	29.824 / 29.824 / 29.567
Length		25.299	51.453



Link Name		27.000	27.001
Section Type		225mm	225mm
Slope		1:200.7	1:199.8
Cover Level		30.800	30.800 / 30.800
Invert Level		29.950	29.836 / 29.836 / 29.571
Length		22.879	52.955



Link Name		28.000
Section Type		225mm
Slope		1:200.5
Cover Level		30.800 / 30.800
Invert Level		29.950 / 29.836
Length		22.862

Rev	Amendment	By	Date
PL0	ISSUED FOR PLANNING	PJM	2019-03-13

Rev	Amendment	By	Date

Client:

CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: DRAINAGE LONGITUDINAL SECTIONS - SHEET 3 OF 6

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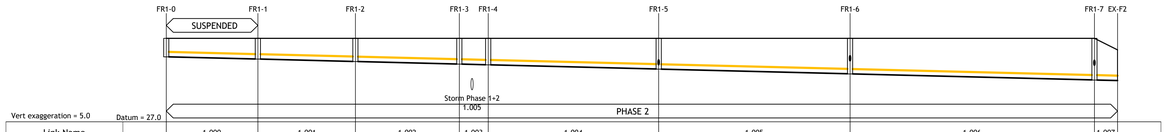
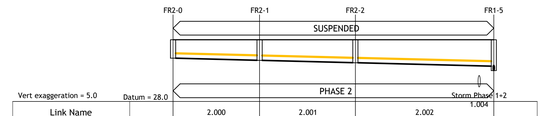
Stage: PLANNING
Scale @ A0: As Shown
Technician Check: PJ Mulcahy
Engineer Check: PTimlin
Approved: DGallery
Drawing No: 181-306-057
Rev: PL0



Link Name		1.000	1.001	1.002	1.003	1.004	1.005	1.006	1.007
Section Type		225mm	225mm	225mm	225mm	225mm	225mm	225mm	225mm
Slope		1:199.4	1:199.2	1:199.9	1:201.8	1:199.7	1:199.8	1:200.0	1:197.9
Cover Level		30.850	30.850	30.850	30.850	30.850	30.850	30.850	30.850 / 30.315
Invert Level		30.000	29.894 / 29.894	29.792 / 29.792	29.662 / 29.662	29.629 / 29.629	29.432 / 29.432	29.211 / 29.211	28.929 / 28.929 / 28.902
Length		21.138	22.507	23.985	6.661	39.338	44.160	56.395	5.342

PIPERUN 1 - PHASE 2 FOUL - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100



Link Name		2.000	2.001	2.002	
Section Type		225mm	225mm	225mm	
Slope		1:199.6	1:199.2	1:199.6	
Cover Level		30.850	30.850	30.850	30.850
Invert Level		30.000	29.900 / 29.900	29.789 / 29.789	29.629
Length		19.958	22.106	31.940	

PIPERUN 2 - PHASE 2 FOUL - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Link Name		3.000	
Section Type		225mm	
Slope		1:199.5	
Cover Level		30.850	30.850
Invert Level		30.000	29.815
Length		36.914	

PIPERUN 3 - FOUL PHASE 2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Link Name		4.000	4.001	
Section Type		225mm	225mm	
Slope		1:200.4	1:199.6	
Cover Level		30.825	30.850	30.850
Invert Level		29.970	29.846 / 29.846	29.606
Length		24.844	47.911	

PIPERUN 4 - FOUL PHASE 2- LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Date Drawn: 2019-03-08
Drawn By: PJ Mulcahy
Date Issued: 2019-03-13
Issued By: PJMulcahy

Rev	Amendment	By	Date	Rev	Amendment	By	Date
PL0	ISSUED FOR PLANNING	PJM	2019-03-13				

Client:
CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: DRAINAGE LONGITUDINAL SECTIONS - SHEET 4 OF 6

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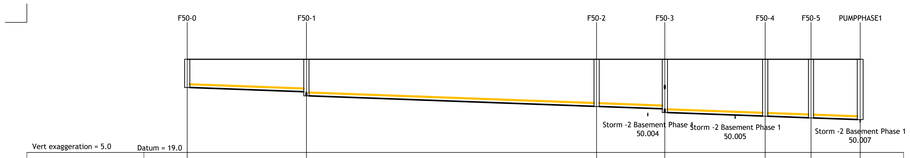
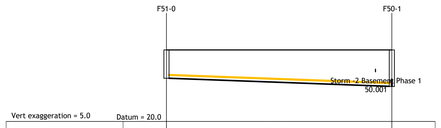
Stage: PLANNING
Scale @ A0: As Shown
Technician Check: PJ Mulcahy
Engineer Check: ITimlin
Approved: DGallery
Drawing No: 183-106-058 | Rev: PL0



Vert exaggeration = 5.0 Datum = 19.0

Link Name		50.000	50.001	50.002	50.003	50.004	50.005	
Section Type		150mm	150mm	150mm	150mm	150mm	150mm	
Slope		1:136.1	1:136.1	1:135.7	1:136.2	1:135.6	1:136.7	
Cover Level		23.300	23.300	23.300	23.300	23.300	23.300	23.300
Invert Level		22.000	21.798 21.618	21.126 21.126	21.010 20.845	20.675 20.675	20.497 20.497	20.514
Length		27.500	66.960	15.741	23.156	10.577	11.347	

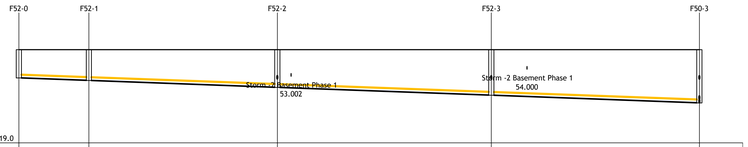
PIPERUN 50 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100



Vert exaggeration = 5.0 Datum = 20.0

Link Name		51.000	
Section Type		150mm	
Slope		1:136.1	
Cover Level		23.300	23.300
Invert Level		22.000	21.618
Length		52.000	

PIPERUN 51 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100



Vert exaggeration = 5.0 Datum = 19.0

Link Name		52.000	52.001	52.002	52.003
Section Type		150mm	150mm	150mm	150mm
Slope		1:135.8	1:135.9	1:136.0	1:136.0
Cover Level		23.300	23.300	23.300	23.300	23.300
Invert Level		22.000	21.881 21.881	21.561 21.561	21.198 21.198	20.845
Length		16.159	43.487	49.367	48.013	

PIPERUN 52 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Vert exaggeration = 5.0 Datum = 20.0

Link Name		53.000	
Section Type		150mm	
Slope		1:137.2	
Cover Level		23.300	23.300
Invert Level		22.000	21.946
Length		7.408	

PIPERUN 53 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Vert exaggeration = 5.0 Datum = 20.0

Link Name		54.000	
Section Type		150mm	
Slope		1:136.7	
Cover Level		23.300	23.300
Invert Level		22.000	21.942
Length		7.931	

PIPERUN 54 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Vert exaggeration = 5.0 Datum = 19.0

Link Name		55.000	
Section Type		150mm	
Slope		1:135.1	
Cover Level		23.300	23.300
Invert Level		22.000	21.941
Length		7.969	

PIPERUN 55 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

Vert exaggeration = 5.0 Datum = 19.0

Link Name		60.000	60.001	
Section Type		150mm	150mm	
Slope		1:100.0	1:100.0	
Cover Level		23.300	23.300	23.300
Invert Level		21.995	21.145 21.145	20.835
Length		85.000	30.965	

PIPERUN 60 - FOUL BASEMENT LEVEL -2 - LONGITUDINAL SECTION
SCALE HORIZONTAL 1:500 VERTICAL 1:100

COLOUR DRAWING ☒

Date Drawn: 2019-03-08
Drawn By: PJ Mulcahy
Date Issued: 2019-03-13
Issued By: PJMulcahy

Rev	Amendment	By	Date	Rev	Amendment	By	Date
P1.0	ISSUED FOR PLANNING	P.JM.	2019-03-13				

Client:

CROWN SQUARE DEVELOPMENTS LTD.

Job: CROWN SQUARE PROJECT GALWAY
Title: DRAINAGE LONGITUDINAL SECTIONS - SHEET 6 OF 6

PUNCH consulting engineers
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Stage: PLANNING
Scale @ A0: As Shown
Technician Check: PJ Mulcahy
Engineer Check: PTimlin
Approved: DGallery
Drawing No: 183-106-060 Rev: P1.0

Appendix E – Rainfall Supporting Data

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Fergal Timlin
Site name:	Crown Square Development
Site location:	Monivea Road, Galway

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	53.28796° N
Longitude:	9.02134° W

Reference:	6484561
Date:	2018-10-25T10:07:56

Methodology	IH124

Site characteristics

Total site area (ha)	5.4

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	1	1
HOST class	---	---
SPR/SPRHOST	0.1	0.1

Hydrological characteristics

	Default	Edited
SAAR (mm)	1281	1281
Hydrological region	13	13
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	1.65	1.65
Growth curve factor: 100 year	1.95	1.95

Notes:

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

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

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

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	1.84	1.84
1 in 1 year (l/s)	1.56	1.56
1 in 30 years (l/s)	3.04	3.04
1 in 100 years (l/s)	3.59	3.59

Appendix F - Surface Water Calculations - Micro Drainage

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Blocks 2-4

Pipe Sizes Standard Manhole Sizes Standard

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.500	Minimum Backdrop Height (m)	0.000
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm Blocks 2-4

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.511	4-8	1.183	8-12	0.059

Total Area Contributing (ha) = 1.754

Total Pipe Volume (m³) = 295.877

Network Design Table for Storm Blocks 2-4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
21.000	66.008	0.330	200.0	0.096	5.00	0.0	0.600	o	300	
21.001	12.195	0.061	200.0	0.049	0.00	0.0	0.600	o	300	
21.002	69.239	0.346	200.0	0.216	0.00	0.0	0.600	o	300	
22.000	45.550	0.228	200.0	0.155	5.00	0.0	0.600	o	225	
21.003	39.461	0.197	200.0	0.108	0.00	0.0	0.600	o	375	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
21.000	50.00	5.99	29.925	0.096	0.0	0.0	0.0	1.11	78.3	13.0
21.001	50.00	6.18	29.595	0.145	0.0	0.0	0.0	1.11	78.3	19.6
21.002	50.00	7.22	29.349	0.361	0.0	0.0	0.0	1.11	78.3	48.9
22.000	50.00	5.82	29.925	0.155	0.0	0.0	0.0	0.92	36.6	21.0
21.003	50.00	7.73	29.003	0.624	0.0	0.0	0.0	1.28	141.1	84.5

Network Design Table for Storm Blocks 2-4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
23.000	73.703	0.369	199.7	0.286	5.00	0.0	0.600	o	300	
21.004	73.227	0.366	200.0	0.220	0.00	0.0	0.600	o	450	
24.000	45.116	0.226	199.6	0.304	5.00	0.0	0.600	o	300	
21.005	80.759	0.200	403.8	0.000	0.00	0.0	0.600	o	2000	
25.000	56.239	0.281	200.1	0.320	5.00	0.0	0.600	o	300	
21.006	7.898	0.039	200.0	0.000	0.00	0.0	0.600	o	225	
21.007	31.157	0.156	200.0	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
23.000	50.00	6.11	29.925	0.286	0.0	0.0	0.0	1.11	78.4	38.7
21.004	50.00	8.58	28.806	1.130	0.0	0.0	0.0	1.43	228.1	153.0
24.000	50.00	5.68	30.000	0.304	0.0	0.0	0.0	1.11	78.4	41.2
21.005	50.00	9.11	26.100	1.434	0.0	0.0	0.0	2.54	7971.9	194.2
25.000	50.00	5.85	27.000	0.320	0.0	0.0	0.0	1.11	78.3	43.3
21.006	50.00	5.14	25.900	0.000	3.1	0.0	0.0	0.92	36.6	3.1
21.007	50.00	5.71	25.861	0.000	3.1	0.0	0.0	0.92	36.6	3.1

Free Flowing Outfall Details for Storm Blocks 2-4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
21.007	EX-S2	28.030	25.705	0.000	0	0

Simulation Criteria for Storm Blocks 2-4

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Storm Blocks 2-4

Hydro-Brake Optimum® Manhole: S21-6, DS/PN: 21.006, Volume (m³): 260.2

Unit Reference	MD-SHE-0071-3100-2000-3100
Design Head (m)	2.000
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	71
Invert Level (m)	25.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.1
Flush-Flo™	0.313	2.3
Kick-Flo®	0.640	1.8
Mean Flow over Head Range	-	2.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.4	3.000	3.7	7.000	5.6
0.200	2.2	1.400	2.6	3.500	4.0	7.500	5.7
0.300	2.3	1.600	2.8	4.000	4.3	8.000	5.9
0.400	2.3	1.800	2.9	4.500	4.5	8.500	6.1
0.500	2.2	2.000	3.1	5.000	4.7	9.000	6.3
0.600	2.0	2.200	3.2	5.500	5.0	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.2		
1.000	2.3	2.600	3.5	6.500	5.4		

Storage Structures for Storm Blocks 2-4

Tank or Pond Manhole: S21-6, DS/PN: 21.006

Invert Level (m) 25.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	450.0	2.200	450.0	2.201	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm Blocks 2-4

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.300
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	100
Climate Change (%)	10

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
21.000	15 Winter	100	+10%	100/15 Summer				
21.001	15 Winter	100	+10%	100/15 Summer				
21.002	15 Winter	100	+10%	100/15 Summer				
22.000	15 Winter	100	+10%	100/15 Summer				
21.003	15 Winter	100	+10%	100/15 Summer				
23.000	15 Winter	100	+10%	100/15 Summer				
21.004	15 Winter	100	+10%	100/15 Summer				
24.000	15 Winter	100	+10%	100/15 Summer				
21.005	2880 Winter	100	+10%	100/2880 Winter				
25.000	2880 Winter	100	+10%	100/15 Summer				
21.006	2880 Winter	100	+10%	100/15 Summer				
21.007	2880 Winter	100	+10%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
21.000	S21-0	30.731	0.506	0.000	0.38	0.0	28.1	SURCHARGED
21.001	S21-1	30.627	0.732	0.000	0.83	0.0	51.4	SURCHARGED
21.002	S21-2	30.554	0.905	0.000	1.19	0.0	88.9	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm Blocks 2-4

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
22.000	S22-0	30.515	0.365	0.000	1.49	0.0	52.0	SURCHARGED
21.003	S21-3	30.020	0.642	0.000	1.31	0.0	167.7	SURCHARGED
23.000	S23-0	30.531	0.306	0.000	1.32	0.0	99.2	SURCHARGED
21.004	S21-4	29.698	0.443	0.000	1.49	0.0	318.1	SURCHARGED
24.000	S24-0	30.579	0.279	0.000	1.51	0.0	110.6	SURCHARGED
21.005	S21-5	28.474	0.374	0.000	0.00	0.0	19.9	SURCHARGED
25.000	S25-0	28.474	1.174	0.000	0.06	0.0	4.4	SURCHARGED
21.006	S21-6	28.474	2.349	0.000	0.12	0.0	3.5	SURCHARGED
21.007	S21-7	25.908	-0.177	0.000	0.10	0.0	3.5	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Blocks 2-4

Pipe Sizes Standard Manhole Sizes Standard

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.500	Minimum Backdrop Height (m)	0.000
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm Blocks 2-4

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.511	4-8	1.183	8-12	0.059

Total Area Contributing (ha) = 1.754

Total Pipe Volume (m³) = 295.877

Network Design Table for Storm Blocks 2-4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
21.000	66.008	0.330	200.0	0.096	5.00	0.0	0.600	o	300	
21.001	12.195	0.061	200.0	0.049	0.00	0.0	0.600	o	300	
21.002	69.239	0.346	200.0	0.216	0.00	0.0	0.600	o	300	
22.000	45.550	0.228	200.0	0.155	5.00	0.0	0.600	o	225	
21.003	39.461	0.197	200.0	0.108	0.00	0.0	0.600	o	375	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
21.000	50.00	5.99	29.925	0.096	0.0	0.0	0.0	1.11	78.3	13.0
21.001	50.00	6.18	29.595	0.145	0.0	0.0	0.0	1.11	78.3	19.6
21.002	50.00	7.22	29.349	0.361	0.0	0.0	0.0	1.11	78.3	48.9
22.000	50.00	5.82	29.925	0.155	0.0	0.0	0.0	0.92	36.6	21.0
21.003	50.00	7.73	29.003	0.624	0.0	0.0	0.0	1.28	141.1	84.5

Network Design Table for Storm Blocks 2-4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
23.000	73.703	0.369	199.7	0.286	5.00	0.0	0.600	o	300	
21.004	73.227	0.366	200.0	0.220	0.00	0.0	0.600	o	450	
24.000	45.116	0.226	199.6	0.304	5.00	0.0	0.600	o	300	
21.005	80.759	0.200	403.8	0.000	0.00	0.0	0.600	o	2000	
25.000	56.239	0.281	200.1	0.320	5.00	0.0	0.600	o	300	
21.006	7.898	0.039	200.0	0.000	0.00	0.0	0.600	o	225	
21.007	31.157	0.156	200.0	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
23.000	50.00	6.11	29.925	0.286	0.0	0.0	0.0	1.11	78.4	38.7
21.004	50.00	8.58	28.806	1.130	0.0	0.0	0.0	1.43	228.1	153.0
24.000	50.00	5.68	30.000	0.304	0.0	0.0	0.0	1.11	78.4	41.2
21.005	50.00	9.11	26.100	1.434	0.0	0.0	0.0	2.54	7971.9	194.2
25.000	50.00	5.85	27.000	0.320	0.0	0.0	0.0	1.11	78.3	43.3
21.006	50.00	5.14	25.900	0.000	3.1	0.0	0.0	0.92	36.6	3.1
21.007	50.00	5.71	25.861	0.000	3.1	0.0	0.0	0.92	36.6	3.1

Free Flowing Outfall Details for Storm Blocks 2-4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
21.007	EX-S2	28.030	25.705	0.000	0	0

Simulation Criteria for Storm Blocks 2-4

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Storm Blocks 2-4

Hydro-Brake Optimum® Manhole: S21-6, DS/PN: 21.006, Volume (m³): 260.2

Unit Reference	MD-SHE-0071-3100-2000-3100
Design Head (m)	2.000
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	71
Invert Level (m)	25.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.1
Flush-Flo™	0.313	2.3
Kick-Flo®	0.640	1.8
Mean Flow over Head Range	-	2.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.4	3.000	3.7	7.000	5.6
0.200	2.2	1.400	2.6	3.500	4.0	7.500	5.7
0.300	2.3	1.600	2.8	4.000	4.3	8.000	5.9
0.400	2.3	1.800	2.9	4.500	4.5	8.500	6.1
0.500	2.2	2.000	3.1	5.000	4.7	9.000	6.3
0.600	2.0	2.200	3.2	5.500	5.0	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.2		
1.000	2.3	2.600	3.5	6.500	5.4		

Storage Structures for Storm Blocks 2-4

Tank or Pond Manhole: S21-6, DS/PN: 21.006

Invert Level (m) 25.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	450.0	2.200	450.0	2.201	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm Blocks 2-4

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.300
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	30
Climate Change (%)	0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
21.000	15 Winter	30	0%					
21.001	15 Winter	30	0%	30/15 Winter				
21.002	15 Winter	30	0%	30/15 Summer				
22.000	15 Winter	30	0%	30/15 Summer				
21.003	15 Winter	30	0%	30/15 Summer				
23.000	15 Winter	30	0%					
21.004	15 Winter	30	0%	30/15 Summer				
24.000	15 Winter	30	0%	30/15 Summer				
21.005	2880 Winter	30	0%					
25.000	2880 Winter	30	0%	30/15 Summer				
21.006	2880 Winter	30	0%	30/15 Summer				
21.007	2880 Winter	30	0%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
21.000	S21-0	30.048	-0.177	0.000	0.33	0.0	25.0	OK
21.001	S21-1	29.920	0.025	0.000	0.71	0.0	43.7	SURCHARGED
21.002	S21-2	29.861	0.212	0.000	1.00	0.0	74.8	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm Blocks 2-4

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
22.000	S22-0	30.212	0.062	0.000	1.15	0.0	40.1	SURCHARGED
21.003	S21-3	29.575	0.197	0.000	1.02	0.0	130.5	SURCHARGED
23.000	S23-0	30.188	-0.037	0.000	1.00	0.0	75.2	OK
21.004	S21-4	29.366	0.111	0.000	1.15	0.0	245.5	SURCHARGED
24.000	S24-0	30.320	0.020	0.000	1.07	0.0	78.4	SURCHARGED
21.005	S21-5	27.448	-0.652	0.000	0.00	0.0	14.9	OK
25.000	S25-0	27.448	0.148	0.000	0.04	0.0	3.3	SURCHARGED
21.006	S21-6	27.448	1.323	0.000	0.09	0.0	2.7	SURCHARGED
21.007	S21-7	25.903	-0.183	0.000	0.08	0.0	2.7	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Phase 1+2

Pipe Sizes Standard Manhole Sizes Standard

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.500	Minimum Backdrop Height (m)	0.000
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm Phase 1+2

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.587	4-8	2.049	8-12	0.245

Total Area Contributing (ha) = 2.881

Total Pipe Volume (m³) = 413.862

Network Design Table for Storm Phase 1+2

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	21.407	0.107	200.0	0.241	5.00	0.0	0.600	o	300	
1.001	32.110	0.161	200.0	0.095	0.00	0.0	0.600	o	300	
2.000	16.500	0.083	200.0	0.095	5.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.32	29.925	0.241	0.0	0.0	0.0	1.11	78.3	32.6
1.001	50.00	5.80	29.818	0.336	0.0	0.0	0.0	1.11	78.3	45.5
2.000	50.00	5.30	29.925	0.095	0.0	0.0	0.0	0.92	36.6	12.9

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.002	18.366	0.092	200.0	0.020	0.00	0.0	0.600	o	300	
1.003	43.895	0.219	200.0	0.244	0.00	0.0	0.600	o	450	
3.000	20.860	0.104	200.0	0.098	5.00	0.0	0.600	o	300	
3.001	22.473	0.112	200.0	0.098	0.00	0.0	0.600	o	300	
3.002	30.792	0.154	200.0	0.187	0.00	0.0	0.600	o	300	
1.004	38.676	0.193	200.4	0.034	0.00	0.0	0.600	o	525	
1.005	32.619	0.163	200.1	0.000	0.00	0.0	0.600	o	525	
1.006	68.566	0.343	199.9	0.185	0.00	0.0	0.600	o	525	
1.007	27.883	0.139	200.6	0.136	0.00	0.0	0.600	o	2000	
4.000	56.923	0.285	200.0	0.210	5.00	0.0	0.600	o	300	
5.000	55.052	0.275	200.2	0.233	5.00	0.0	0.600	o	300	
4.001	6.196	0.031	199.9	0.100	0.00	0.0	0.600	o	300	
4.002	8.212	0.027	300.0	0.295	0.00	0.0	0.600	o	600	
4.003	4.463	0.015	300.0	0.000	0.00	0.0	0.600	o	600	
1.008	38.789	0.200	193.9	0.118	0.00	0.0	0.600	o	2300	
1.009	40.482	0.202	200.4	0.046	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.002	50.00	6.08	29.657	0.451	0.0	0.0	0.0	1.11	78.3	61.1
1.003	50.00	6.59	28.900	0.695	0.0	0.0	0.0	1.43	228.1	94.1
3.000	50.00	5.31	29.925	0.098	0.0	0.0	0.0	1.11	78.3	13.3
3.001	50.00	5.65	29.821	0.196	0.0	0.0	0.0	1.11	78.3	26.5
3.002	50.00	6.11	29.708	0.383	0.0	0.0	0.0	1.11	78.3	51.9
1.004	50.00	7.00	28.681	1.112	0.0	0.0	0.0	1.58	341.7	150.6
1.005	50.00	7.34	28.488	1.112	0.0	0.0	0.0	1.58	342.0	150.6
1.006	50.00	8.07	28.325	1.297	0.0	0.0	0.0	1.58	342.2	175.6
1.007	50.00	5.13	27.982	0.000	40.0	0.0	0.0	3.61	11327.4	40.0
4.000	50.00	5.86	29.925	0.210	0.0	0.0	0.0	1.11	78.3	28.4
5.000	50.00	5.83	29.925	0.233	0.0	0.0	0.0	1.11	78.3	31.6
4.001	50.00	5.95	29.640	0.543	0.0	0.0	0.0	1.11	78.4	73.5
4.002	50.00	6.05	29.609	0.838	0.0	0.0	0.0	1.40	396.0	113.5
4.003	50.00	6.10	29.582	0.838	0.0	0.0	0.0	1.40	396.0	113.5
1.008	50.00	6.26	27.843	0.956	40.0	0.0	0.0	3.99	16586.2	169.5
1.009	50.00	6.87	27.642	1.002	40.0	0.0	0.0	1.11	78.2«	175.7

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
6.000	42.734	0.214	199.7	0.040	5.00	0.0	0.600	o	225	
7.000	42.486	0.212	200.4	0.035	5.00	0.0	0.600	o	225	
6.001	17.068	0.085	200.8	0.027	0.00	0.0	0.600	o	225	
6.002	11.971	0.060	199.5	0.026	0.00	0.0	0.600	o	225	
8.000	37.699	0.188	200.5	0.020	5.00	0.0	0.600	o	225	
8.001	26.414	0.132	200.1	0.020	0.00	0.0	0.600	o	225	
8.002	10.975	0.055	199.5	0.030	0.00	0.0	0.600	o	225	
8.003	38.380	0.192	199.9	0.089	0.00	0.0	0.600	o	225	
8.004	6.550	0.033	198.5	0.034	0.00	0.0	0.600	o	225	
9.000	44.150	0.200	220.8	0.050	5.00	0.0	0.600	o	1500	
8.005	33.826	0.169	200.2	0.075	0.00	0.0	0.600	o	375	
6.003	8.078	0.040	202.0	0.000	0.00	0.0	0.600	o	375	
6.004	22.501	0.075	300.0	0.000	0.00	0.0	0.600	o	600	
6.005	2.811	0.009	312.3	0.000	0.00	0.0	0.600	o	600	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.000	50.00	5.77	29.925	0.040	0.0	0.0	0.0	0.92	36.6	5.4
7.000	50.00	5.77	29.925	0.035	0.0	0.0	0.0	0.92	36.6	4.7
6.001	50.00	6.08	29.711	0.102	0.0	0.0	0.0	0.92	36.5	13.8
6.002	50.00	6.30	27.860	0.128	0.0	0.0	0.0	0.92	36.7	17.3
8.000	50.00	5.68	30.000	0.020	0.0	0.0	0.0	0.92	36.6	2.7
8.001	50.00	6.16	29.812	0.040	0.0	0.0	0.0	0.92	36.6	5.4
8.002	50.00	6.36	28.000	0.070	0.0	0.0	0.0	0.92	36.7	9.5
8.003	50.00	7.05	27.945	0.159	0.0	0.0	0.0	0.92	36.6	21.5
8.004	50.00	7.17	27.753	0.193	0.0	0.0	0.0	0.92	36.8	26.1
9.000	50.00	5.26	26.700	0.050	0.0	0.0	0.0	2.88	5094.9	6.8
8.005	50.00	7.61	26.500	0.318	0.0	0.0	0.0	1.28	141.0	43.1
6.003	50.00	7.72	26.331	0.446	0.0	0.0	0.0	1.27	140.4	60.4
6.004	50.00	5.27	26.291	0.000	50.0	0.0	0.0	1.40	396.0	50.0
6.005	50.00	5.30	26.216	0.000	50.0	0.0	0.0	1.37	388.1	50.0

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.010	5.489	0.018	304.9	0.000	0.00	0.0	0.600	o	225	
1.011	4.584	0.100	45.8	0.000	0.00	0.0	0.600	o	225	
1.012	11.556	0.039	300.0	0.000	0.00	0.0	0.600	o	225	
1.013	52.654	0.320	164.5	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.010	50.00	5.12	26.207	0.000	7.1	0.0	0.0	0.74	29.6	7.1
1.011	50.00	5.16	26.189	0.000	7.1	0.0	0.0	1.94	77.0	7.1
1.012	50.00	5.42	26.089	0.000	7.1	0.0	0.0	0.75	29.8	7.1
1.013	50.00	6.28	26.050	0.000	7.1	0.0	0.0	1.02	40.4	7.1

Free Flowing Outfall Details for Storm Phase 1+2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	EX-S1	26.790	25.730	0.000	0	0

Simulation Criteria for Storm Phase 1+2

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Storm Phase 1+2

Hydro-Brake Optimum® Manhole: S1-7, DS/PN: 1.007, Volume (m³): 21.8

Unit Reference	MD-SHE-0254-4000-2000-4000
Design Head (m)	2.000
Design Flow (l/s)	40.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	254
Invert Level (m)	27.982
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	40.0
Flush-Flo™	0.599	39.8
Kick-Flo®	1.297	32.5
Mean Flow over Head Range	-	34.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.2	1.200	35.2	3.000	48.6	7.000	73.3
0.200	26.1	1.400	33.7	3.500	52.4	7.500	75.8
0.300	36.8	1.600	35.9	4.000	55.8	8.000	78.2
0.400	38.7	1.800	38.0	4.500	59.1	8.500	80.5
0.500	39.6	2.000	40.0	5.000	62.2	9.000	82.8
0.600	39.8	2.200	41.8	5.500	65.2	9.500	85.0
0.800	39.3	2.400	43.6	6.000	68.0		
1.000	38.0	2.600	45.4	6.500	70.7		

Hydro-Brake Optimum® Manhole: S6-4, DS/PN: 6.004, Volume (m³): 4.0

Unit Reference	MD-SHE-0284-5000-1800-5000
Design Head (m)	1.800
Design Flow (l/s)	50.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	284
Invert Level (m)	26.291
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	50.0
Flush-Flo™	0.559	49.9

Hydro-Brake Optimum® Manhole: S6-4, DS/PN: 6.004, Volume (m³): 4.0

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	1.224	41.5
Mean Flow over Head Range	-	42.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.9	1.200	42.5	3.000	63.9	7.000	96.5
0.200	29.3	1.400	44.3	3.500	68.9	7.500	99.8
0.300	46.8	1.600	47.2	4.000	73.5	8.000	103.0
0.400	49.0	1.800	50.0	4.500	77.8	8.500	106.1
0.500	49.8	2.000	52.6	5.000	81.9	9.000	109.1
0.600	49.9	2.200	55.0	5.500	85.8	9.500	112.0
0.800	48.9	2.400	57.4	6.000	89.5		
1.000	47.1	2.600	59.7	6.500	93.1		

Non Return Valve Manhole: S6-5, DS/PN: 6.005, Volume (m³): 10.9

Hydro-Brake Optimum® Manhole: S1-10, DS/PN: 1.010, Volume (m³): 9.8

Unit Reference	MD-SHE-0110-7100-2000-7100
Design Head (m)	2.000
Design Flow (l/s)	7.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	110
Invert Level (m)	26.207
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	7.1
Flush-Flo™	0.479	6.4
Kick-Flo®	0.979	5.1
Mean Flow over Head Range	-	5.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	0.300	6.1	0.500	6.4	0.800	6.0
0.200	5.6	0.400	6.3	0.600	6.3	1.000	5.1

Hydro-Brake Optimum® Manhole: S1-10, DS/PN: 1.010, Volume (m³): 9.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	5.6	2.400	7.7	5.000	10.9	8.000	13.7
1.400	6.0	2.600	8.0	5.500	11.4	8.500	14.1
1.600	6.4	3.000	8.6	6.000	11.9	9.000	14.5
1.800	6.8	3.500	9.2	6.500	12.4	9.500	14.9
2.000	7.1	4.000	9.8	7.000	12.8		
2.200	7.4	4.500	10.4	7.500	13.3		

Storage Structures for Storm Phase 1+2

Tank or Pond Manhole: S1-7, DS/PN: 1.007

Invert Level (m) 27.982

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	320.0	2.000	320.0	2.001	0.0

Tank or Pond Manhole: S1-9, DS/PN: 1.009

Invert Level (m) 27.642

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	2.300	250.0	2.301	0.0

Tank or Pond Manhole: S8-5, DS/PN: 8.005

Invert Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	230.0	1.700	230.0	1.701	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.300
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	100
Climate Change (%)	10

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+10%	100/15 Summer				
1.001	15 Winter	100	+10%	100/15 Summer				
2.000	15 Winter	100	+10%	100/15 Summer				
1.002	15 Winter	100	+10%	100/15 Summer				
1.003	1440 Winter	100	+10%	100/15 Summer				
3.000	15 Winter	100	+10%	100/15 Summer				
3.001	15 Winter	100	+10%	100/15 Summer				
3.002	15 Winter	100	+10%	100/15 Summer				
1.004	1440 Winter	100	+10%	100/15 Summer				
1.005	1440 Winter	100	+10%	100/15 Summer				
1.006	1440 Winter	100	+10%	100/15 Summer				
1.007	1440 Winter	100	+10%					
4.000	15 Winter	100	+10%	100/15 Summer				
5.000	15 Winter	100	+10%	100/15 Summer				
4.001	15 Winter	100	+10%	100/15 Summer				
4.002	15 Winter	100	+10%	100/15 Summer				
4.003	15 Summer	100	+10%					
1.008	1440 Winter	100	+10%					
1.009	1440 Winter	100	+10%	100/15 Summer				
6.000	15 Winter	100	+10%					

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
7.000	15 Winter	100	+10%					
6.001	15 Winter	100	+10%	100/15 Winter				
6.002	15 Summer	100	+10%	100/15 Summer				
8.000	15 Winter	100	+10%					
8.001	15 Winter	100	+10%					
8.002	15 Winter	100	+10%	100/15 Summer				
8.003	15 Winter	100	+10%	100/15 Summer				
8.004	15 Winter	100	+10%	100/15 Summer				
9.000	8640 Winter	100	+10%					
8.005	8640 Winter	100	+10%	100/30 Winter				
6.003	8640 Winter	100	+10%	100/15 Summer				
6.004	8640 Winter	100	+10%	100/60 Summer				
6.005	8640 Winter	100	+10%	100/15 Winter				
1.010	1440 Winter	100	+10%	100/15 Summer				
1.011	1440 Winter	100	+10%					
1.012	1440 Winter	100	+10%					
1.013	1440 Winter	100	+10%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	S1-0	30.787	0.562	0.000	1.16	0.0	79.8	FLOOD RISK
1.001	S1-1	30.644	0.526	0.000	1.49	0.0	106.6	SURCHARGED
2.000	S2-0	30.356	0.206	0.000	0.99	0.0	32.2	SURCHARGED
1.002	S1-2	30.272	0.315	0.000	2.13	0.0	143.6	SURCHARGED
1.003	S1-3	29.720	0.370	0.000	0.08	0.0	16.0	SURCHARGED
3.000	S3-0	30.582	0.357	0.000	0.51	0.0	34.8	SURCHARGED
3.001	S3-1	30.493	0.373	0.000	0.98	0.0	67.8	SURCHARGED
3.002	S3-2	30.385	0.377	0.000	1.86	0.0	132.5	SURCHARGED
1.004	S1-4	29.718	0.513	0.000	0.09	0.0	25.6	SURCHARGED
1.005	S1-5	29.717	0.704	0.000	0.09	0.0	25.5	SURCHARGED
1.006	TANK1	29.716	0.866	0.000	0.09	0.0	29.6	SURCHARGED
1.007	S1-7	29.714	-0.268	0.000	0.00	0.0	10.3	OK
4.000	S4-0	30.846	0.621	0.000	0.89	0.0	66.4	FLOOD RISK
5.000	S5-0	30.847	0.622	0.000	0.94	0.0	69.4	FLOOD RISK
4.001	S4-1	30.641	0.700	0.000	2.89	0.0	158.7	SURCHARGED
4.002	S4-2	30.221	0.012	0.000	1.11	0.0	260.3	SURCHARGED
4.003	S4-3	30.182	0.000	0.000	1.13	0.0	247.2	OK
1.008	TANK2	29.613	-0.529	0.000	0.00	0.0	29.5	OK
1.009	S1-9	29.612	1.670	0.000	0.18	0.0	12.8	SURCHARGED
6.000	S6-0	30.031	-0.119	0.000	0.44	0.0	15.2	OK
7.000	S7-0	30.023	-0.127	0.000	0.38	0.0	13.3	OK
6.001	S6-1	29.938	0.002	0.000	1.05	0.0	34.4	SURCHARGED
6.002	S6-2	28.135	0.050	0.000	1.35	0.0	42.2	SURCHARGED
8.000	S8-0	30.073	-0.152	0.000	0.22	0.0	7.6	OK
8.001	S8-1	29.920	-0.117	0.000	0.46	0.0	15.5	OK
8.002	S8-2	28.732	0.507	0.000	0.83	0.0	25.6	SURCHARGED
8.003	S8-3	28.667	0.497	0.000	1.59	0.0	55.0	SURCHARGED
8.004	S8-4	28.160	0.182	0.000	2.31	0.0	65.5	SURCHARGED
9.000	TANK3	28.116	-0.084	0.000	0.00	0.0	0.3	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
8.005	S8-5	28.116	1.241	0.000	0.07	0.0	8.7	SURCHARGED
6.003	S6-3	28.121	1.415	0.000	0.08	0.0	8.3	FLOOD RISK
6.004	S6-4	28.121	1.230	0.000	0.02	0.0	7.1	FLOOD RISK
6.005	S6-5	28.119	1.303	0.000	0.05	0.0	11.2	SURCHARGED
1.010	S1-10	29.655	3.223	0.000	0.39	0.0	9.0	SURCHARGED
1.011	PI	26.258	-0.156	0.000	0.20	0.0	9.0	OK
1.012	S1-12	26.182	-0.132	0.000	0.36	0.0	9.0	OK
1.013	S1-13	26.124	-0.152	0.000	0.23	0.0	9.0	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm Phase 1+2

Pipe Sizes Standard Manhole Sizes Standard

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.500	Minimum Backdrop Height (m)	0.000
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm Phase 1+2

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.587	4-8	2.049	8-12	0.245

Total Area Contributing (ha) = 2.881

Total Pipe Volume (m³) = 413.862

Network Design Table for Storm Phase 1+2

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	21.407	0.107	200.0	0.241	5.00	0.0	0.600	o	300	
1.001	32.110	0.161	200.0	0.095	0.00	0.0	0.600	o	300	
2.000	16.500	0.083	200.0	0.095	5.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.32	29.925	0.241	0.0	0.0	0.0	1.11	78.3	32.6
1.001	50.00	5.80	29.818	0.336	0.0	0.0	0.0	1.11	78.3	45.5
2.000	50.00	5.30	29.925	0.095	0.0	0.0	0.0	0.92	36.6	12.9

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.002	18.366	0.092	200.0	0.020	0.00	0.0	0.600	o	300	
1.003	43.895	0.219	200.0	0.244	0.00	0.0	0.600	o	450	
3.000	20.860	0.104	200.0	0.098	5.00	0.0	0.600	o	300	
3.001	22.473	0.112	200.0	0.098	0.00	0.0	0.600	o	300	
3.002	30.792	0.154	200.0	0.187	0.00	0.0	0.600	o	300	
1.004	38.676	0.193	200.4	0.034	0.00	0.0	0.600	o	525	
1.005	32.619	0.163	200.1	0.000	0.00	0.0	0.600	o	525	
1.006	68.566	0.343	199.9	0.185	0.00	0.0	0.600	o	525	
1.007	27.883	0.139	200.6	0.136	0.00	0.0	0.600	o	2000	
4.000	56.923	0.285	200.0	0.210	5.00	0.0	0.600	o	300	
5.000	55.052	0.275	200.2	0.233	5.00	0.0	0.600	o	300	
4.001	6.196	0.031	199.9	0.100	0.00	0.0	0.600	o	300	
4.002	8.212	0.027	300.0	0.295	0.00	0.0	0.600	o	600	
4.003	4.463	0.015	300.0	0.000	0.00	0.0	0.600	o	600	
1.008	38.789	0.200	193.9	0.118	0.00	0.0	0.600	o	2300	
1.009	40.482	0.202	200.4	0.046	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.002	50.00	6.08	29.657	0.451	0.0	0.0	0.0	1.11	78.3	61.1
1.003	50.00	6.59	28.900	0.695	0.0	0.0	0.0	1.43	228.1	94.1
3.000	50.00	5.31	29.925	0.098	0.0	0.0	0.0	1.11	78.3	13.3
3.001	50.00	5.65	29.821	0.196	0.0	0.0	0.0	1.11	78.3	26.5
3.002	50.00	6.11	29.708	0.383	0.0	0.0	0.0	1.11	78.3	51.9
1.004	50.00	7.00	28.681	1.112	0.0	0.0	0.0	1.58	341.7	150.6
1.005	50.00	7.34	28.488	1.112	0.0	0.0	0.0	1.58	342.0	150.6
1.006	50.00	8.07	28.325	1.297	0.0	0.0	0.0	1.58	342.2	175.6
1.007	50.00	5.13	27.982	0.000	40.0	0.0	0.0	3.61	11327.4	40.0
4.000	50.00	5.86	29.925	0.210	0.0	0.0	0.0	1.11	78.3	28.4
5.000	50.00	5.83	29.925	0.233	0.0	0.0	0.0	1.11	78.3	31.6
4.001	50.00	5.95	29.640	0.543	0.0	0.0	0.0	1.11	78.4	73.5
4.002	50.00	6.05	29.609	0.838	0.0	0.0	0.0	1.40	396.0	113.5
4.003	50.00	6.10	29.582	0.838	0.0	0.0	0.0	1.40	396.0	113.5
1.008	50.00	6.26	27.843	0.956	40.0	0.0	0.0	3.99	16586.2	169.5
1.009	50.00	6.87	27.642	1.002	40.0	0.0	0.0	1.11	78.2«	175.7

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
6.000	42.734	0.214	199.7	0.040	5.00	0.0	0.600	o	225	
7.000	42.486	0.212	200.4	0.035	5.00	0.0	0.600	o	225	
6.001	17.068	0.085	200.8	0.027	0.00	0.0	0.600	o	225	
6.002	11.971	0.060	199.5	0.026	0.00	0.0	0.600	o	225	
8.000	37.699	0.188	200.5	0.020	5.00	0.0	0.600	o	225	
8.001	26.414	0.132	200.1	0.020	0.00	0.0	0.600	o	225	
8.002	10.975	0.055	199.5	0.030	0.00	0.0	0.600	o	225	
8.003	38.380	0.192	199.9	0.089	0.00	0.0	0.600	o	225	
8.004	6.550	0.033	198.5	0.034	0.00	0.0	0.600	o	225	
9.000	44.150	0.200	220.8	0.050	5.00	0.0	0.600	o	1500	
8.005	33.826	0.169	200.2	0.075	0.00	0.0	0.600	o	375	
6.003	8.078	0.040	202.0	0.000	0.00	0.0	0.600	o	375	
6.004	22.501	0.075	300.0	0.000	0.00	0.0	0.600	o	600	
6.005	2.811	0.009	312.3	0.000	0.00	0.0	0.600	o	600	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.000	50.00	5.77	29.925	0.040	0.0	0.0	0.0	0.92	36.6	5.4
7.000	50.00	5.77	29.925	0.035	0.0	0.0	0.0	0.92	36.6	4.7
6.001	50.00	6.08	29.711	0.102	0.0	0.0	0.0	0.92	36.5	13.8
6.002	50.00	6.30	27.860	0.128	0.0	0.0	0.0	0.92	36.7	17.3
8.000	50.00	5.68	30.000	0.020	0.0	0.0	0.0	0.92	36.6	2.7
8.001	50.00	6.16	29.812	0.040	0.0	0.0	0.0	0.92	36.6	5.4
8.002	50.00	6.36	28.000	0.070	0.0	0.0	0.0	0.92	36.7	9.5
8.003	50.00	7.05	27.945	0.159	0.0	0.0	0.0	0.92	36.6	21.5
8.004	50.00	7.17	27.753	0.193	0.0	0.0	0.0	0.92	36.8	26.1
9.000	50.00	5.26	26.700	0.050	0.0	0.0	0.0	2.88	5094.9	6.8
8.005	50.00	7.61	26.500	0.318	0.0	0.0	0.0	1.28	141.0	43.1
6.003	50.00	7.72	26.331	0.446	0.0	0.0	0.0	1.27	140.4	60.4
6.004	50.00	5.27	26.291	0.000	50.0	0.0	0.0	1.40	396.0	50.0
6.005	50.00	5.30	26.216	0.000	50.0	0.0	0.0	1.37	388.1	50.0

Network Design Table for Storm Phase 1+2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.010	5.489	0.018	304.9	0.000	0.00	0.0	0.600	o	225	
1.011	4.584	0.100	45.8	0.000	0.00	0.0	0.600	o	225	
1.012	11.556	0.039	300.0	0.000	0.00	0.0	0.600	o	225	
1.013	52.654	0.320	164.5	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.010	50.00	5.12	26.207	0.000	7.1	0.0	0.0	0.74	29.6	7.1
1.011	50.00	5.16	26.189	0.000	7.1	0.0	0.0	1.94	77.0	7.1
1.012	50.00	5.42	26.089	0.000	7.1	0.0	0.0	0.75	29.8	7.1
1.013	50.00	6.28	26.050	0.000	7.1	0.0	0.0	1.02	40.4	7.1

Free Flowing Outfall Details for Storm Phase 1+2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.013	EX-S1	26.790	25.730	0.000	0	0

Simulation Criteria for Storm Phase 1+2

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Storm Phase 1+2

Hydro-Brake Optimum® Manhole: S1-7, DS/PN: 1.007, Volume (m³): 21.8

Unit Reference	MD-SHE-0254-4000-2000-4000
Design Head (m)	2.000
Design Flow (l/s)	40.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	254
Invert Level (m)	27.982
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	40.0
Flush-Flo™	0.599	39.8
Kick-Flo®	1.297	32.5
Mean Flow over Head Range	-	34.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.2	1.200	35.2	3.000	48.6	7.000	73.3
0.200	26.1	1.400	33.7	3.500	52.4	7.500	75.8
0.300	36.8	1.600	35.9	4.000	55.8	8.000	78.2
0.400	38.7	1.800	38.0	4.500	59.1	8.500	80.5
0.500	39.6	2.000	40.0	5.000	62.2	9.000	82.8
0.600	39.8	2.200	41.8	5.500	65.2	9.500	85.0
0.800	39.3	2.400	43.6	6.000	68.0		
1.000	38.0	2.600	45.4	6.500	70.7		

Hydro-Brake Optimum® Manhole: S6-4, DS/PN: 6.004, Volume (m³): 4.0

Unit Reference	MD-SHE-0284-5000-1800-5000
Design Head (m)	1.800
Design Flow (l/s)	50.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	284
Invert Level (m)	26.291
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	50.0
Flush-Flo™	0.559	49.9

Hydro-Brake Optimum® Manhole: S6-4, DS/PN: 6.004, Volume (m³): 4.0

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	1.224	41.5
Mean Flow over Head Range	-	42.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.9	1.200	42.5	3.000	63.9	7.000	96.5
0.200	29.3	1.400	44.3	3.500	68.9	7.500	99.8
0.300	46.8	1.600	47.2	4.000	73.5	8.000	103.0
0.400	49.0	1.800	50.0	4.500	77.8	8.500	106.1
0.500	49.8	2.000	52.6	5.000	81.9	9.000	109.1
0.600	49.9	2.200	55.0	5.500	85.8	9.500	112.0
0.800	48.9	2.400	57.4	6.000	89.5		
1.000	47.1	2.600	59.7	6.500	93.1		

Non Return Valve Manhole: S6-5, DS/PN: 6.005, Volume (m³): 10.9

Hydro-Brake Optimum® Manhole: S1-10, DS/PN: 1.010, Volume (m³): 9.8

Unit Reference	MD-SHE-0110-7100-2000-7100
Design Head (m)	2.000
Design Flow (l/s)	7.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	110
Invert Level (m)	26.207
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	7.1
Flush-Flo™	0.479	6.4
Kick-Flo®	0.979	5.1
Mean Flow over Head Range	-	5.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	0.300	6.1	0.500	6.4	0.800	6.0
0.200	5.6	0.400	6.3	0.600	6.3	1.000	5.1

Hydro-Brake Optimum® Manhole: S1-10, DS/PN: 1.010, Volume (m³): 9.8

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	5.6	2.400	7.7	5.000	10.9	8.000	13.7
1.400	6.0	2.600	8.0	5.500	11.4	8.500	14.1
1.600	6.4	3.000	8.6	6.000	11.9	9.000	14.5
1.800	6.8	3.500	9.2	6.500	12.4	9.500	14.9
2.000	7.1	4.000	9.8	7.000	12.8		
2.200	7.4	4.500	10.4	7.500	13.3		

Storage Structures for Storm Phase 1+2

Tank or Pond Manhole: S1-7, DS/PN: 1.007

Invert Level (m) 27.982

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	320.0	2.000	320.0	2.001	0.0

Tank or Pond Manhole: S1-9, DS/PN: 1.009

Invert Level (m) 27.642

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	2.300	250.0	2.301	0.0

Tank or Pond Manhole: S8-5, DS/PN: 8.005

Invert Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	230.0	1.700	230.0	1.701	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.300
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	30
Climate Change (%)	0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	30/15 Summer				
1.001	15 Winter	30	0%	30/15 Summer				
2.000	15 Winter	30	0%					
1.002	15 Winter	30	0%	30/15 Summer				
1.003	15 Winter	30	0%					
3.000	15 Winter	30	0%	30/15 Summer				
3.001	15 Winter	30	0%	30/15 Summer				
3.002	15 Winter	30	0%	30/15 Summer				
1.004	960 Winter	30	0%					
1.005	960 Winter	30	0%	30/240 Winter				
1.006	960 Winter	30	0%	30/180 Winter				
1.007	960 Winter	30	0%					
4.000	15 Winter	30	0%	30/15 Summer				
5.000	15 Winter	30	0%	30/15 Summer				
4.001	15 Winter	30	0%	30/15 Summer				
4.002	15 Winter	30	0%					
4.003	15 Winter	30	0%					
1.008	960 Winter	30	0%					
1.009	960 Winter	30	0%	30/15 Summer				
6.000	15 Winter	30	0%					

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
7.000	15 Winter	30	0%					
6.001	15 Winter	30	0%					
6.002	15 Winter	30	0%					
8.000	15 Winter	30	0%					
8.001	15 Winter	30	0%					
8.002	15 Winter	30	0%	30/15 Summer				
8.003	15 Winter	30	0%	30/15 Summer				
8.004	15 Winter	30	0%	30/15 Summer				
9.000	7200 Winter	30	0%					
8.005	7200 Winter	30	0%	30/120 Summer				
6.003	7200 Winter	30	0%	30/15 Winter				
6.004	7200 Winter	30	0%	30/120 Winter				
6.005	7200 Winter	30	0%	30/60 Winter				
1.010	960 Winter	30	0%	30/15 Summer				
1.011	960 Winter	30	0%					
1.012	960 Winter	30	0%					
1.013	960 Winter	30	0%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	S1-0	30.355	0.130	0.000	0.82	0.0	56.5	SURCHARGED
1.001	S1-1	30.273	0.155	0.000	1.08	0.0	77.1	SURCHARGED
2.000	S2-0	30.119	-0.031	0.000	0.77	0.0	24.9	OK
1.002	S1-2	30.074	0.117	0.000	1.55	0.0	104.4	SURCHARGED
1.003	S1-3	29.208	-0.142	0.000	0.78	0.0	159.1	OK
3.000	S3-0	30.274	0.049	0.000	0.35	0.0	24.1	SURCHARGED
3.001	S3-1	30.191	0.070	0.000	0.67	0.0	46.1	SURCHARGED
3.002	S3-2	30.098	0.090	0.000	1.27	0.0	90.6	SURCHARGED
1.004	S1-4	29.123	-0.082	0.000	0.09	0.0	25.3	OK
1.005	S1-5	29.121	0.108	0.000	0.09	0.0	24.8	SURCHARGED
1.006	TANK1	29.120	0.270	0.000	0.09	0.0	27.7	SURCHARGED
1.007	S1-7	29.118	-0.864	0.000	0.00	0.0	12.3	OK
4.000	S4-0	30.405	0.180	0.000	0.65	0.0	48.0	SURCHARGED
5.000	S5-0	30.428	0.203	0.000	0.72	0.0	53.2	SURCHARGED
4.001	S4-1	30.278	0.338	0.000	2.20	0.0	120.8	SURCHARGED
4.002	S4-2	30.040	-0.170	0.000	0.80	0.0	187.6	OK
4.003	S4-3	30.015	-0.167	0.000	0.85	0.0	186.0	OK
1.008	TANK2	29.021	-1.121	0.000	0.00	0.0	28.1	OK
1.009	S1-9	29.021	1.079	0.000	0.17	0.0	12.1	SURCHARGED
6.000	S6-0	30.012	-0.138	0.000	0.30	0.0	10.6	OK
7.000	S7-0	30.005	-0.145	0.000	0.27	0.0	9.3	OK
6.001	S6-1	29.865	-0.071	0.000	0.80	0.0	26.0	OK
6.002	S6-2	28.085	0.000	0.000	1.00	0.0	31.4	OK
8.000	S8-0	30.060	-0.165	0.000	0.15	0.0	5.3	OK
8.001	S8-1	29.900	-0.137	0.000	0.32	0.0	10.9	OK
8.002	S8-2	28.347	0.122	0.000	0.59	0.0	18.1	SURCHARGED
8.003	S8-3	28.310	0.140	0.000	1.13	0.0	39.2	SURCHARGED
8.004	S8-4	28.050	0.072	0.000	1.66	0.0	47.2	SURCHARGED
9.000	TANK3	27.659	-0.541	0.000	0.00	0.0	0.3	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm Phase 1+2

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
8.005	S8-5	27.659	0.784	0.000	0.07	0.0	8.6	SURCHARGED
6.003	S6-3	27.693	0.987	0.000	0.08	0.0	8.2	SURCHARGED
6.004	S6-4	27.694	0.803	0.000	0.03	0.0	7.9	SURCHARGED
6.005	S6-5	27.662	0.846	0.000	0.04	0.0	9.3	SURCHARGED
1.010	S1-10	29.066	2.634	0.000	0.35	0.0	8.2	SURCHARGED
1.011	PI	26.254	-0.160	0.000	0.18	0.0	8.2	OK
1.012	S1-12	26.177	-0.137	0.000	0.32	0.0	8.2	OK
1.013	S1-13	26.120	-0.155	0.000	0.21	0.0	8.2	OK

Appendix G - Correspondence with Galway City Council

Memorandum

Project Title	Crown Square Development	**From**	Fergal Timlin
Project No	183106	**To**	Frank Clancy, John Sheehan
Subject	Surface Water Sewers Strategy High Level Overview	**Cc**	Joe McGuire
Date	11am 30th July 2018		

Notes:

Meeting Location: Galway City Council Headquarters, Forster Street, Galway City

Meeting Attendees: Frank Clancy (FC) (Senior Executive Engineer) GCC, John Sheehan (JS) (Executive Technician) GCC, Fergal Timlin (FT) PUNCH, Emma Tarpey (ET) PUNCH

Meeting Agenda: Surface Water Sewers Strategy High Level Overview

1) Following introductions with JS & FC, during which they welcomed the development, FT began the meeting by providing an overview of the previous drainage construction drawings and identifying the locations of the 3 previously proposed attenuation tanks.
2) JS had a copy of the original planning drawings and noted that the locations of the attenuation tanks had changed from that submitted with the original planning application (061102-004PL2 attached). However JS acknowledged that the attenuation tank locations as shown on the drainage construction drawing (mpp-sw-00-03-003 C2) may have been agreed between PUNCH and GCC post planning.
3) The previous drainage construction drawing notes that surface water discharge from the site is 30l/s (which equates to 6l/s/ha)
    a) FC and JS noted that surface water discharge from the site of 30l/s (which equates to 6l/s/ha) appears not to be in compliance with Galway City Council general requirements and the Greater Dublin Strategic Drainage Strategy (GDSDS)
    b) JS noted that the 450mm surface water pipe (that the previously proposed development outfalls to) downsizes to a 375mm pipe downstream of the site on the Monivea Road. JS has concerns that the existing surface water sewers may not have capacity to accept 30l/s. A figure closer to 2l/s/ha was noted by JS.
    c) JS/FC noted that they will undertake a capacity assessment of the existing surface water network
    d) FT noted that prior to the development of the Crown site, there was no form of surface water control on site and peak flows from the site were estimated at 170 l/s. FT also noted that surface water currently being pumped from the site is likely to be greater than 30l/s. JS agreed that the flow from the site was currently greater than 2l/s/ha but this is a temporary arrangement.
    e) JS/FC noted that for GCC to consider a surface water discharge greater than 2l/s/ha, justification for same would be required and that a number of Suds measures will be required to be utilised on the site (green roofs, rainwater harvesting etc.). JS/FC noted that proposed surface water discharge rate and SuDS proposals require to be agreed with GCC
4) JS noted that there is an existing 600mm surface water pipe located to the north of the site. JS noted that GCC have a preference for discharging the outflow from the site to this sewer

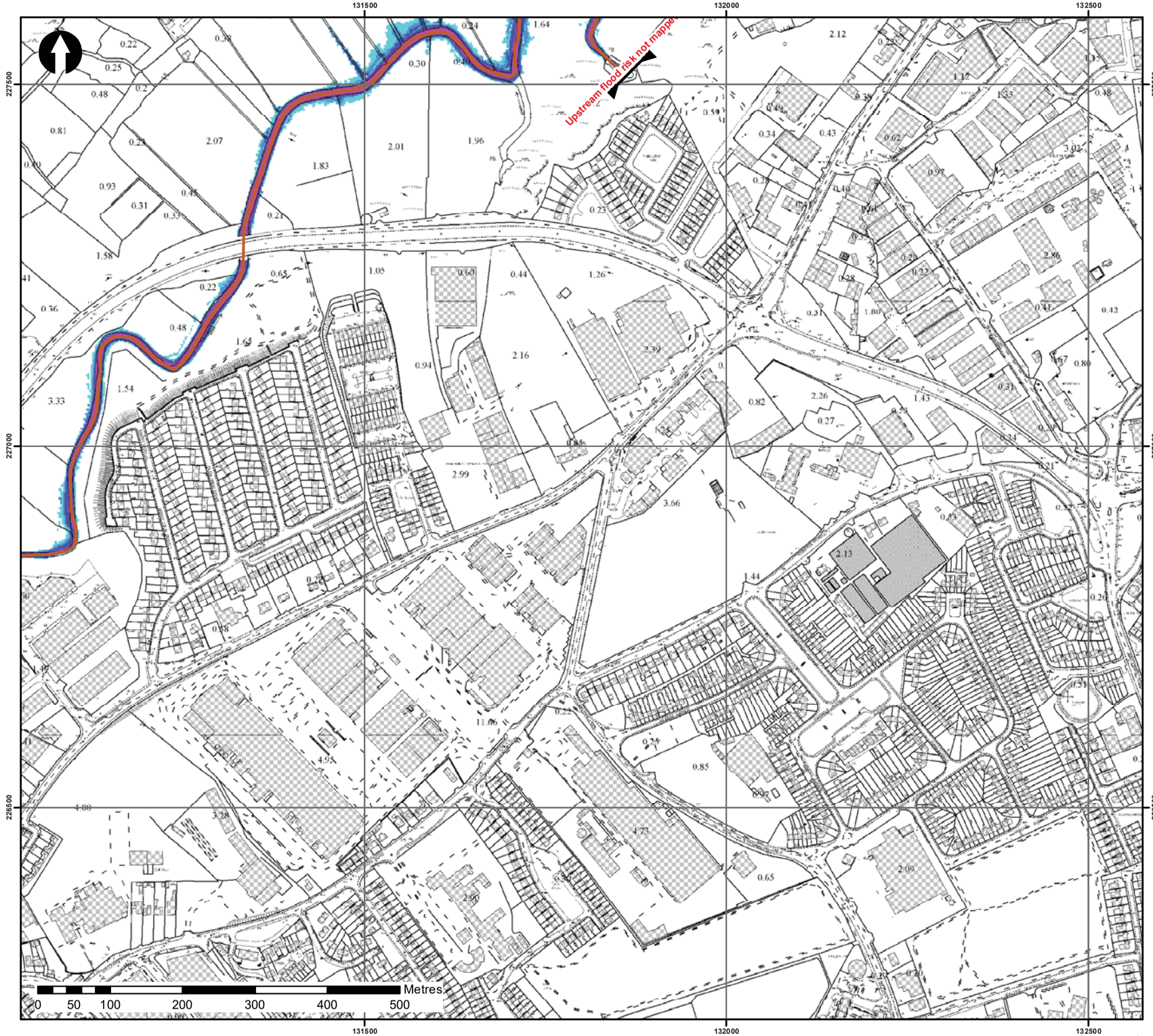
a) FT noted that attenuation tank 2 was already constructed and that it was proposed to maintain the tank as constructed, with an outflow to the 450mm surface water pipe on the Monivea Road.
b) FC/JS noted that the surface water outfall from the site may be split between the existing 450mm and 600mm surface water pipes

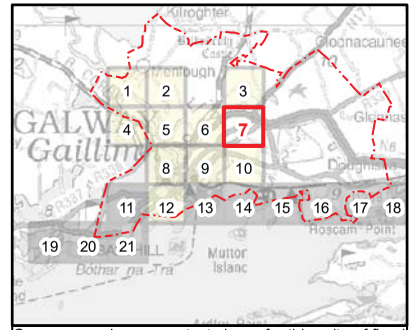
5) FT noted the route of the proposed surface water outfall is subject to location of existing services etc. A GPR survey is due to commence shortly to confirm location of services.
6) FC/JS noted that they are happy to liaise with the design team as the overall design is developed

Signed: _____ Date: 2nd August 2018

Fergal D. Timlin

Appendix H – CFRAM Mapping





Grey squares have no extent shown for this suite of flood maps so no maps have been produced.

AFA Boundary

Modelled River Centreline

10% AEP

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

IMPORTANT USER NOTE:
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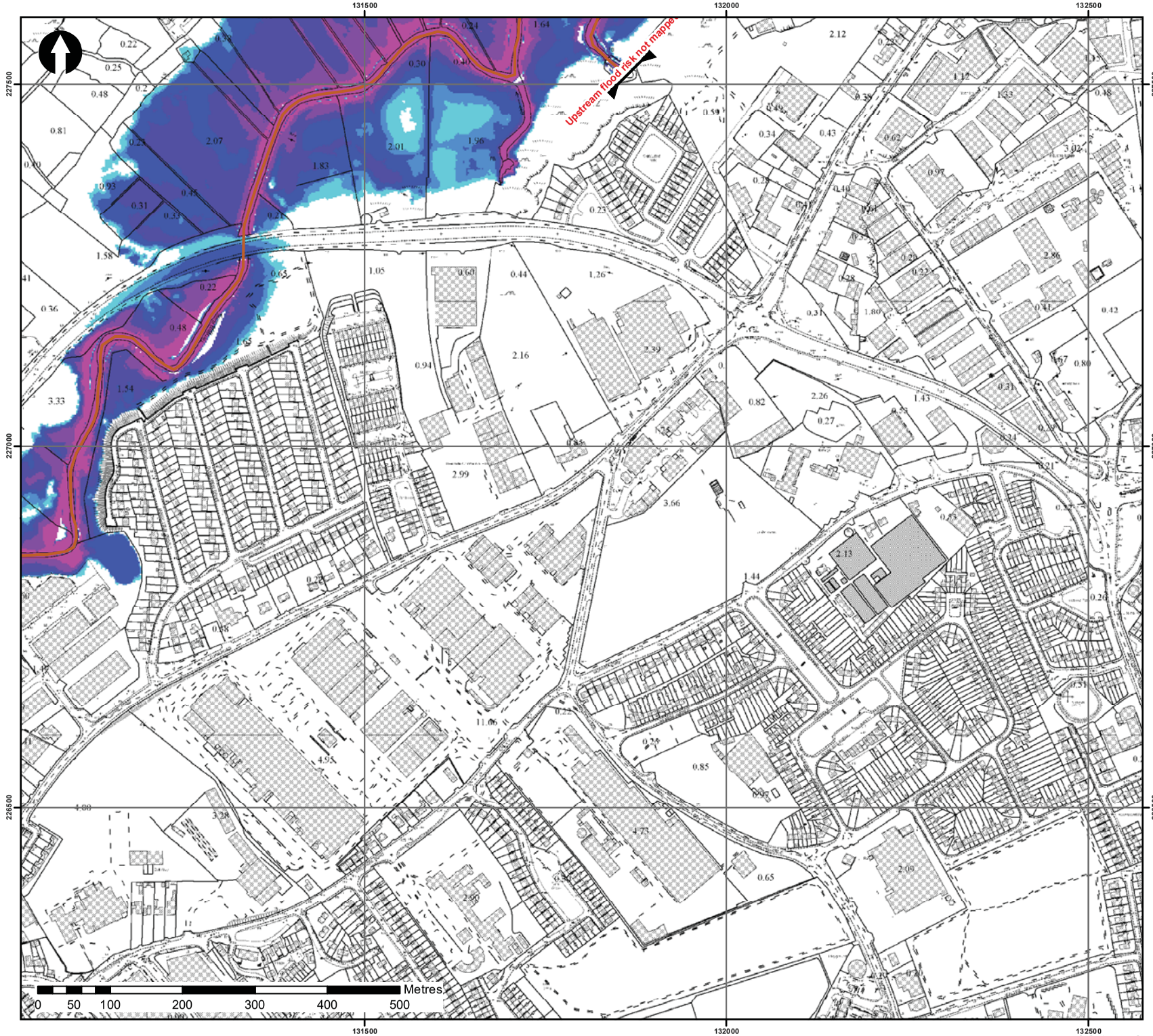
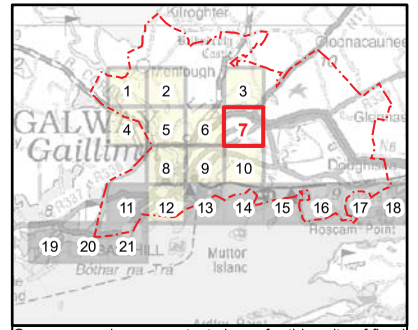
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City Flood Depth (10% AEP)			Final
Map Type: Flood Depth (10% AEP)			
Map Area: HPW		Source: Fluvial	Scenario: Current
Drawn by: KF	Date: May 2017	Scale: 1:5,000	
Checked by: TS	Date: May 2017		
Approved by: JC	Date: May 2017		Original @ A3
Map No: W30GLW_DPFCD100_F1		**Sheet:** 7 of 21	





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AFA Boundary

Modelled River Centreline

0.1% AEP

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

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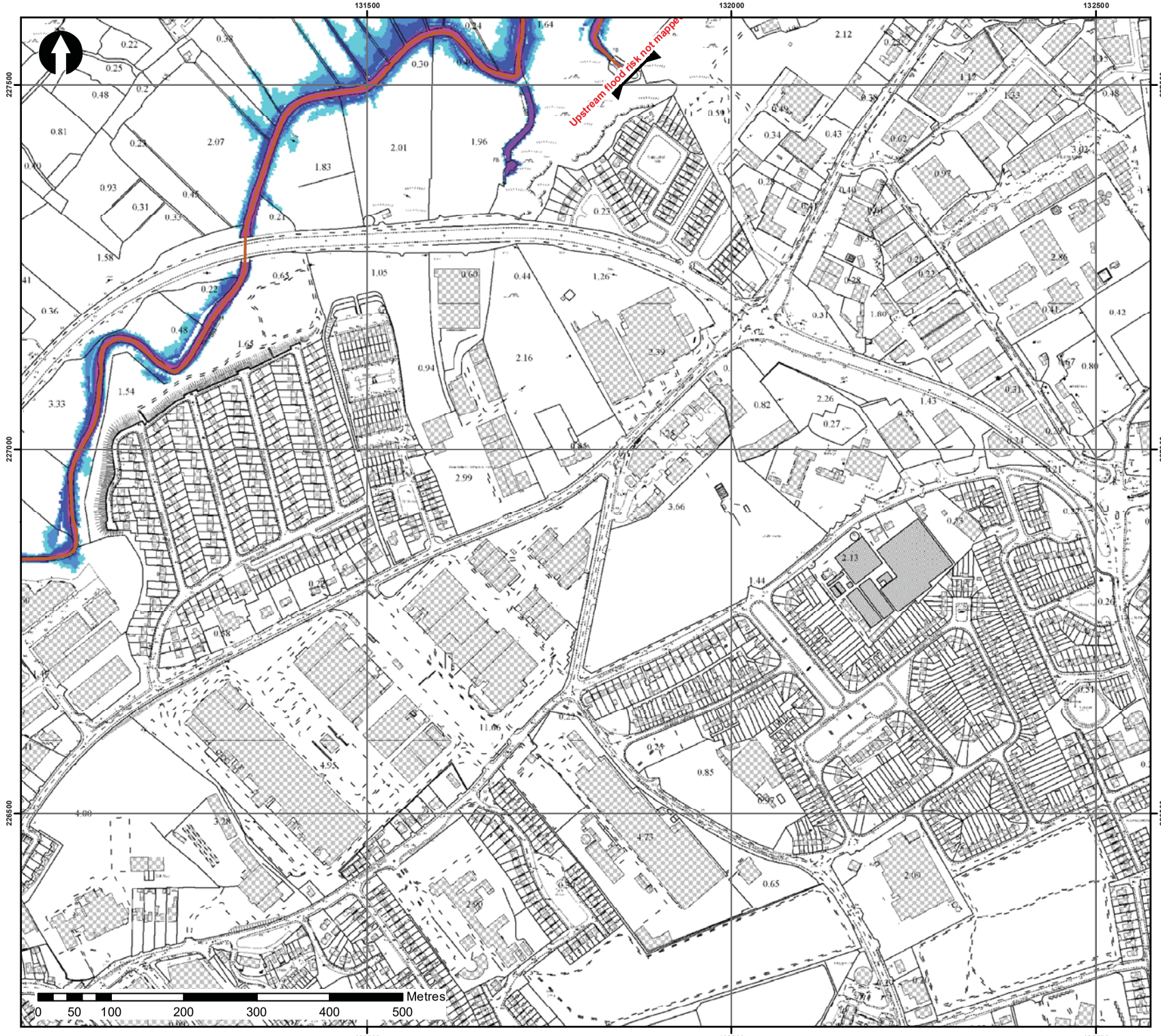
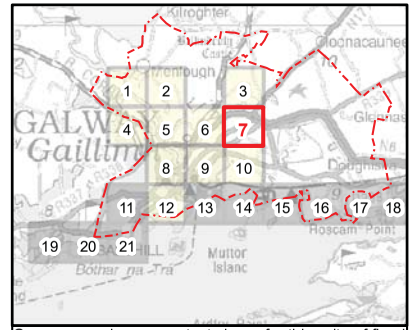
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City Flood Depth (0.1% AEP)			Final
Map Type: Flood Depth (0.1% AEP)			
Map Area: HPW		Source: Fluvial	Scenario: Current
Drawn by: KF	Date: May 2017	Scale: 1:5,000	
Checked by: TS	Date: May 2017		
Approved by: JC	Date: May 2017		Original @ A3
Map No: W30GLW_DPFCD001_F1		**Sheet:** 7 of 21	





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AFA Boundary

Modelled River Centreline

1% AEP

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- > 2.0

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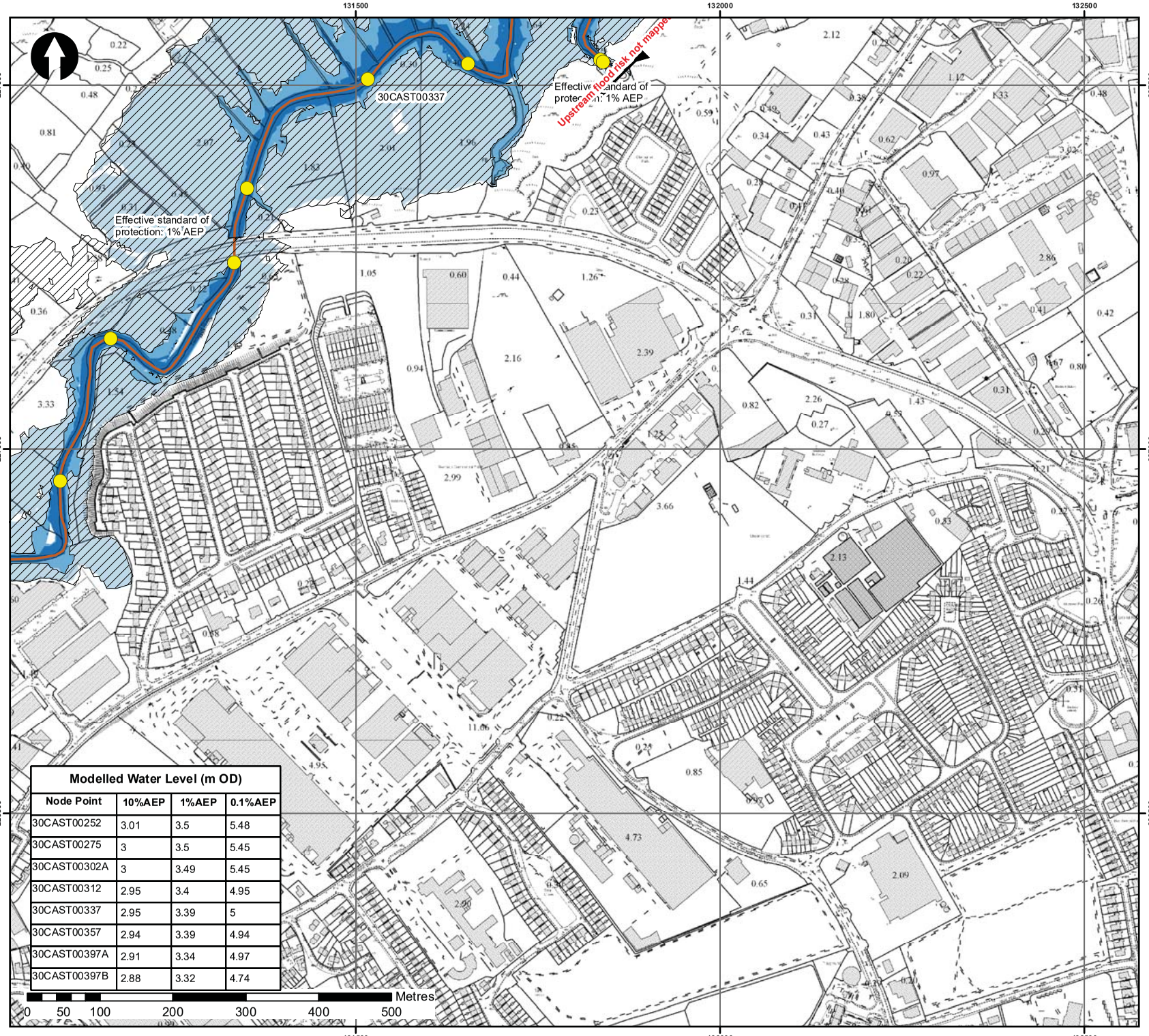
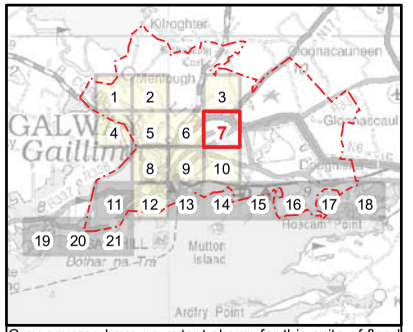
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City Flood Depth (1% AEP)			Final
Map Type: Flood Depth (1% AEP)			
Map Area: HPW		Source: Fluvial	Scenario: Current
Drawn by: KF	Date: May 2017	Scale: 1:5,000	
Checked by: TS	Date: May 2017		
Approved by: JC	Date: May 2017		Original @ A3
Map No: W30GLW_DPFCD010_F1		**Sheet:** 7 of 21	



Modelled Water Level (m OD)			
Node Point	10%AEP	1%AEP	0.1%AEP
30CAST00252	3.01	3.5	5.48
30CAST00275	3	3.5	5.45
30CAST00302A	3	3.49	5.45
30CAST00312	2.95	3.4	4.95
30CAST00337	2.95	3.39	5
30CAST00357	2.94	3.39	4.94
30CAST00397A	2.91	3.34	4.97
30CAST00397B	2.88	3.32	4.74



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AFA Boundary

Defended Area

Model Nodes

Modelled River Centreline

10% AEP Fluvial Extent

1% AEP Fluvial Extent

0.1% AEP Fluvial Extent

IMPORTANT USER NOTE:
THE FLOWS PRESENTED IN THIS MAP ARE RELEVANT TO THE LOCATION SHOWN ONLY. THEY SHOULD NOT BE USED WITHOUT FIRST REFERRING TO THE HYDRAULIC MODELLING REPORT TO UNDERSTAND THE CONTEXT OF THE HYDROLOGY AT THE SITE.

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CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City Flood Extent			Final
Map Type: Flood Extent			
Map Area: HPW		Source: Fluvial	Scenario: Current
Drawn by: KF	Date: Dec 2017	Scale: 1:5,000	
Checked by: TS	Date: Dec 2017		
Approved by: JC	Date: Dec 2017		Original @ A3
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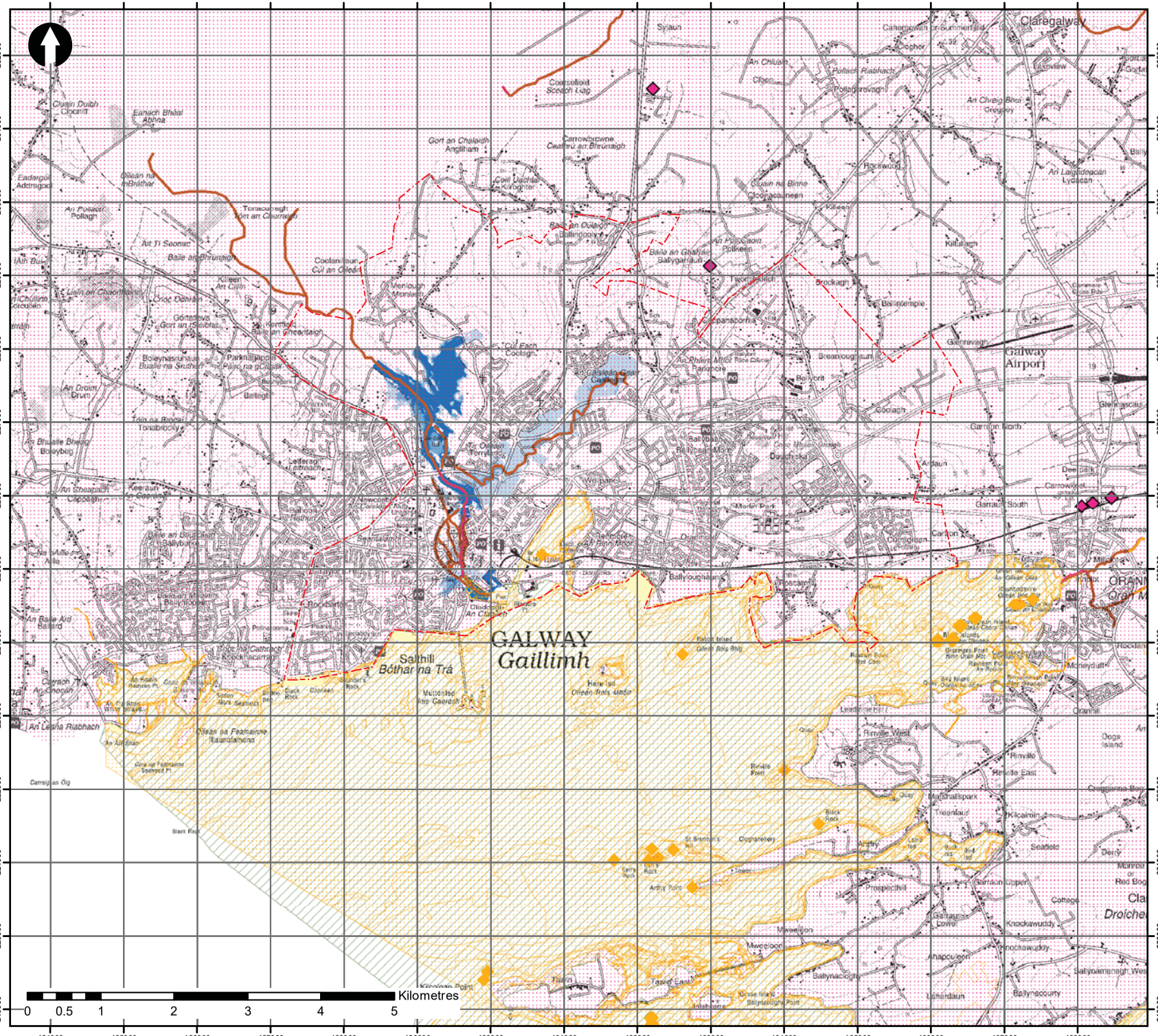

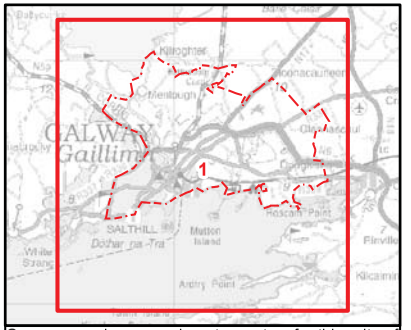

Grey squares have no relevent receptors for this suite of risk maps so no maps have been produced.

AFA Boundary

Modelled River Centreline

10% AEP Fluvial Extent

1% AEP Fluvial Extent

0.1% AEP Fluvial Extent

General Risk – Environment

- IED Sites
- Designated for Drinking Water Abstraction
- Designated for Drinking Water Abstraction
- Recreational Waters
- SAC Water Dependent
- SAC Water Dependent
- SAC Water Dependent
- SPA Water Dependent

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WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City Fluvial General Risk - Environment			
Map Type: General Risk - Environment			Final
Map Area: HPW		Source: Fluvial	Scenario: Current
Drawn by: KF	Date: May 2017	Scale:	1:50,000
Checked by: TS	Date: May 2017		Original @ A3
Approved by: JC	Date: May 2017		
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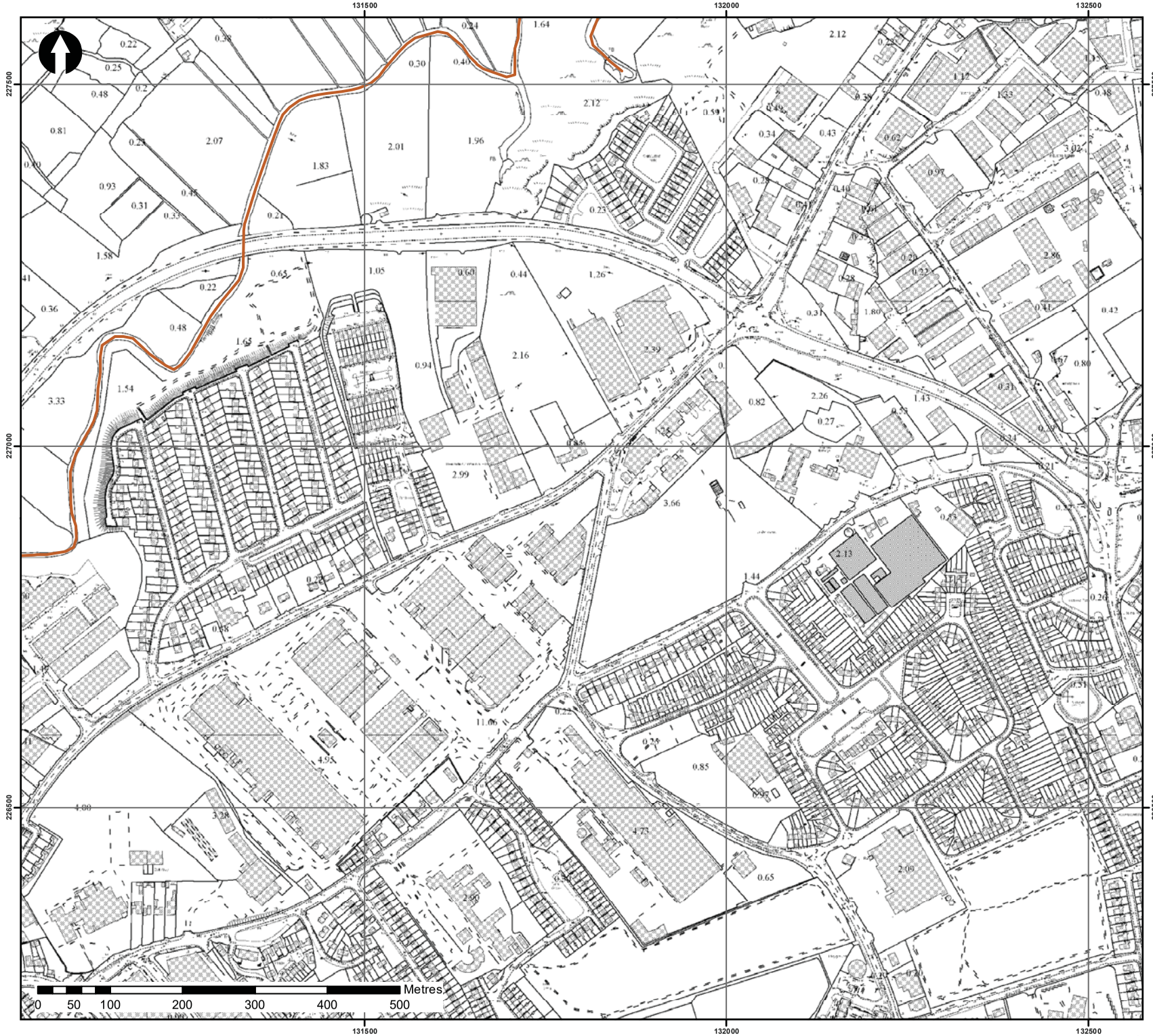

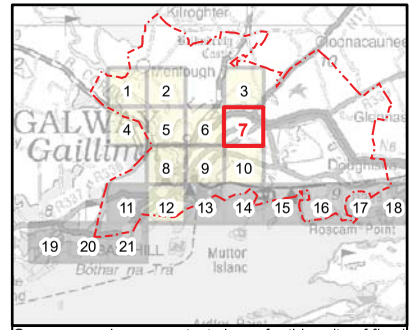

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AFA Boundary

Modelled River Centreline

10% AEP

Inhabitants (No / Ha)

- 1 - 5
- 5 - 20
- 20 - 40
- > 40

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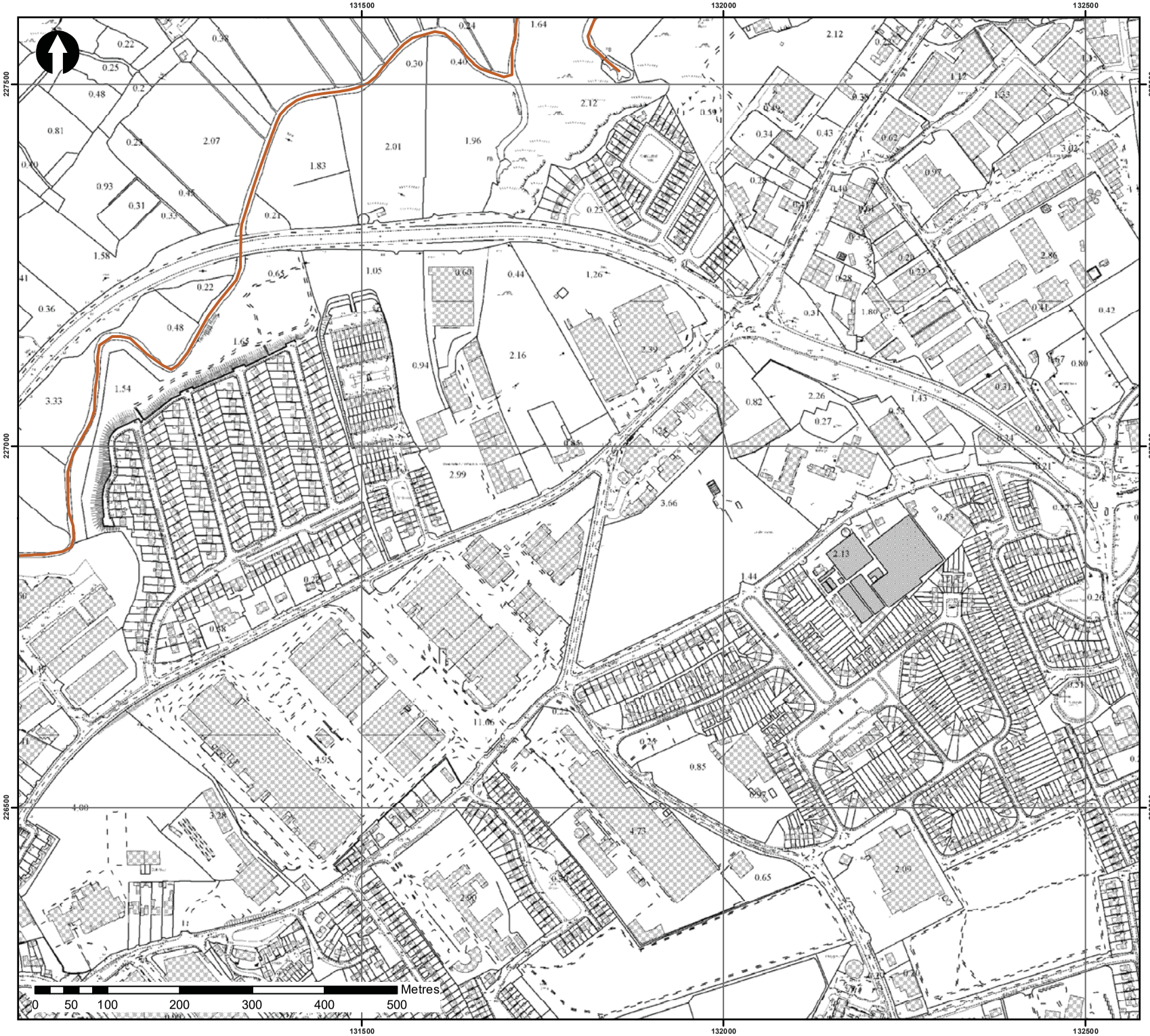
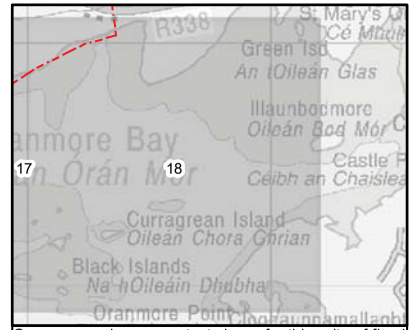
WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City No. Inhabitants (10% AEP)			Final
Map Type:	Specific Risk - No. Inhabitants (10% AEP)		
Map Area:	HPW	Source: Fluvial	Scenario: Current
Drawn by:	KF Date: Jun 2017	Scale:	1:5,000
Checked by:	TS Date: Jun 2017		Original @ A3
Approved by:	JC Date: Jun 2017		
Map No:	W30GLW_RIFCD100_F1_07	**Sheet:**	7 of 21





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AFA Boundary

Modelled River Centreline

0.1% AEP

Inhabitants (No / Ha)

- 1 - 5
- 5 - 20
- 20 - 40
- > 40

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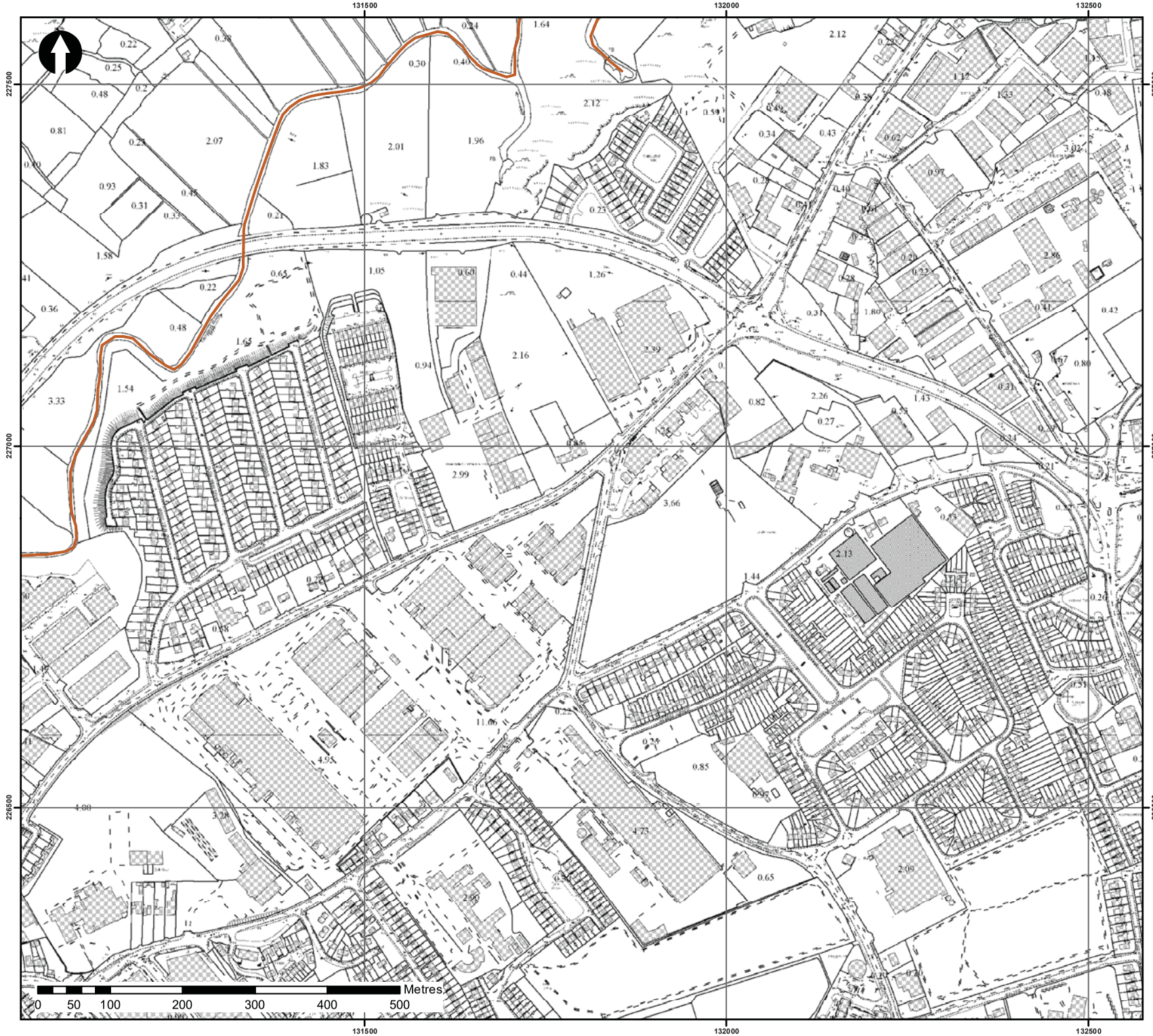
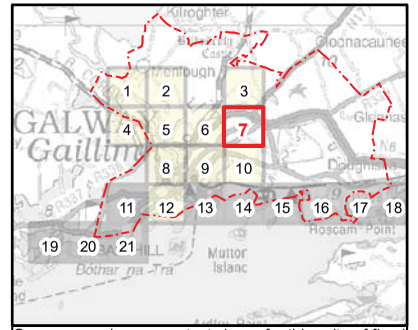
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City No. Inhabitants (0.1% AEP)			Final
Map Type:	Specific Risk - No. Inhabitants (0.1% AEP)		
Map Area:	HPW	Source: Fluvial	Scenario: Current
Drawn by:	KF Date: Jun 2017	Scale:	1:5,000
Checked by:	TS Date: Jun 2017		Original @ A3
Approved by:	JC Date: Jun 2017		
Map No:	W30GLW_RIFCD001_F1_07	**Sheet:**	7 of 21





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AFA Boundary

Modelled River Centreline

1% AEP

Inhabitants (No / Ha)

- 1 - 5
- 5 - 20
- 20 - 40
- > 40

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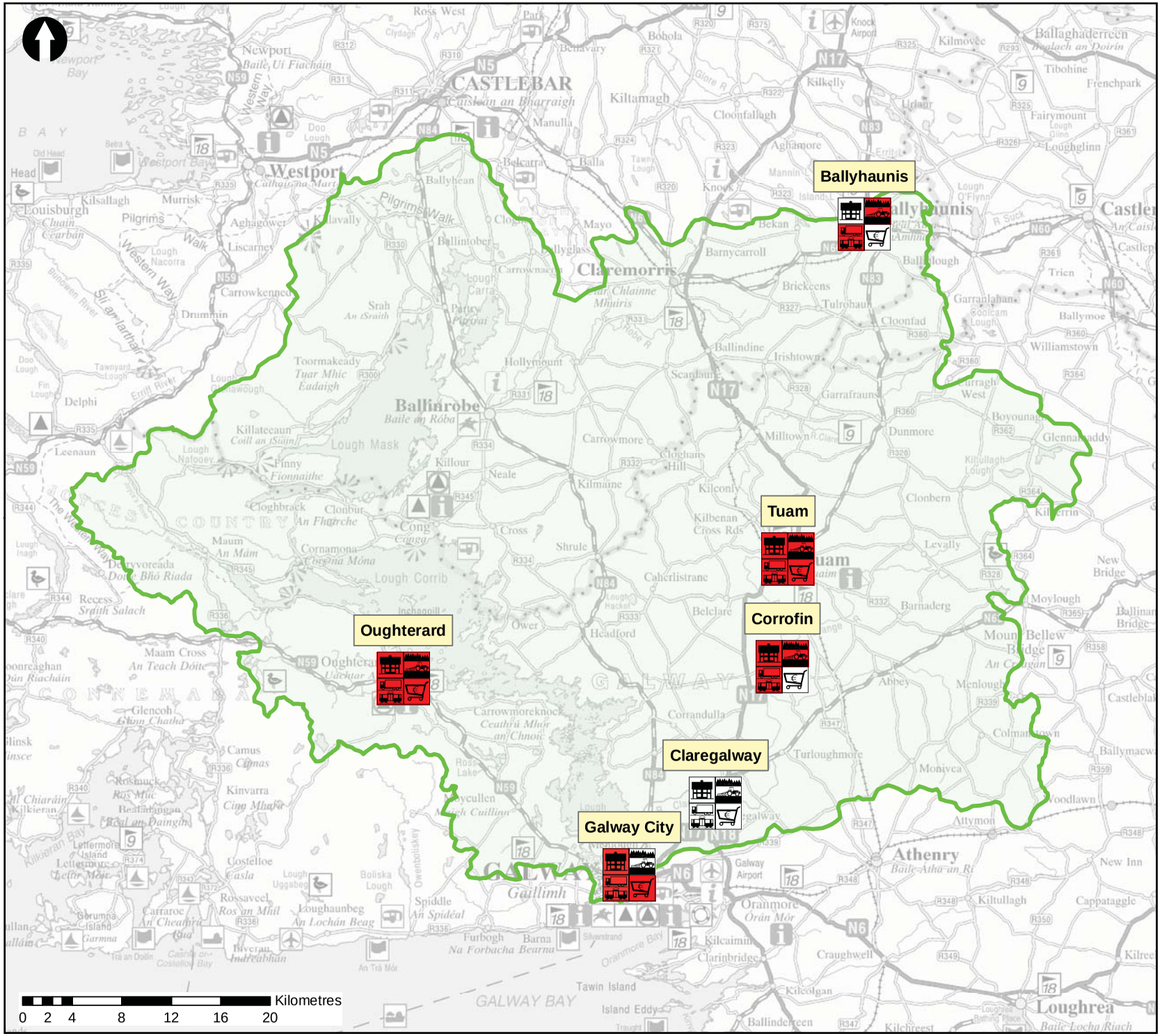
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: Galway City No. Inhabitants (1% AEP)			Final
Map Type:	Specific Risk - No. Inhabitants (1% AEP)		
Map Area:	HPW	Source: Fluvial	Scenario: Current
Drawn by:	KF Date: Jun 2017	Scale:	1:5,000
Checked by:	TS Date: Jun 2017		Original @ A3
Approved by:	JC Date: Jun 2017		
Map No: W30GLW_RIFCD010_F1_07		**Sheet:**	7 of 21



Risk Map: Type of Economic Activity
UoM 30 Corrib

Fluvial 0.1% AEP
Economic Activity

- Property
- Infrastructure
- Rural
- Economic

Risk

- Activity At Risk
- Activity Not At Risk

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WESTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

Map: UoM 30 Corrib - Type of Economic Activity 0.1% AEP			
Map Type: Specific Risk - Type of Economic Activity			Final
Map Area: UoM 30		Source: Fluvial	Scenario: Current
Drawn by: DR Date: Aug 2016		Scale:	1:300,000
Checked by: JC Date: Aug 2016			Original @ A3
Approved by: SPW Date: Aug 2016			
Map No: W30_RTFCD001_F1_01	**Sheet:** 1 of 1		