



Proposed Residential Development at Farrankelly, Delgany, Co. Wicklow



Civil – Engineering Planning Report

Client:

Cairn Homes Properties Ltd,
7 Grand Canal,
Grand Canal Street Lower,
Dublin 2

September 2019

Proposed Residential Development at Farrankelly, Delgany, Co. Wicklow

Planning Report

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Proposed Residential Development at Farrankelly, Delgany, Co. Wicklow

Planning Report

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1. INTRODUCTION

This report sets out the basis for the planning stage design of the scheme in terms of surface drainage, foul drainage, water supply and flood risk.

2. PROJECT DESCRIPTION

The proposed development involves the construction of 426 no. of housing units broken down into 178 no. of semi-detached houses, 47 no. of town houses, 20 no. of detached houses, 88 no. of duplex houses, 3 apartment blocks with 93 no. of apartments, sport pitches and a creche with the provision of car parking spaces on the grounds to the north-west of Eden Gate and to the west of Kilcoole Road in Farrankelly, Co. Wicklow. The proposed development has a gross site area of approximately 21 hectares.

3. SITE INFORMATION

3.1 Site Location

The proposed development is located on lands to the north-west of Eden Gate and to the west of Kilcoole Road in Farrankelly, Co. Wicklow. The site is bounded by Eden Gate housing estate to the south-east, Glenbrook estate to the south and further residential properties to the west, green field and commercial businesses to the north and Kilcoole Road (R761) to the east at Farrankelly, Delgany, Greystones Co. Wicklow. Figure 1 below shows the Site Location.



Figure 1: Site Location

3.2 Site Topography

The terrain is steep with a fall up to 13m across the site from the west side at a high point of 57.5m OD to a level of 39m OD at Kilcoole Road and up to 16.5m from Eden Gate at 52m OD to a level of 35.5m OD beside the industrial businesses to the north. The site falls in the north-south direction towards the Three Trouts River at the northern boundary of the site.

Generally the proposed housing is to the southern portion of the site at high level with the new greenway being proposed, along the Three Trouts river.

Refer to Appendix F for the Topography Survey

3.3 Site Hydrology

The GSI mapping website, www.gsi.ie, classifies the groundwater aquifer in the area as poor aquifer bedrock which is generally unproductive except for local zones. The groundwater vulnerability at the site is mainly classified as high with small areas classified as moderate and low.

Refer to Appendix E for details of the OPW Flood Records.

Refer to Appendix A for details of the GSI Maps.

3.4 Site Geology

Information obtained from the GSI website indicates that the bedrock in the area is mainly categorized as limestone sands and gravels with small areas of Irish sea till derived from Cambrian sandstones and shales.

Refer to Appendix A for details of the GSI Maps.

4. WATER SUPPLY

4.1 Existing Water Supply

The site is greenfield and is not currently served by a public watermain. The Eden Gate development to the south of the site are well supplied with 100 mm watermain according to Irish Water Records.

There is also an existing watermain approximately 0.5km to the south on the Kilcoole Road which serves the Glenbrook and Glenherron Estates. Irish Water have confirmed in the pre-connection enquiry that the watermain on the Kilcoole Road has capacity to serve the proposed development.

Refer to Appendix B for Irish Water Records.

4.2 Proposed Water Supply

It is proposed to provide water to the development through a new connection to the existing 150mm uPVC watermain on Kilcoole Road (R701), adjacent to the proposed development the new connection will require the extension of the existing water network by approximately 315m.

A pre-connection enquiry was submitted to Irish Water to determine the suitability of the proposed water supply to the site. Irish Water has confirmed that the existing systems currently have capacity. In addition a Statement of Design Acceptance has been issued for the proposed development and is included with the planning application.

The daily demand has been calculated as 190.8 m³/day, refer to section 5.2.1 below.

All watermains will be constructed in accordance with Irish Water requirements following consultation with Irish Water New Connections at construction stage.

Refer to appendix B for Irish Water Records.

Refer to appendix C for Pre-connection enquiry form submitted to Irish Water.

Refer to drawing FK-ROD-Z0-00-DR-C-0041-0044 for proposed watermain layout.

5. FOUL DRAINAGE

It is proposed to provide new separate surface water and foul drainage systems to serve the proposed development. This section outlines the existing foul drainage services onsite and gives our proposals for the additional foul water drainage requirements proposed for the development.

A pre-connection enquiry was submitted to Irish Water to determine the suitability of the proposed foul drainage capacity for the site. Irish Water has confirmed that the existing systems currently have capacity. In addition a Statement of Design Acceptance has been issued for the proposed development and is included with the planning application.

5.1 Existing Foul Drainage

The site is not currently served by public foul drainage infrastructure. Nevertheless, the Eden Gate development is well served by a 300mm diameter foul sewer, which crosses the proposed site and it is proposed that the foul sewer is diverted.

Refer to Appendix B for Irish Water Records.

5.2 Proposed Foul Drainage

It is proposed to divert the existing 300mm foul sewer traversing the site from the Eden Gate residential estate to north-east of the site to construct a new foul network that will serve the proposed development. Existing manholes will be use for the connection and discharge of the new diverted foul drainage network. New foul drainage system will be in place prior to the diversion of the foul sewer.

A pumping station will also be required to pump sewage from the northern part of the site that will accommodate 46 dwellings. The foul sewerage will then connect to the new gravity system where it will make its way to the public foul sewer and hence into the Irish Water system.

A pre-connection enquiry was submitted to Irish Water to determine the suitability of the proposed foul drainage capacity for the site. Irish Water has confirmed that the existing systems currently have capacity. In addition a Statement of Design Acceptance has been issued for the proposed development and is included with the planning application.

All foul drainage shall be constructed in accordance with Greater Dublin Regional Code of Practice for Drainage Works and Irish Water requirements.

Refer to drawing FK-ROD-Z0-00-DR-C-0031-0035 for proposed foul network layout

5.2.1 Rationale for Pumping Station Requirements.

Refer to drawing FK-ROD-Z0-00-DR-C-0031-0035 for proposed foul network layout

As part of the development, a pumping station is required to accommodate the foul drainage from 46 units at the north of the site. Gravity options were originally investigated for these system but it is physically impossible to connect to the closest foul system without crossing through third party lands which are not in the control of the applicant or by impacting on the existing flood plain of the Three Trouts River which is not acceptable to either the Office of Public Works or Wicklow County Council.

Figures 2 - 4 below shows the potential route to the closest foul sewer in the control of Irish Water which actually crosses the Three Trouts River in two locations in an elevated pipe. The

connection level at 24.186m OD. However due to the topography of the site, the proposed foul sewer could not be designed all the way to Three Trout Stream underground as there is a dip in a topography where the proposed pipe was running through. In order for the design to work the ground would need to be elevated which would cause multiple environmental and flooding issues due to the pipe requiring a berm in this location. This would have made a major impact on the stream's floodplain and would have resulted in a dam within the floodplain. Due to the loss of the floodplain downstream, compensatory area would have to be made upstream within the boundary line of the proposed development. In this particular case there were not enough land available to compensate the amount of the floodplain that was being lost and would require modelling of the entire catchment of the Three Trouts river from its source including any potential discharges. This is unfortunately an impossible task due to the unknown and older nature of the river and connections upstream.



Figure 2: Proposed Gravity Foul Sewer Towards Three Trout Stream



Figure 3: Topography around the proposed Pipe 20(1) SW end

- * Clarification to the design capacity requirements in Section 7 and Section 9 of the Code of Practice: Wastewater Treatment and Disposal Systems serving Single Houses (p.e. <10), Aug 2013

Max Design Flow:

= 191,700 l/day

Max Organic Load:

= 76,680 kg (BOD5)/day

Population Equivalent Value:

= 1,272 P.E

It should also be noted that the creche discharge is included in the above figures as the majority of users will be from the proposed housing.

Refer to Appendix C for Pre-connection enquiry form submitted to Irish Water.

6. SURFACE WATER DRAINAGE

It is proposed to provide new separate surface water drainage and foul water drainage to serve the proposed development. This section outlines the existing surface water drainage services onsite and gives our proposal for the additional surface water drainage requirements as part of the development.

6.1 Existing Surface Water Drainage

The site drains from south-west to north-east and rainfall currently percolates through the subsoil to underwater. The runoff from the adjacent Eden Gate is collected into the existing storm water system which crosses the proposed site parallel to the foul sewer which will require a diversion. This diversion has been discussed and agreed with Wicklow County Council in principle. Wicklow County Council will not confirm this until the planning application has been formally approved.

Refer to Appendix B for Irish Water Records.

6.2 Proposed Surface Water Drainage

It is proposed to divert the existing 600mm concrete sewer traversing the site from Eden gate in the south to the north of private lands by constructing a new surface drainage system that will collect runoff from roads and roofs together with any additional runoff from landscape areas which does not percolate to ground. Existing manholes will be use for the connection and discharge of the new diverted surface water network.

The surface water drainage system will be designed to ensure adequate capacity is achieved with minimum self-cleansing velocity in the pipes of 1.0 m/s when flowing half full.

Given the size of the development, the site has been divided in eight areas for surface water collection purposes. It is proposed to provide a network of 225mm diameter pipes for each of these areas and to connect them to separate attenuation tanks.

Following consultation with Wicklow County Council, the allowable run-off rate has been restricted to 2 litres/second/hectare, which is actually less than Greenfield run-off rates determined as per the Greater Dublin Strategic Drainage Study. This will result in increased storage volumes on the site and lower flows being discharged generally. The tanks have been sized to provide storage for 1 in 100-year rainfall event including a 10% increase for a

climate change for the entire development with the discharge rate limited from 2.85 l/s to 3.28 l/s depending on the zone that the attenuation tank is located in.

Surface water drainage will discharge from Attenuation Tanks E and F to the Three Trout Stream to the north of the site, Attenuation Tank A will be discharged through a gravity surface water sewer just to the north of the site entrance at Kilcoole Road (R761) and Attenuation Tanks B,C,D will be discharged through the diverted surface water sewer that runs from Eden Gate to the south towards private lands to the north .

Proposed attenuation tanks have the following volumes:

Attenuation Tank ID.	Location	Contributing Area (m ²)	Impermeability Factor	Vol. required (m ³)	Vol. provided (m ³)
A	See drawing FK-ROD-Z0-XX-DR-C-0035	13,772	0.35	449.63	453
B	See drawing FK-ROD-Z0-XX-DR-C-0035	24,500	0.35	821.53	825
C	See drawing FK-ROD-Z0-XX-DR-C-0036	30,000	0.40	1224.13	1227
D	See drawing FK-ROD-Z0-XX-DR-C-0036	10,000	0.34	309.04	310
E	See drawing FK-ROD-Z0-XX-DR-C-0038	29,533	0.40	1201.23	1204
F	See drawing FK-ROD-Z0-XX-DR-C-0037	35,000	0.39	1387.25	1141

All surface water drainage shall be constructed in accordance with Greater Dublin Regional Code of Practice for Drainage Works and Wicklow County Council Requirements.

Refer to drawing FK-ROD-Z0-00-DR-C-0035-0038 for proposed surface water system layout.

Refer to drawing FK-ROD-Z0-00-DR-C-0039 for surface water drainage areas.

Refer to Appendix D for Surface Water Calculations

6.2.1 SUDS Approach

This should be read in conjunction with the following:

- i. Appendix D – Surface Water Calculations*
- ii. Drawing FK-ROD-Z0-00-DR-C-0031-0035*

As part of the development, a number of different SuDS measures are proposed to minimise the impact on water quality and quantity of the runoff and maximise the amenity and biodiversity opportunities within the site.

The Ground Investigation Report indicates variable permeability across the site, which makes the use of groundwater recharge difficult to determine. Therefore the measures detailed below have been designed to take account of potential percolation, but have not been incorporated into any storage calculations. This will result in additional storage being available in extreme events.

The proposed SuDS measures will include a combination of Source Control, Site Control and Regional Control measures as part of a Management Train whereby the surface water is managed locally in small sub-catchments rather than being conveyed to and managed in large systems further down the catchment. The combination of the SuDS measures outlined below will maximise the potential for surface water infiltration to the subsoil, reducing the impact on the existing surface water drainage network. The proposed techniques will offer a high level of treatment processes and nutrient removal of the runoff, particularly during the "first flush".

The SuDS design for the proposed development is based on dividing the site into several smaller catchment areas in order to provide source control. In this way the surface water is attenuated and treated close to the site of its runoff.

It is proposed to provide the following SuDS measures:

1. Attenuation Tank
2. Permeable Paving
3. Gullies discharging to tree pits in green areas
4. Filter drains

Attenuation Tanks

The attenuation tanks have been sized to provide storage for runoff from the roofs, footpaths and any runoff from the green areas which does not percolate to the ground. The volumes of the attenuation tanks include a 10% increase in rainfall depth to allow for climate change. The tanks are sized using the assumption that no percolation will occur. However, the ground investigation report does indicate varying degrees of percolation on the site. Due to this, the attenuation tanks will allow some percolation to occur until the volumes are simply too great, at which point it will be stored and released through the flow control devices.

Permeable Paving

Permeable paving will be provided for car parking spaces and driveways within the site. It is proposed to provide storage beneath the permeable paving areas to attenuate any surface water runoff from these areas. These storage areas will have a depth of 300mm and will have a voids ratio of 30%. All roof drainage will initially run through the permeable paving stone layers to initially catch the first flush of water from the site. While the permeable paving will contain overflows to the main drainage system, the majority of the water will be held in the stone layer and allowed to percolate to the ground providing an additional layer of filtration.

Gullies discharging to tree pits in green areas

It is proposed that a number of gullies will be provided on roads surrounding the green-open spaces which will not discharge to the overall surface water system but instead will provide an irrigation system to the tree pits and landscaping within each of these zones. This will be provided through the use of a perforated pipe running through the zones with a stone surround. Regardless, it must also be noted that the storage and pipe system have not been designed to take advantage of this reduced volume which will also result in a slightly conservative design. Due to this, an overflow will be provided from the filter drain back to the main system.

Filter drains

A number of drains on the site will consist of filter drains to pick up the first flows through the system. These have been indicated on the drawings. These pipes will reduce and slow the first flow of water in a storm event containing it within the overall site. The pipe network has been designed to assume that these pipes become overwhelmed during a major storm event but will contain the first flush.

7. FLOOD RISK ASSESSMENT

A Flood Risk Assessment has been provided separately.

8. SUMMARY

- Water will be supplied to the development from a new connection to the existing 200mm HDPE watermain on Kilcoole Rd. The new connection will require the extension of the existing water network by approximately 315m.
- Separate foul and surface water drainage system will be constructed to serve the site.
- The existing 300mm foul sewer traversing the site from the Eden Gate residential estate to north-east of the site will be diverted to construct a new foul network that will serve the proposed development. Existing manholes will be use for the connection and discharge of the new diverted foul drainage network.
- A pumping station is proposed to serve 46 dwellings that will pump the sewage from northern part of the subject site that will pump the sewage to the middle of the site where it will connect into proposed gravity sewer and then will be discharged thereafter.
- A Statement of Design Acceptance has been issued by Irish Water for the proposed water supply and foul drainage network
- The site will incorporate several soft SuDS measures promoting treatment and infiltration of surface water to underlying subsoil including, Permeable Paving for driveways and house surrounds, filter drains, and attenuation tanks where required.
- Any excess surface water from the site which does not infiltrate to the subsoil will be discharge from Attenuation Tanks E and F to the Three Trout Stream to the north of the site, Attenuation Tank A will be discharged through a gravity surface water sewer just to the north of the site entrance at Kilcoole Road (R761) and Attenuation Tanks B,C,D will be discharged through the diverted surface water sewer that runs from Eden Gate to the south towards private lands to the north
- There is no history of flooding on the site and the site is outside the pluvial and fluvial indicative 0.1% AEP flood extent (Zone C) based on the mapping. Therefore, no Justification Test is required for the residential element of the scheme. (Refer to Flood Risk Assessment)
- Pavement makeup for the proposed access road will be in accordance with Wicklow County Council Taking in Charge Policy.

APPENDIX A

GSI MAPS

Legend

— Bedrock Aquifer
— Faults

Gravel Aquifer

Locally Important
Gravel Aquifer
Regionally Important
Gravel Aquifer

Bedrock Aquifer

Rkc - Regionally
Important Aquifer -
Karstified (conduit)
Rkd - Regionally
Important Aquifer -
Karstified (diffuse)
RK - Regionally
Important Aquifer -
Karstified
Rf - Regionally
Important Aquifer -
Fissured bedrock
Lm - Locally
Important Aquifer -
Bedrock which is
Generally Moderately
Productive

Lk - Locally Important
Aquifer - Karstified

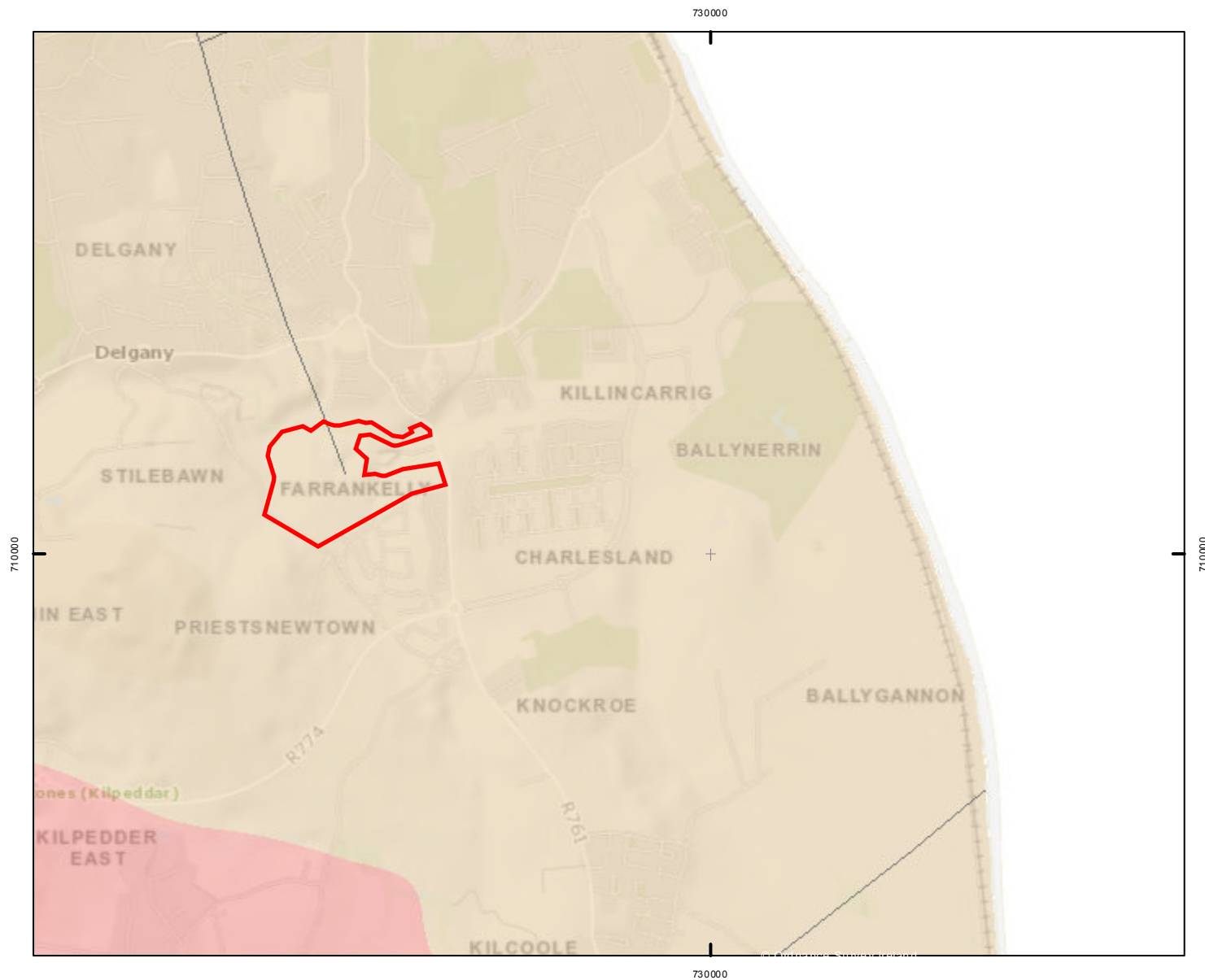
LI - Locally Important
Aquifer - Bedrock
which is Moderately
Productive only in
Local Zones

PI - Poor Aquifer -
Bedrock which is
Generally
Unproductive except
for Local Zones

Pu - Poor Aquifer -
Bedrock which is
Generally
Unproductive

□ Lake

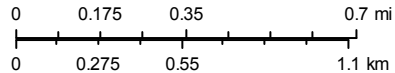
□ Proposed site location



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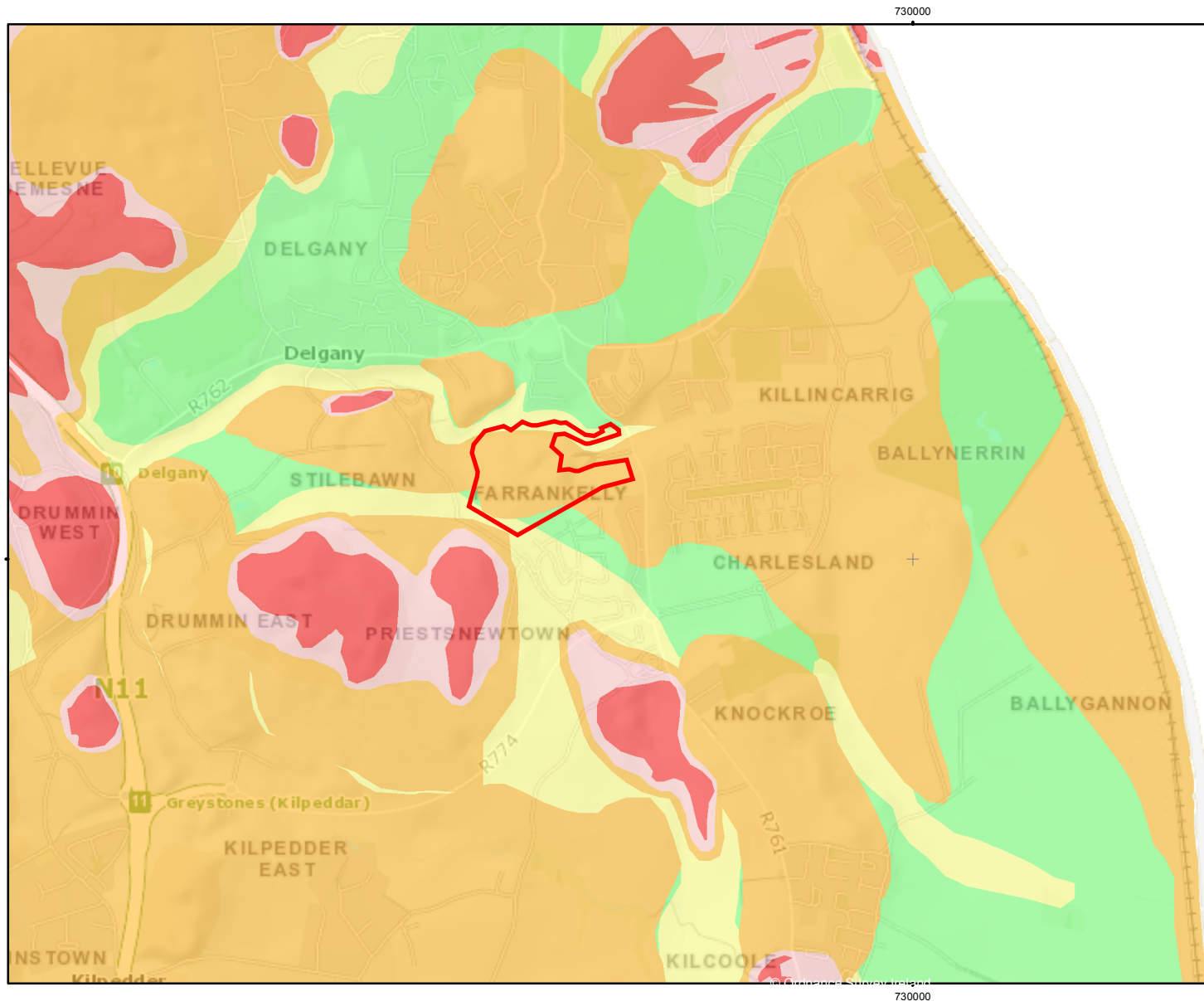


Groundwater Data

Legend

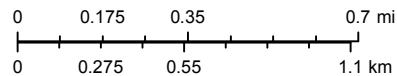
Groundwater Vulnerability

- X - Rock at or near surface or Karst
- E - Extreme
- H - High
- M - Moderate
- L - Low
- Proposed site location



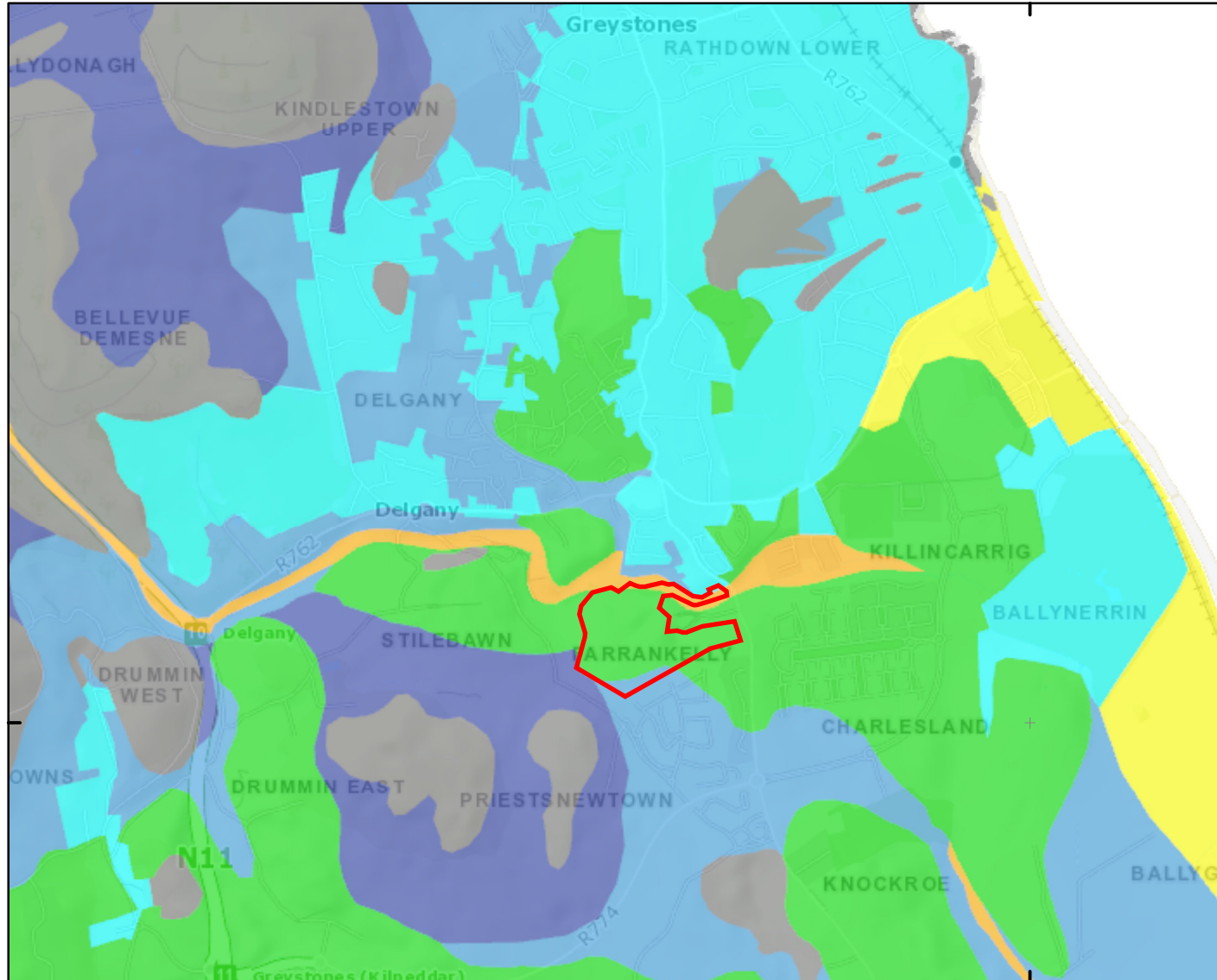
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Legend

Teagasc Subsoils

- A - Alluvium
 - Ac - Alluvium (clayey)
 - Ag - Alluvium (gravelly)
 - Asi - Asi
 - BktPt - Blanket peat
 - FenPt - Fen peat
 - RsPt - Raised peat (intact)
 - Cut - Cutover raised peat
 - AcEsk - Esker comprised of gravels of acidic reaction
 - BasEsk - Esker comprised of gravels of basic reaction
 - GBI - Gravels derived from basic igneous rocks
 - GCh - Gravels derived from cherts
 - GCSs - Gravels derived from Cambrian sandstones
 - GCSsS - Gravels derived from Cambrian sandstones and shales
 - GDCs - Gravels derived from Devonian and Carboniferous sandstones
 - GDSs - Gravels derived from Devonian sandstones
 - GLPDSs - Gravels derived from Lower Palaeozoic and Devonian sandstones
 - GLPS - Gravels derived from Lower Palaeozoic shales
 - GLPSs - Gravels derived from Lower Palaeozoic sandstones
 - GLPSSs - Gravels derived from Lower Palaeozoic sandstones and shales
 - GLs - Gravels derived from limestones
 - GNSSs - Gravels derived from Namurian sandstones and shales
 - GMp - Gravels derived from metamorphic rocks
 - GGr - Gravels derived from granites
 - GQz - Gravels derived from quartzites
 - Rck - Bedrock outcrop or subcrop
 - KaRck - Karstified bedrock outcrop or subcrop
 - Scree - Scree
 - L - Lacustrine sediments
 - Lc - Lacustrine clays
 - Ls - Lacustrine sands
 - Lsi - Lacustrine silts
 - Mrl - Lake marl
 - MGs - Marine gravels and sands (often raised)
 - Mbs - Marine beach sands
 - Msi - Marine silts
 - Mc - Marine clays
 - Mesc - Estuarine silts and clays
 - Marsh - Marsh
 - TdMr - Tidal marsh
 - Ae0 - Aeolian sediments
 - Ws - Windblown sands
 - Wsd - Windblown sands in dunes
 - Made - Made ground
 - IrSTAv - Irish Sea Till derived from acid volcanic rocks
 - IrSTCSsS - Irish Sea Till derived from Cambrian sandstones and shales
 - IrSTDsS - Irish Sea Till derived from Devonian sandstones
 - IrSTLPSsS - Irish Sea Till derived from Lower Palaeozoic sandstones and shales
 - IrSTLs - Irish Sea Till derived from limestones
 - TAv - Till derived from acid volcanic rocks
 - TBI - Till derived from basic igneous rocks
 - TCh - Till derived from cherts
 - TCSsCh - Till derived from Carboniferous sandstones and cherts
 - TCSsS - Till derived from Cambrian sandstones and shales
 - TDCSs - Till derived from Devonian and Carboniferous sandstones
 - TDCSsS - Till derived from Devonian and Carboniferous sandstones and shales
 - TDSs - Till derived from Devonian sandstones
 - TGr - Till derived from granites
 - TLPDSs - Till derived from Lower Palaeozoic and Devonian sandstones
 - TLPS - Till derived from Lower Palaeozoic shales
 - TLPSs - Till derived from Lower Palaeozoic sandstones
 - TLPSsS - Till derived from Lower Palaeozoic sandstones and shales
 - TLs - Till derived from limestones
 - TMp - Till derived from metamorphic rocks
 - TNSSs - Till derived from Namurian sandstones and shales
 - TNCSSs - Till derived from Namurian and Carboniferous sandstones and shales
 - TQz - Till derived from quartzites
- Water
- Proposed site location

Scale: 1:25,000

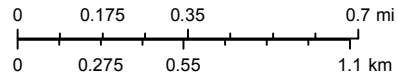
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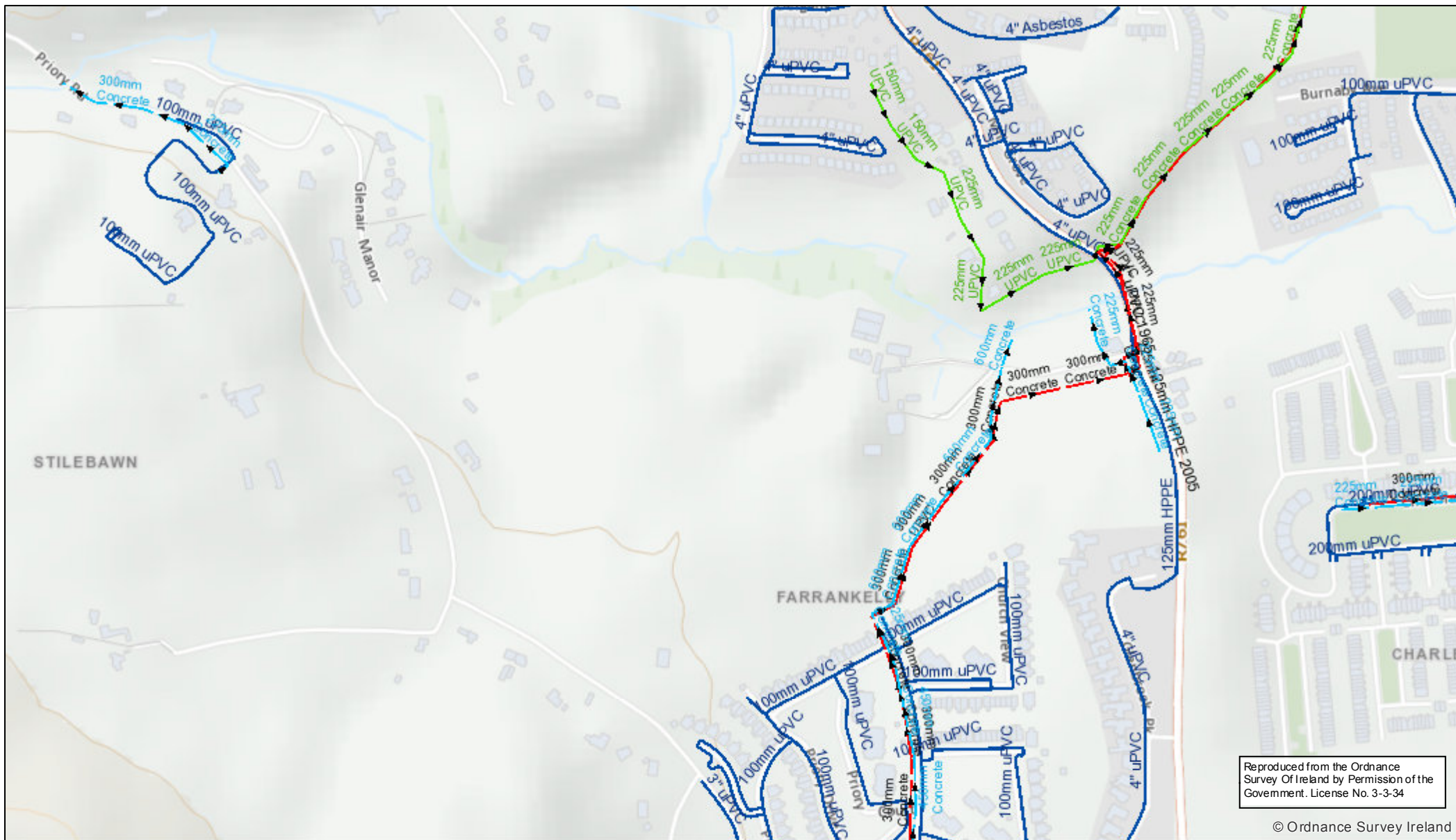


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Snapshot Date: August 7, 2018

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APPENDIX B
IRISH WATER RECORDS

Irish Water Web Map



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January 18, 2017

Legend

	Surface		Combined		Unknown		Overflow		Foul
	Surface		Foul		Combined		Unknown		Overflow
	Treatment plant		Overflow		Foul		Combined		Unknown

1:9,028

0 0.075 0.15 0.3 mi

0 0.1 0.2 0.4 km

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

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APPENDIX C
PRECONNECTION ENQUIRY FORM

Andrew Thomson (agent)
Roughan & O'Donovan,
Arena House
Arena Road
Sandyford,
Dublin

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

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

www.water.ie

12 September 2019

**Re: Design Submission for Farrankelly Townland, Co. Wicklow (the “Development”)
(the “Design Submission”) / Connection Reference No: 7934419884**

Dear Andrew Thomson,

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: Donal O'Dwyer
Phone: (022) 54606
Email: dodwyer@water.ie

Yours sincerely,



Maria O'Dwyer
Connections and Developer Services

Appendix A

Document Title & Revision

- [FK-ROD-Z0-XX-DR-C-0030 Rev. P5 Foul Water Longitudinal Sections]
- [FK-ROD-Z0-XX-DR-C-0031 Rev. P9 Proposed Drainage Layout Sheet 1]
- [FK-ROD-Z0-XX-DR-C-0032 Rev. P8 Proposed Drainage Layout Sheet 2]
- [FK-ROD-Z0-XX-DR-C-0033 Rev. P8 Proposed Drainage Layout Sheet 3]
- [FK-ROD-Z0-XX-DR-C-0034 Rev. P11 Proposed Drainage Layout Sheet 4]
- [FK-ROD-Z0-XX-DR-C-0041 Rev. P9 Proposed Watermain Layout Sheet 1]
- [FK-ROD-Z0-XX-DR-C-0042 Rev. P8 Proposed Watermain Layout Sheet 2]
- [FK-ROD-Z0-XX-DR-C-0043 Rev. P7 Proposed Watermain Layout Sheet 3]
- [FK-ROD-Z0-XX-DR-C-0044 Rev. P6 Proposed Watermain Layout Sheet 4]
- [FK-ROD-Z0-XX-DR-C-0045 Rev. P6 Watermain Longitudinal Sections]

Standard Details/Code of Practice Exemption:
<N/A>

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.

Andrew Thomson (agent)
Roughan & O'Donovan,
Arena House
Arena Road
Sandyford,
Dublin



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

17 July 2018

Dear Sir/Madam,

**Re: Customer Reference No 7934419884 pre-connection enquiry - Subject to contract | Contract denied
Connection for 440 unit development at Farrankelly Townland, Co. Wicklow**

Irish Water has reviewed your pre-connection enquiry in relation to
water and wastewater connections at Farrankelly Townland, Co. Wicklow

Based upon the details you have provided with your pre-connection enquiry and on the capacity currently available 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 can be facilitated.

Strategic Housing Development

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

A. In advance of submitting your full application to An Bord Pleanála 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.

B. 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 and appropriate connection fee paid at a later date.

Water

In order to complete the proposed connection at the development, the water network will have to be extended by approximately 540m. Irish Water currently does not have any plans to extend its network in this area. Should you wish to consider extending the water infrastructure to a point to connect to the Irish Water network, please contact Irish Water.

Wastewater

Note the presence of a 300mm foul sewer traversing the subject site and the requirement to comply with Irish Water's Wayleave requirements in relation to this infrastructure.

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 Utility Regulation.

If you have any further questions, please contact Fionán Ginty from the design team on 018925734 or email fginty@water.ie. For further information, visit www.water.ie/connections

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

Stiúrthóirí / Directors: Mike Quinn (Chairman), Jerry Grant, Cathal Marley, Brendan Murphy, Michael G. O'Sullivan
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalhbóid, Baile Átha Cliath 1, D01 NP86 / Cokvill House, 24-26 Talbot Street, Dublin 1, D01 NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.
Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363

Pre-connection enquiry form

Industrial and commercial developments, mixed use

developments, housing developments, business developments



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

Please refer to the **Guide to completing the pre-connection enquiry form** on page 12 of this document when completing the form.

Section A | Applicant details

1 **WPRN number (where available):**

2 **Applicant details:**

Registered company name (if applicable):

Trading name (if applicable):

Company registration number (if applicable):

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

Contact name:

Postal address:

Eircode:

Telephone:

Mobile:

Email:

3 **Agent details (if applicable):**

Contact name:

Company name (if applicable):

Postal address:

Eircode:

Telephone:

Email:

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

Applicant

Agent

Section B | Site details

5 **Site address:**

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

7 **Local Authority:**
Local Authority that granted planning permission (if applicable):

8 **Has full planning permission been granted?** Yes No
If 'Yes', please provide the current or previous planning reference number:

9 **Previous use of this site (if applicable):**

10 **Date that previous development was last occupied (if applicable):** / /

11 **Are there poor ground conditions on-site?** Yes No
If 'Yes', please include site investigation report and a detailed site-specific report on the approach being taken to deal with ground conditions specifically with regard to pipe support and trenching.

12 **Are there potential contaminated land issues?** Yes No
If 'Yes', please include a detailed site-specific report on the approach being taken to deal with contaminated land and the measures being taken to mitigate the impact on infrastructure.

13 **Is the development compliant with the local area development plan?** Yes No

Section C | Water connection and demand details

- 14 Is there an existing connection to public water mains at the site? Yes No
- 15 Is this enquiry for an additional connection to the one already installed? Yes No
- 16 Is this enquiry to increase the size of an existing water connection? Yes No
- 17 Is this enquiry for a new water connection? Yes No
- 18 Approximate date water connection is required: / /

19 Please indicate pre-development water demand (if applicable):

Pre-development peak hour water demand		I/s
Pre-development average hour water demand		I/s

Pre-development refers to brownfield sites only. Please include calculations on the attached sheet provided.

20 Please indicate the domestic water demand (housing developments only):

Post-development peak hour water demand		I/s
Post-development average hour water demand		I/s

Please include calculations on the attached sheet provided.

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

Post-development peak hour water demand		I/s
Post-development average hour water demand		I/s

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

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

Post-development peak hour water demand		I/s
Post-development average hour water demand		I/s

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

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

 m

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

 m

Section E | Development details

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

Property type	Total number of units for this application
Domestic	
Office	
Residential care home	
Hotel	
Factory	
School	
Institution	
Retail unit	
Industrial unit	
Other (please specify)	

43 Approximate start date of proposed development:

 / /

44 Is the development multi-phased?

Yes No

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

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



Site Boundary

Not Scaled

Irish Grid Co-ordinates:
Easting: 328815
Northing: 210225

Project: FARRANKELLY

Element: Average and Peak Water Demand

By	Date	Rev.	Chkd
JC	10-4-18		

Ref	Calculations / Notes / Sketch	Output / Action
-----	-------------------------------	-----------------

Average Water Demand

440 units

$$2.7 \frac{\text{persons}}{\text{unit}} \cdot 1.25 \text{ (future expansion)} = 3.375 \frac{\text{persons}}{\text{unit}}$$

$$\text{Total number of persons} = 440 \text{ units} \cdot 3.375 \frac{\text{persons}}{\text{unit}} = 1485 \text{ persons}$$

Estimated water consumption of each person: $150 \frac{\text{l}}{\text{person} \cdot \text{day}}$

$$\begin{aligned} \text{Total consumption} &= 150 \frac{\text{l}}{\text{person} \cdot \text{day}} \cdot 1485 \text{ persons} = 222750 \frac{\text{l}}{\text{day}} \\ &= \boxed{2.583 \frac{\text{l}}{\text{s}}} \end{aligned}$$

Peak Water Demand = $Pf_{\text{Dom}} \cdot PG$

$PG = \text{population usage} = 2.583 \frac{\text{l}}{\text{s}}$

$Pf_{\text{Dom}} = \text{peaking factor for domestic wastewater flow}$

For 1485 persons, $Pf_{\text{Dom}} = 3$ (Refer to Code of Practice for Wastewater Infrastructure)

Then, $3 \cdot 2.583 \frac{\text{l}}{\text{s}} =$

$$= \boxed{7.749 \frac{\text{l}}{\text{s}}}$$

Project:	FARRANKELLY	By	Date	Rev.	Chkd
Element:	Design Foul Flow Calculation	JC	10-4-18		

Ref	Calculations / Notes / Sketch	Output / Action
-----	-------------------------------	-----------------

1- DRY WEATHER FLOW CALCULATION (Average Discharge)

Development size: 440 units (dwellings and apartments)

$$\frac{\text{Dry weather flow (DWF)}}{\text{unit}} = 446 \frac{\text{l}}{\text{unit}} \rightarrow \text{for domestic wastewater}$$

↓
2.7 persons per house and a per capita Wastewater flow of 150 l per head per day along with a 10% unit consumption allowance

(Refer to Code of Practice for Wastewater Infrastructure)

Accounting for future expansion: $1.25 \cdot 446 \frac{\text{l}}{\text{unit}} = 558 \frac{\text{l}}{\text{unit}}$

$$\text{DWF} = 440 \text{ units} \cdot 558 \frac{\text{l}}{\text{unit} \cdot \text{day}} = 245520 \frac{\text{l}}{\text{day}} = \boxed{2.84 \frac{\text{l}}{\text{s}}}$$

(Average Discharge)

2- DESIGN FOUL FLOW CALCULATION = $Pf_{\text{dom}} \cdot PG + I$; (Peak Discharge)

PG = population usage

$$\rightarrow 2.7 \frac{\text{persons}}{\text{unit}} \cdot 1.25 (\text{future expansion}) \cdot 150 \frac{\text{l}}{\text{day} \cdot \text{person}}$$

$$\cdot 440 \text{ units} = 222750 \frac{\text{l}}{\text{day}}$$

I = infiltration

$$\rightarrow 10\% \cdot PG = 22275 \frac{\text{l}}{\text{day}}$$

Pf_{dom} (Peaking factor for domestic wastewater flow)

$$\text{Population} = 2.7 \frac{\text{persons}}{\text{unit}} \cdot 1.25 (\text{future expansion}) \cdot 440 \text{ units} =$$

$$= 1485 \text{ persons, then } Pf_{\text{dom}} = 3$$



Arena House
Arena Road, Sandyford
Dublin 18
Tel: 01-294 0800
E-mail: info@rod.ie

Project Number	Sub No.

Section/Sk.	Sheet	Rev

Project:	By	Date	Rev.	Chkd
Element:				

Ref	Calculations / Notes / Sketch	Output / Action
-----	-------------------------------	-----------------

$$3.222750 \frac{l}{day} + 22275 \frac{l}{day} = 690525 \frac{l}{day} = 7.99 \frac{l}{s}$$

Hence, the design foul flow = $7.99 \frac{l}{s}$ (Peak Discharge)

Project: FARRANKELLY

Element: Pipe size & Gradient

By	Date	Rev.	Chkd
XC	10-4-18		

Ref	Calculations / Notes / Sketch	Output / Action
-----	-------------------------------	-----------------

Pipe size & Gradient

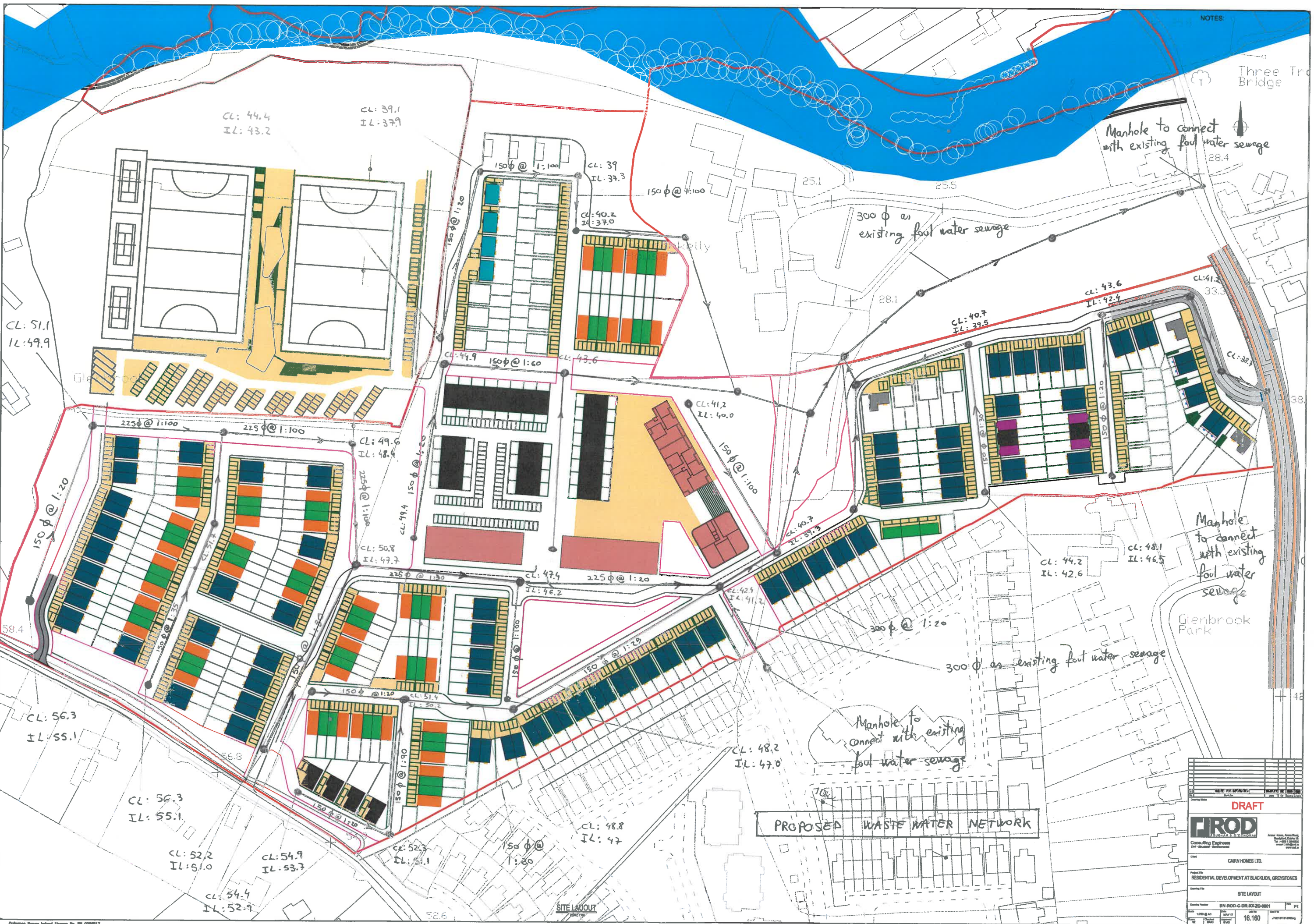
Peak Wastewater Flow = $7.99 \frac{l}{s}$

Diameter to analyze: 150 mm
 Gradient to analyze: 1 in 100 } $v = 0.874 \frac{m}{s}; Q = 15.439$

$$\frac{Q_p}{Q} = \frac{7.99}{15.439} = 0.52 \rightarrow \frac{v_p}{v} = 1$$

$$v_p = 1 \cdot v = 0.874 \frac{m}{s} \left\{ \begin{array}{l} > v_{min} \text{ self cleaning} = 0.75 \frac{m}{s} \\ < v_{max} = 2 \frac{m}{s} \end{array} \right.$$

Then, $\phi 150$ mm at 1 in 100 gradient can be used.



NOTES

Three Bridge Tr

Manhole to connect with existing foul water sewage

300φ as existing foul water sewage

Manhole to connect with existing foul water sewage

Glenbrook Park

300φ as existing foul water sewage

Manhole to connect with existing foul water sewage

PROPOSED WASTE WATER NETWORK

SITE LAYOUT

DRAFT	
FIROD FOURMAN & CRENSHAW	
Consulting Engineers Civil, Structural, Environmental	
Client: CARRN HOMES LTD.	
Project: RESIDENTIAL DEVELOPMENT AT BLACKLION, GREYSTONES	
Drawing Title: SITE LAYOUT	
Drawing Number: BN-ROD-C-DR-303-20-0001	Scale: 1:100
Author: 1/20/20	Check: 16.160
Date: 16.160	Scale: 1:100
<small>DO NOT SCALE LINE PLOTTED DIMENSIONS ONLY</small>	

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Guide to completing the pre-connection enquiry form

This form should be completed by applicants enquiring about the feasibility of a water and/or wastewater connection to Irish Water infrastructure.

The Irish Water Codes of Practice are available at www.water.ie for reference.

Section A | Applicant Details

- Question 1:** 'Water Point Reference Number (WPRN)' is a unique number assigned to every single water services connection in the country. The WPRN is prominently displayed on correspondence received from Irish Water, and can be found on water bills, previous connection offers, or previous enquiries in relation to the site. Existing customers and brownfield sites should have a WPRN. New customers are not required to answer this question.
- Question 2:** This question requires the applicant or company enquiring about the feasibility of a connection to identify themselves, their postal address, and to provide their contact details.
- Question 3:** If the applicant has employed a consulting engineer or an agent to manage the enquiry on their behalf, the agent's address and contact details should be recorded here.
- Question 4:** Please indicate whether it is the applicant or the agent who should receive future correspondence in relation to the enquiry.

Section B | Site details

- Question 5:** This is the address of the site requiring the water/wastewater service connection and for which this enquiry is being made.
- Question 6:** Please provide the Irish Grid co-ordinates of the proposed site. Irish grid positions on maps are expressed in two dimensions as Eastings (E or X) and Northings (N or Y) relative to an origin. You will find these coordinates on your Ordnance Survey map which is required to be submitted with an application.
- Question 7:** Please identify the Local Authority that is or will be dealing with your planning application, for example Cork City Council.
- Question 8:** Please indicate if planning permission has been granted for this application, and if so, please provide the planning permission reference number.
- Question 9:** Please specify the previous use of the site that is proposed to be developed, for example if greenfield, please state 'Agricultural'.
- Question 10:** Please specify the date that the development site was last occupied. Your answer will help us to determine the previous water usage/wastewater load of the development. If the site was previously greenfield, then this question does not need to be completed.
- Question 11:** Please provide details in relation to the ground conditions on the site if they are known to be poor, for example soil with a low bearing capacity, high water table, presence of peat, silt, etc. If a site investigation report is available, please include it with your enquiry.
- Question 12:** Please provide details in relation to contaminated land on your site (if any); this will determine what pipe material will be appropriate in the vicinity of the contaminated ground.
- Question 13:** Please indicate if the development is compliant with the local area development plan. You should contact your Local Authority in this regard and confirm same by ticking the appropriate box.

Section C | Water connection and demand details

- Question 14:** Please indicate if a water connection already exists for this site.
- Question 15:** Please indicate if this enquiry concerns an additional connection to one already installed on the site.
- Question 16:** Please indicate if you are proposing to upgrade the water connection to facilitate an increase in water demand. Irish Water will determine what impact this will have on our infrastructure.
- Question 17:** Please indicate if this enquiry concerns a new water connection for this site.
- Question 18:** Please indicate the approximate date that the proposed connection to the water infrastructure will be required.

- Question 19:** If the site was previously in use, please provide details of the pre-development peak hour and average hour water demand.
- Question 20:** Please provide calculations for domestic water demand and include your calculations on the calculation sheet provided. Demand rates (peak and average) are site specific. Average demand is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Water Infrastructure.
- Question 21:** If this connection enquiry concerns a business premises, please provide calculations for the water demand and include your calculations on the calculation sheet provided. Business premises include shops, offices, hotels, schools, etc. Demand rates (peak and average) are site specific. Average demand is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Water Infrastructure.
- Question 22:** If this connection enquiry is for an industrial premises, please calculate the water demand and include your calculations on the calculation sheet provided. Demand rates (peak and average) are site specific. Average demand is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). The peak demand for sizing of the pipe network will be as per the specific business production requirements. For design purposes, please refer to the Irish Water Codes of Practice for Water Infrastructure.
- Question 23:** Please specify the ground level at the location where connection to the public water mains will be made. This is required in order to determine if there is sufficient pressure in the existing water infrastructure to serve your proposed development. Levels should be quoted in metres relative to Malin Head Ordnance Datum.
- Question 24:** Please specify the highest finished floor level on-site. This is required in order to determine if there is sufficient pressure in the existing water infrastructure to serve your proposed development. Levels should be quoted in metres relative to Malin Head Ordnance Datum.
- Question 25:** If storage is required, water storage capacity of 24-hour water demand must usually be provided at the proposed site. In some cases, 24-hour storage capacity may not be required, for example 24-hour storage for a domestic house would be provided in an attic storage tank. Please calculate the 24-hour water storage requirements and include your calculations on the attached sheet provided. Please also confirm that on-site storage is being provided by ticking the appropriate box.
- Question 26:** The water supply system shall be designed and constructed to reliably convey the water flows that are required of the development including fire flow requirements by the Fire Authority. The Fire Authority will provide the requirement for fire flow rates that the water supply system will have to carry. Please note that while flows in excess of your required demand may be achieved in the Irish Water network and could be utilised in the event of a fire, Irish Water cannot guarantee a flow rate to meet your fire flow requirement. To guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development. Please include your calculations on the attached sheet provided, and further provide confirmation of the Fire Authority requirements.
- Question 27:** Please identify proposed additional water supply sources, that is, do you intend to connect to the public water mains or the public mains and supplement from other sources? If supplementing public water supply with a supply from another source, please provide details as to how the potable water supply is to be protected from cross contamination at the premises.

Section D | Wastewater connection and discharge details

- Question 28:** Please indicate if a wastewater connection to a public sewer already exists for this site.
- Question 29:** Please indicate if this enquiry relates to an additional wastewater connection to one already installed.
- Question 30:** Please indicate if you are proposing to upgrade the wastewater connection to facilitate an increased discharge. Irish Water will determine what impact this will have on our infrastructure.
- Question 31:** Please indicate if this enquiry relates to a new wastewater connection for this site.
- Question 32:** Please specify the approximate date that the proposed connection to the wastewater infrastructure will be required.
- Question 33:** If the site was previously in use, please provide details of the pre-development peak and average wastewater discharge.

- Question 34:** Please provide calculations for domestic wastewater discharge and include your calculations on the attached sheet provided. Discharge rates (peak and average) are site specific. Average discharge is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Wastewater Infrastructure.
- Question 35:** If this enquiry relates to a business premises, please provide calculations for the wastewater discharge and include your calculations on the attached sheet provided. Business premises include shops, offices, hotels, schools, etc. Discharge rates (peak and average) are site specific. Average discharge is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). For design purposes, please refer to the Irish Water Codes of Practice for Wastewater Infrastructure.
- Question 36:** If this enquiry relates to an industrial premises, please provide calculations for the wastewater discharge and include your calculations on the calculation sheet provided. Discharge rates (peak and average) are site specific. Average discharge is the total daily volume divided by a 24-hour time period and expressed in litres per second (l/s). The peak discharge for sizing of the pipe network will be as per the specific business production requirements. For design purposes, please refer to the Irish Water Codes of Practice for Wastewater Infrastructure.
- Question 37:** Please specify the maximum and average concentrations and the maximum daily load of each of the wastewater characteristics listed in the wastewater organic load table (if not domestic effluent), and also specify if any other significant concentrations are expected in the effluent. Please complete the table and provide additional supporting documentation if relevant. Note that the concentration shall be in mg/l and the load shall be in kg/day. Note that for business premises (shops, offices, schools, hotels, etc.) for which only domestic effluent will be discharged (excluding discharge from canteens/restaurants which would require a Trade Effluent Discharge licence), there is no need to complete this question.
- Question 38:** In exceptional circumstances, such as brownfield sites, where the only practical outlet for storm/surface water is to a combined sewer, Irish Water will consider permitting a restricted attenuated flow to the combined sewer. Storm/surface water will only be accepted from brownfield sites that already have a storm/surface water connection to a combined sewer and the applicant must demonstrate how the storm/surface water flow from the proposed site is minimised using sustainable urban drainage system (SUDS). This type of connection will only be considered on a case by case basis. Please advise if the proposed development intends discharging surface water to the combined wastewater collection system. If so, please submit detailed calculations in relation to attenuation volumes, peak discharges and total discharge volumes.
- Question 39:** Please specify if the development needs to pump its wastewater discharge to gain access to Irish Water infrastructure.
- Question 40:** Please specify the ground level at the location where connection to the public sewer will be made. This is required to determine if the development can be connected to the public sewer via gravity discharge. Levels should be quoted in metres relative to Malin Head Ordnance Datum.
- Question 41:** Please specify the lowest floor level of the proposed development. This is required in order to determine if the development can be connected to the public sewer via gravity discharge. Levels should be quoted in metres relative to Malin Head Ordnance Datum.

Section E | Development details

- Question 42:** Please specify the number of different property/premises types by filling in the table provided.
- Question 43:** Please indicate the approximate commencement date of works on the development.
- Question 44:** Please indicate if a phased building approach is to be adopted when developing the site. If so, please provide details of the phase master-plan and the proposed variation in water demand/wastewater discharge as a result of the phasing of the development.

Section F | Supporting documentation

Please provide additional information as listed.

Section G | Declaration

Please review the declaration, sign, and return the completed application form to Irish Water by email or by post using the contact details provided in Section G.

A large, empty rectangular box with a thin black border, occupying most of the page. It is intended for the user to write their notes.

A large, empty rectangular box with a thin black border, occupying most of the page. It is intended for the user to write their notes.

APPENDIX D
SURFACE WATER CALCULATIONS

		INPUT		
Total Area to be Drained		13.772	xref	
Impermeability Factor		0.35		
Storm Return Period	T	100	Yrs	
Allowable Discharge per hectare		4.11	l/s	
Time of Concentration	TC	5.00	min	
2 Day M5 (mm) =		123.90	mm	
Ratio 60 Minute M5/2 Day M5	r	0.27		
Impermeable Area		4820.2	Sq m	
Allowable Discharge	P	0.34	Cu m/min	
60 Minute M5		33.45	mm	

ROUGHAN & O'DONOVAN
Consulting Engineers

SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5 - 60 / (48 * r))$ $Cr = J0 + J1 * (M5 - D) + J2 * (M5 - D)^2$
 $X = LN(721 / (1 + 15 * D))$
 $Y = LN(48 * r / 1.06)$ $LN((M5 - D) / M5 - D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721 / 16)$
 $LN(M5 - D) = LN(D) + W + (X * Y) / Z$

Project No.:	16.146
Project:	Farrankelly_Zone A
Date:	11-Jun-2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	403.732	24.224	69.98
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	352.006	21.120	102.23
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	311.730	18.704	126.88
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	264.385	15.863	153.57
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	230.611	13.837	173.80
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	205.592	12.336	190.28
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	180.642	10.839	208.33
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	157.834	9.470	226.62
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	140.933	8.456	241.86
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	108.600	6.516	276.33
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	89.776	5.387	301.23
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	77.270	4.636	320.67
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	68.272	4.096	336.55
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	61.444	3.687	349.90
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	56.060	3.364	361.35
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	51.690	3.101	371.33
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	48.063	2.884	380.13
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	44.997	2.700	387.94
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	42.362	2.542	394.91
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	34.681	2.081	416.47
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	29.662	1.780	430.65
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	26.088	1.565	439.91
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	23.396	1.404	445.64
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	21.283	1.277	448.69
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	19.575	1.175	449.63
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	18.161	1.090	448.87
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	16.969	1.018	446.69
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	15.948	0.957	443.33
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	15.062	0.904	438.94
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	14.285	0.857	433.67
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	13.598	0.816	427.63
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	12.984	0.779	420.91
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	12.433	0.746	413.58
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	11.935	0.716	405.70
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	11.482	0.689	397.33
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	11.068	0.664	388.52
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	10.688	0.641	379.30

MAXIMUM STORAGE REQUIRED (Cu. M) = 449.63

		INPUT		
Total Area to be Drained		24.500	xref	
Impermeability Factor		0.35		
Storm Return Period	T	100	Yrs	
Allowable Discharge per hectare		3.85	l/s	
Time of Concentration	TC	5.00	min	
2 Day M5 (mm) =		123.90	mm	
Ratio 60 Minute M5/2 Day M5	r	0.27		
Impermeable Area		8575	Sq m	
Allowable Discharge	P	0.57	Cu m/min	
60 Minute M5		33.45	mm	

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SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5-60/(48*r))$ $Cr = J0 + J1 * (M5-D) + J2 * (M5-D)^2$
 $X = LN(721/(1 + 15 * D))$
 $Y = LN(48 * r/1.06)$ $LN((M5-D)/M5-D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721/16)$
 $LN(M5-D) = LN(D) + W + (X * Y)/Z$

Project No.:	16.146
Project:	Farrankelly_Zone B
Date:	11-Jun-2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min Q	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	718.227	43.094	124.79
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	626.209	37.573	182.25
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	554.559	33.274	226.17
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	470.333	28.220	273.77
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	410.250	24.615	309.87
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	365.742	21.945	339.30
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	321.358	19.281	371.56
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	280.782	16.847	404.29
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	250.715	15.043	431.59
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	193.196	11.592	493.47
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	159.710	9.583	538.33
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	137.461	8.248	573.49
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	121.454	7.287	602.31
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	109.307	6.558	626.62
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	99.729	5.984	647.58
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	91.956	5.517	665.90
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	85.503	5.130	682.11
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	80.048	4.803	696.59
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	75.361	4.522	709.56
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	61.696	3.702	750.19
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	52.767	3.166	777.70
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	46.410	2.785	796.46
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	41.620	2.497	808.94
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	37.862	2.272	816.65
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	34.824	2.089	820.61
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	32.309	1.939	821.53
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	30.187	1.811	819.95
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	28.371	1.702	816.24
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	26.795	1.608	810.73
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	25.413	1.525	803.64
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	24.190	1.451	795.18
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	23.099	1.386	785.50
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	22.118	1.327	774.75
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	21.232	1.274	763.02
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	20.426	1.226	750.42
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	19.689	1.181	737.03
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	19.014	1.141	722.91

MAXIMUM STORAGE REQUIRED (Cu. M) = 821.53

		INPUT		
Total Area to be Drained		30.000	xref	
Impermeability Factor		0.40		
Storm Return Period	T	100	Yrs	
Allowable Discharge per hectare		3.77	l/s	
Time of Concentration	TC	5.00	min	
2 Day M5 (mm) =		123.90	mm	
Ratio 60 Minute M5/2 Day M5	r	0.27		
Impermeable Area		12000	Sq m	
Allowable Discharge	P	0.68	Cu m/min	
60 Minute M5		33.45	mm	

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SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5-60/(48*r))$ $Cr = J0 + J1 * (M5-D) + J2 * (M5-D)^2$
 $X = LN(721/(1 + 15 * D))$
 $Y = LN(48 * r/1.06)$ $LN((MT-D)/M5-D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721/16)$
 $LN(M5-D) = LN(D) + W + (X * Y)/Z$

Project No.:	16.146
Project:	Farrankelly_Zone C
Date:	11-Jun-2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	1005.099	60.306	175.53
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	876.328	52.580	256.16
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	776.059	46.564	317.85
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	658.192	39.492	384.79
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	574.111	34.447	435.66
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	511.825	30.710	477.18
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	449.713	26.983	522.78
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	392.931	23.576	569.14
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	350.855	21.051	607.90
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	270.361	16.222	696.19
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	223.500	13.410	760.66
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	192.365	11.542	811.55
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	169.965	10.198	853.57
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	152.966	9.178	889.29
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	139.563	8.374	920.30
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	128.685	7.721	947.64
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	119.654	7.179	972.02
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	112.020	6.721	993.98
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	105.462	6.328	1013.81
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	86.338	5.180	1077.46
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	73.843	4.431	1122.72
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	64.947	3.897	1155.76
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	58.244	3.495	1179.99
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	52.985	3.179	1197.56
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	48.733	2.924	1209.89
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	45.213	2.713	1217.97
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	42.245	2.535	1222.53
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	39.702	2.382	1224.13
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	37.497	2.250	1223.19
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	35.563	2.134	1220.06
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	33.852	2.031	1215.00
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	32.325	1.939	1208.25
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	30.953	1.857	1199.98
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	29.712	1.783	1190.36
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	28.584	1.715	1179.51
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	27.554	1.653	1167.55
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	26.608	1.596	1154.58

MAXIMUM STORAGE REQUIRED (Cu. M) = 1224.13

		INPUT		
Total Area to be Drained		10.000	xref	
Impermeability Factor		0.34		
Storm Return Period	T	100	Yrs	
Allowable Discharge per hectare		4.25	l/s	
Time of Concentration	TC	5.00	min	
2 Day M5 (mm) =		123.90	mm	
Ratio 60 Minute M5/2 Day M5	r	0.27		
Impermeable Area		3400	Sq m	
Allowable Discharge	P	0.26	Cu m/min	
60 Minute M5		33.45	mm	

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SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5-60/(48*r))$ $Cr = J0 + J1 * (M5-D) + J2 * (M5-D)^2$
 $X = LN(721/(1 + 15 * D))$
 $Y = LN(48 * r/1.06)$ $LN((MT-D)/M5-D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721/16)$
 $LN(M5-D) = LN(D) + W + (X * Y)/Z$

Project No.:	16.146
Project:	Farrankelly_Zone D
Date:	30/08/2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	284.778	17.087	49.24
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	248.293	14.898	71.96
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	219.883	13.193	89.32
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	186.488	11.189	108.10
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	162.665	9.760	122.32
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	145.017	8.701	133.90
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	127.419	7.645	146.57
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	111.330	6.680	159.39
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	99.409	5.965	170.07
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	76.602	4.596	194.15
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	63.325	3.800	211.48
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	54.503	3.270	224.96
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	48.157	2.889	235.93
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	43.340	2.600	245.12
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	39.543	2.373	252.97
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	36.461	2.188	259.78
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	33.902	2.034	265.75
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	31.739	1.904	271.04
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	29.881	1.793	275.72
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	24.462	1.468	290.01
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	20.922	1.255	299.08
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	18.402	1.104	304.70
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	16.502	0.990	307.81
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	15.012	0.901	309.04
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	13.808	0.828	308.78
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	12.810	0.769	307.32
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	11.969	0.718	304.86
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	11.249	0.675	301.56
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	10.624	0.637	297.55
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	10.076	0.605	292.91
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	9.591	0.575	287.72
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	9.159	0.550	282.06
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	8.770	0.526	275.96
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	8.418	0.505	269.48
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	8.099	0.486	262.66
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	7.807	0.468	255.52
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	7.539	0.452	248.09

MAXIMUM STORAGE REQUIRED (Cu. M) = 309.04

		INPUT		
Total Area to be Drained		29.533	xref	
Impermeability Factor		0.40		
Storm Return Period	T	100	Yrs	
Allowable Discharge per hectare		3.8	l/s	
Time of Concentration	TC	5.00	min	
2 Day M5 (mm) =		123.90	mm	
Ratio 60 Minute M5/2 Day M5	r	0.27		
Impermeable Area		11813.2	Sq m	
Allowable Discharge	P	0.67	Cu m/min	
60 Minute M5		33.45	mm	

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SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5-60/(48*r))$ $Cr = J0 + J1 * (M5-D) + J2 * (M5-D)^2$
 $X = LN(721/(1 + 15 * D))$
 $Y = LN(48 * r/1.06)$ $LN((MT-D)/M5-D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721/16)$
 $LN(M5-D) = LN(D) + W + (X * Y)/Z$

Project No.:	16.146
Project:	Farrankelly_Zone E
Date:	11-Jun-2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	989.453	59.367	172.75
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	862.687	51.761	252.12
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	763.978	45.839	312.84
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	647.946	38.877	378.73
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	565.174	33.910	428.78
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	503.858	30.231	469.64
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	442.713	26.563	514.51
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	386.814	23.209	560.12
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	345.394	20.724	598.25
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	266.153	15.969	685.09
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	220.021	13.201	748.48
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	189.370	11.362	798.50
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	167.319	10.039	839.78
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	150.585	9.035	874.87
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	137.390	8.243	905.32
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	126.681	7.601	932.15
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	117.791	7.067	956.07
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	110.276	6.617	977.61
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	103.820	6.229	997.05
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	84.994	5.100	1059.39
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	72.694	4.362	1103.63
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	63.936	3.836	1135.84
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	57.337	3.440	1159.38
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	52.160	3.130	1176.36
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	47.974	2.878	1188.17
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	44.509	2.671	1195.80
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	41.587	2.495	1199.98
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	39.084	2.345	1201.23
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	36.913	2.215	1199.99
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	35.010	2.101	1196.59
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	33.325	1.999	1191.29
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	31.822	1.909	1184.33
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	30.471	1.828	1175.87
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	29.250	1.755	1166.08
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	28.139	1.688	1155.08
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	27.125	1.627	1142.99
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	26.194	1.572	1129.91

MAXIMUM STORAGE REQUIRED (Cu. M) = 1201.23

INPUT			
Total Area to be Drained	35.000	xref	
Impermeability Factor	0.39		
Storm Return Period	100	Yrs	
Allowable Discharge per hectare	3.71	l/s	
Time of Concentration	5.00	min	
2 Day M5 (mm) =	123.90	mm	
Ratio 60 Minute M5/2 Day M5	0.27		
Impermeable Area	13650	Sq m	
Allowable Discharge	0.78	Cu m/min	
60 Minute M5	33.45	mm	

ROUGHAN & O'DONOVAN
Consulting Engineers

SURFACE WATER ATTENUATION & STORAGE
Version 1.02

Storage C = Q*TS - P*(TS + TC) + P^2*TC/Q

$W = LN(1.06 * M5-60/(48*rr))$ $Cr = J0 + J1 * (M5-D) + J2 * (M5-D)^2$
 $X = LN(721/(1 + 15 * D))$
 $Y = LN(48 * r/1.06)$ $LN((MT-D)/M5-D) = Cr * (LN(T) - 1.5)$
 $Z = LN(721/16)$
 $LN(M5-D) = LN(D) + W + (X * Y)/Z$

Project No.:	16.146
Project:	Farrankelly_Zone F
Date:	11-Jun-2018
Designer:	MS

Time of Storm TS Minutes	Time of Storm D Hours	Time of Concentration TC Minutes	W	X	Y	Z	LN(D)	LN(M5-D)	M5-D mm	Rainfall Intensity mm/hr	Cr				M100-D mm	Rainfall Intensity +10% mm/hr	Discharge to Storage l/s	Discharge to Storage Cu.m/min	Storage Required C Cu. m
											J0	J1	J2	Cr					
3	0.050	5.0	1.007	6.021	2.504	3.808	-2.996	1.969	7.166	143.317	0.165	0.008	-0.000305	0.209	13.706	301.530	1143.300	68.598	199.61
5	0.083	5.0	1.007	5.770	2.504	3.808	-2.485	2.315	10.124	121.490	0.165	0.008	-0.000305	0.218	19.917	262.898	996.823	59.809	291.31
7	0.117	5.0	1.007	5.569	2.504	3.808	-2.148	2.519	12.422	106.474	0.165	0.008	-0.000305	0.221	24.693	232.818	882.767	52.966	361.47
10	0.167	5.0	1.007	5.328	2.504	3.808	-1.792	2.718	15.144	90.863	0.235	-0.001	-0.000017	0.219	29.918	197.458	748.694	44.922	437.60
13	0.217	5.0	1.007	5.134	2.504	3.808	-1.529	2.852	17.328	79.974	0.235	-0.001	-0.000017	0.216	33.925	172.233	653.051	39.183	495.43
16	0.267	5.0	1.007	4.971	2.504	3.808	-1.322	2.953	19.165	71.870	0.235	-0.001	-0.000017	0.214	37.224	153.548	582.201	34.932	542.64
20	0.333	5.0	1.007	4.789	2.504	3.808	-1.099	3.056	21.250	63.751	0.235	-0.001	-0.000017	0.211	40.883	134.914	511.549	30.693	594.48
25	0.417	5.0	1.007	4.600	2.504	3.808	-0.875	3.155	23.455	56.293	0.235	-0.001	-0.000017	0.207	44.651	117.879	446.959	26.818	647.18
30	0.500	5.0	1.007	4.441	2.504	3.808	-0.693	3.233	25.352	50.703	0.250	-0.002	0.000012	0.205	47.844	105.257	399.098	23.946	691.23
45	0.750	5.0	1.007	4.075	2.504	3.808	-0.288	3.398	29.905	39.874	0.250	-0.002	0.000012	0.198	55.301	81.108	307.536	18.452	791.56
60	1.000	5.0	1.007	3.808	2.504	3.808	0.000	3.510	33.453	33.453	0.250	-0.002	0.000012	0.193	60.955	67.050	254.232	15.254	864.79
75	1.250	5.0	1.007	3.597	2.504	3.808	0.223	3.595	36.410	29.128	0.250	-0.002	0.000012	0.189	65.579	57.709	218.815	13.129	922.57
90	1.500	5.0	1.007	3.424	2.504	3.808	0.405	3.663	38.973	25.982	0.250	-0.002	0.000012	0.186	69.531	50.989	193.335	11.600	970.25
105	1.750	5.0	1.007	3.276	2.504	3.808	0.560	3.720	41.252	23.572	0.250	-0.002	0.000012	0.184	73.007	45.890	173.999	10.440	1010.78
120	2.000	5.0	1.007	3.147	2.504	3.808	0.693	3.768	43.313	21.657	0.250	-0.002	0.000012	0.182	76.125	41.869	158.753	9.525	1045.95
135	2.250	5.0	1.007	3.032	2.504	3.808	0.811	3.811	45.203	20.090	0.250	-0.002	0.000012	0.180	78.966	38.605	146.379	8.783	1076.94
150	2.500	5.0	1.007	2.930	2.504	3.808	0.916	3.849	46.953	18.781	0.250	-0.002	0.000012	0.178	81.582	35.896	136.106	8.166	1104.57
165	2.750	5.0	1.007	2.837	2.504	3.808	1.012	3.883	48.587	17.668	0.250	-0.002	0.000012	0.176	84.015	33.606	127.423	7.645	1129.43
180	3.000	5.0	1.007	2.752	2.504	3.808	1.099	3.914	50.122	16.707	0.227	-0.001	0.000003	0.175	86.287	31.639	119.963	7.198	1151.89
240	4.000	5.0	1.007	2.470	2.504	3.808	1.386	4.017	55.511	13.878	0.227	-0.001	0.000003	0.170	94.187	25.901	98.210	5.893	1223.86
300	5.000	5.0	1.007	2.250	2.504	3.808	1.609	4.095	60.050	12.010	0.227	-0.001	0.000003	0.166	100.695	22.153	83.997	5.040	1274.92
360	6.000	5.0	1.007	2.070	2.504	3.808	1.792	4.159	64.012	10.669	0.227	-0.001	0.000003	0.163	106.277	19.484	73.877	4.433	1312.06
420	7.000	5.0	1.007	1.917	2.504	3.808	1.946	4.213	67.553	9.650	0.227	-0.001	0.000003	0.160	111.193	17.473	66.252	3.975	1339.20
480	8.000	5.0	1.007	1.785	2.504	3.808	2.079	4.259	70.770	8.846	0.227	-0.001	0.000003	0.158	115.603	15.895	60.270	3.616	1358.76
540	9.000	5.0	1.007	1.668	2.504	3.808	2.197	4.300	73.728	8.192	0.227	-0.001	0.000003	0.156	119.617	14.620	55.433	3.326	1372.35
600	10.000	5.0	1.007	1.563	2.504	3.808	2.303	4.337	76.474	7.647	0.227	-0.001	0.000003	0.154	123.308	13.564	51.430	3.086	1381.10
660	11.000	5.0	1.007	1.469	2.504	3.808	2.398	4.370	79.044	7.186	0.227	-0.001	0.000003	0.152	126.734	12.673	48.053	2.883	1385.86
720	12.000	5.0	1.007	1.382	2.504	3.808	2.485	4.400	81.462	6.789	0.227	-0.001	0.000003	0.150	129.935	11.911	45.162	2.710	1387.25
780	13.000	5.0	1.007	1.303	2.504	3.808	2.565	4.428	83.750	6.442	0.227	-0.001	0.000003	0.149	132.945	11.249	42.653	2.559	1385.76
840	14.000	5.0	1.007	1.229	2.504	3.808	2.639	4.453	85.924	6.137	0.227	-0.001	0.000003	0.147	135.788	10.669	40.453	2.427	1381.76
900	15.000	5.0	1.007	1.160	2.504	3.808	2.708	4.477	87.997	5.866	0.227	-0.001	0.000003	0.146	138.485	10.156	38.507	2.310	1375.58
960	16.000	5.0	1.007	1.096	2.504	3.808	2.773	4.500	89.980	5.624	0.227	-0.001	0.000003	0.145	141.054	9.697	36.769	2.206	1367.47
1020	17.000	5.0	1.007	1.035	2.504	3.808	2.833	4.521	91.883	5.405	0.227	-0.001	0.000003	0.144	143.508	9.286	35.209	2.113	1357.63
1080	18.000	5.0	1.007	0.979	2.504	3.808	2.890	4.540	93.713	5.206	0.227	-0.001	0.000003	0.142	145.860	8.914	33.798	2.028	1346.25
1140	19.000	5.0	1.007	0.925	2.504	3.808	2.944	4.559	95.477	5.025	0.227	-0.001	0.000003	0.141	148.119	8.575	32.515	1.951	1333.49
1200	20.000	5.0	1.007	0.874	2.504	3.808	2.996	4.577	97.181	4.859	0.227	-0.001	0.000003	0.140	150.293	8.266	31.342	1.881	1319.45
1260	21.000	5.0	1.007	0.825	2.504	3.808	3.045	4.593	98.829	4.706	0.227	-0.001	0.000003	0.139	152.392	7.982	30.267	1.816	1304.27

MAXIMUM STORAGE REQUIRED (Cu. M) = 1387.25

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 329166, Northing: 210081,

DURATION	Interval		Years													
	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.0,	4.2,	4.8,	5.8,	6.4,	6.9,	8.6,	10.4,	11.7,	13.4,	14.9,	16.1,	17.9,	19.3,	20.5,	N/A,
10 mins	4.1,	5.8,	6.7,	8.0,	9.0,	9.7,	11.9,	14.5,	16.2,	18.6,	20.8,	22.4,	25.0,	26.9,	28.6,	N/A,
15 mins	4.9,	6.8,	7.9,	9.5,	10.5,	11.4,	14.1,	17.1,	19.1,	21.9,	24.4,	26.4,	29.4,	31.7,	33.6,	N/A,
30 mins	6.4,	8.9,	10.2,	12.2,	13.5,	14.5,	17.8,	21.5,	23.9,	27.3,	30.3,	32.6,	36.2,	38.9,	41.2,	N/A,
1 hours	8.5,	11.6,	13.3,	15.7,	17.3,	18.6,	22.6,	27.1,	30.0,	34.0,	37.6,	40.3,	44.5,	47.7,	50.4,	N/A,
2 hours	11.3,	15.2,	17.2,	20.2,	22.2,	23.7,	28.6,	34.0,	37.5,	42.4,	46.6,	49.9,	54.8,	58.6,	61.7,	N/A,
3 hours	13.3,	17.7,	20.0,	23.4,	25.7,	27.4,	32.9,	38.9,	42.8,	48.2,	52.9,	56.4,	61.9,	66.1,	69.5,	N/A,
4 hours	14.9,	19.8,	22.3,	26.0,	28.5,	30.3,	36.3,	42.8,	47.0,	52.8,	57.8,	61.6,	67.5,	71.9,	75.6,	N/A,
6 hours	17.5,	23.1,	26.0,	30.2,	32.9,	35.0,	41.7,	48.9,	53.6,	60.0,	65.6,	69.8,	76.2,	81.1,	85.1,	N/A,
9 hours	20.6,	27.0,	30.3,	35.0,	38.1,	40.4,	47.9,	56.0,	61.1,	68.2,	74.3,	79.0,	86.0,	91.4,	95.8,	N/A,
12 hours	23.2,	30.1,	33.7,	38.8,	42.2,	44.8,	52.8,	61.6,	67.1,	74.7,	81.3,	86.3,	93.8,	99.5,	104.2,	N/A,
18 hours	27.3,	35.2,	39.2,	45.0,	48.8,	51.7,	60.7,	70.4,	76.6,	85.0,	92.2,	97.7,	105.9,	112.2,	117.3,	N/A,
24 hours	30.6,	39.3,	43.7,	50.0,	54.1,	57.2,	67.0,	77.4,	84.0,	93.1,	100.8,	106.7,	115.5,	122.2,	127.6,	146.0,
2 days	39.3,	49.5,	54.6,	61.8,	66.4,	70.0,	80.9,	92.5,	99.8,	109.6,	118.0,	124.3,	133.8,	140.9,	146.7,	166.2,
3 days	46.5,	57.9,	63.5,	71.5,	76.6,	80.4,	92.4,	104.9,	112.7,	123.3,	132.3,	139.0,	149.0,	156.6,	162.7,	183.2,
4 days	52.8,	65.3,	71.4,	80.0,	85.5,	89.7,	102.4,	115.8,	124.2,	135.3,	144.8,	151.9,	162.5,	170.4,	176.8,	198.2,
6 days	64.2,	78.5,	85.4,	95.1,	101.3,	105.9,	120.2,	135.0,	144.2,	156.5,	166.8,	174.5,	186.0,	194.6,	201.5,	224.5,
8 days	74.5,	90.3,	97.9,	108.6,	115.4,	120.4,	135.9,	152.0,	161.9,	175.1,	186.2,	194.5,	206.7,	215.9,	223.2,	247.6,
10 days	84.0,	101.2,	109.5,	121.0,	128.3,	133.8,	150.4,	167.6,	178.1,	192.1,	203.9,	212.7,	225.7,	235.3,	243.0,	268.7,
12 days	93.0,	111.5,	120.4,	132.7,	140.5,	146.3,	163.9,	182.1,	193.3,	208.0,	220.5,	229.7,	243.3,	253.4,	261.5,	288.3,
16 days	110.0,	130.8,	140.7,	154.4,	163.1,	169.5,	189.1,	209.0,	221.3,	237.4,	251.0,	261.0,	275.7,	286.6,	295.4,	324.3,
20 days	125.9,	148.8,	159.7,	174.7,	184.2,	191.2,	212.3,	233.9,	247.1,	264.5,	279.0,	289.7,	305.5,	317.2,	326.5,	357.3,
25 days	144.9,	170.2,	182.2,	198.6,	209.0,	216.6,	239.7,	263.1,	277.3,	296.1,	311.7,	323.3,	340.2,	352.7,	362.7,	395.6,

NOTES:

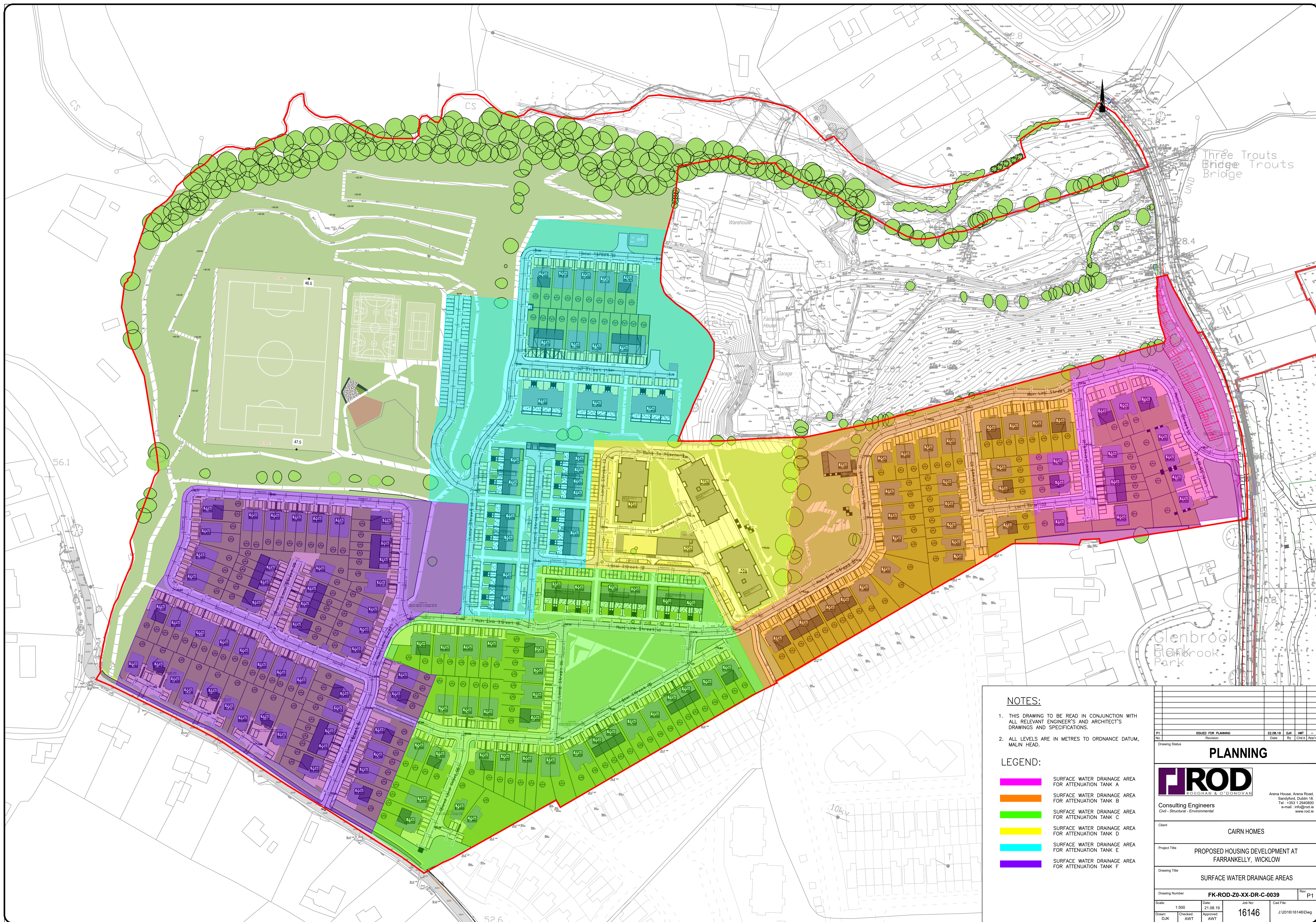
N/A Data not available

These values are derived from a Depth Duration Frequency (DDF) Model

For details refer to:

'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',

Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf



NOTES:

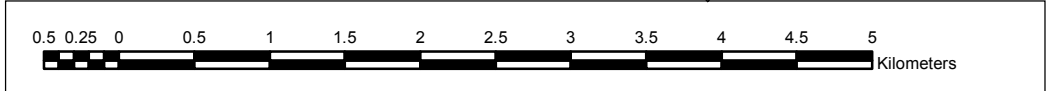
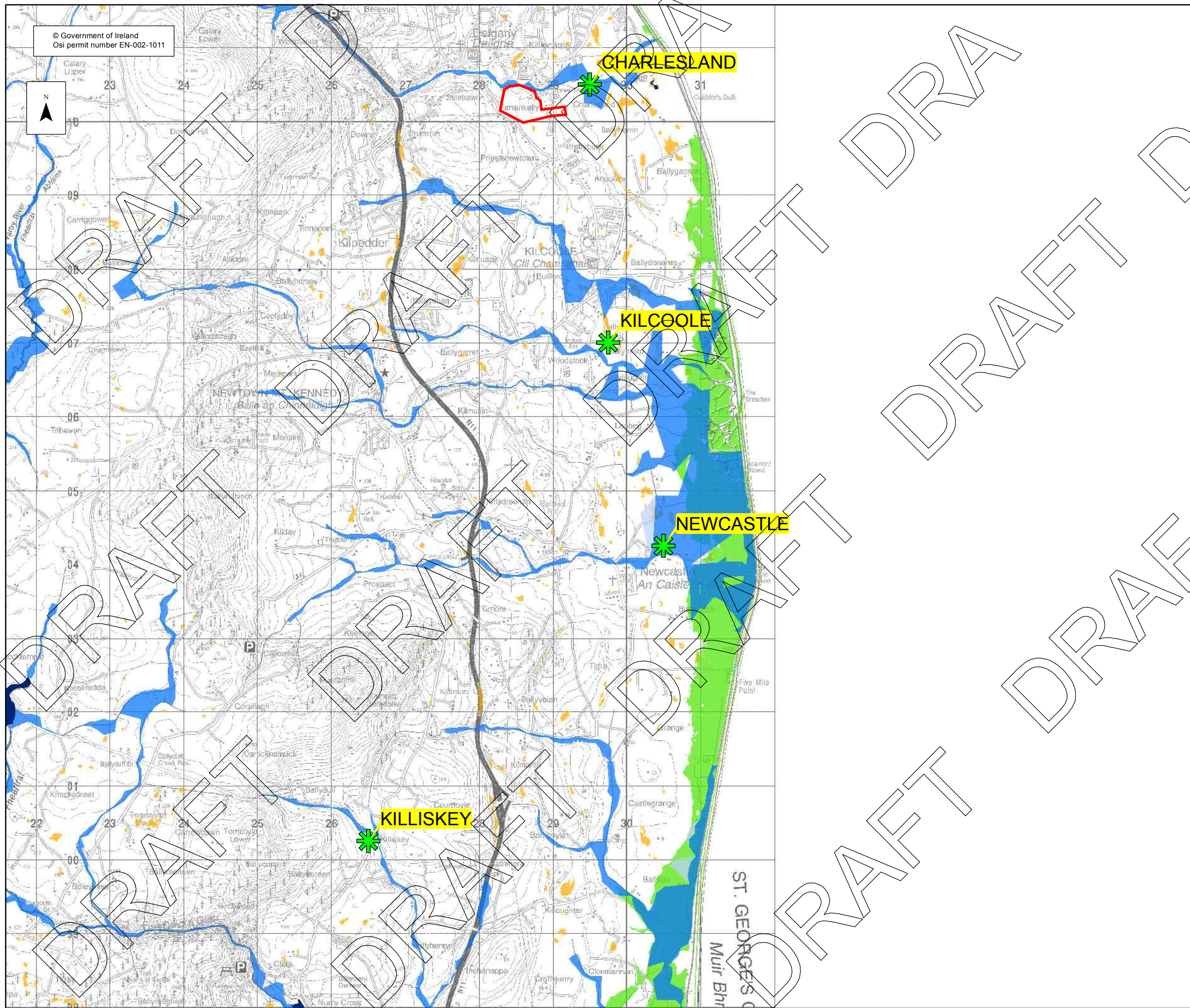
- THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND SPECIFICATIONS.
- ALL LEVELS ARE IN METRES TO ORDNANCE DATUM, MAIN HEAD.

LEGEND:

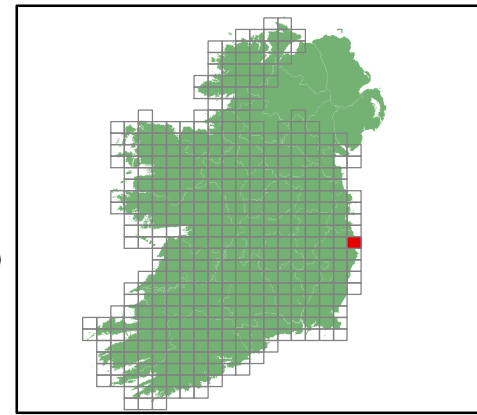
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK A
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK B
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK C
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK D
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK E
- SURFACE WATER DRAINAGE AREA FOR ATTENUATION TANK F

ISSUED FOR PLANNING		22.08.19	DJK	AWT
No.	Revision	Date	By	Check/ App'd
PLANNING				
PROD ROUGHAN & O'DONOVAN				
Consulting Engineers Civil - Structural - Environmental				
CAIRN HOMES				
Project Title PROPOSED HOUSING DEVELOPMENT AT FARRANKELLY, WICKLOW				
Drawing Title SURFACE WATER DRAINAGE AREAS				
Drawing Number FK-ROD-20-XX-DR-C-0039		Date 21.08.19		Rev P1
Scale 1:500	Checked DJK	Approved AWT	Job No. 16146	Cad File J:\2016\16146\DWG

APPENDIX E
OPW FLOOD RECORDS



Location Plan :



Legend:

- Flood Extents**
- Fluvial - Indicative 1% AEP (100-yr) Event
 - Fluvial - Extreme Event
 - Coastal - Indicative 0.5% AEP (200-yr) Event
 - Coastal - Extreme Event
 - Pluvial - Indicative 1% AEP (100-yr) Event
 - Pluvial - Extreme Event
 - Groundwater Flood Extents
 - Lakes / Turloughs
- PFRA Outcomes**
- ✱ Probable Area for Further Assesment
 - ✱ Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
 Jonathon Swift Street
 Trim
 Co Meath
 Ireland



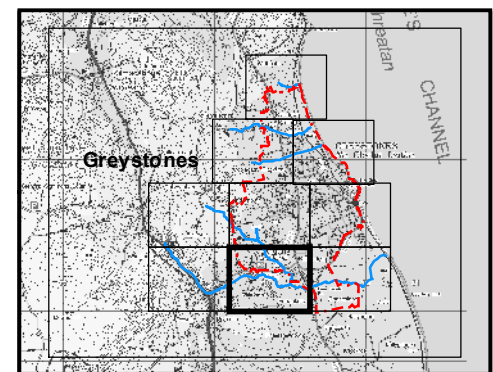
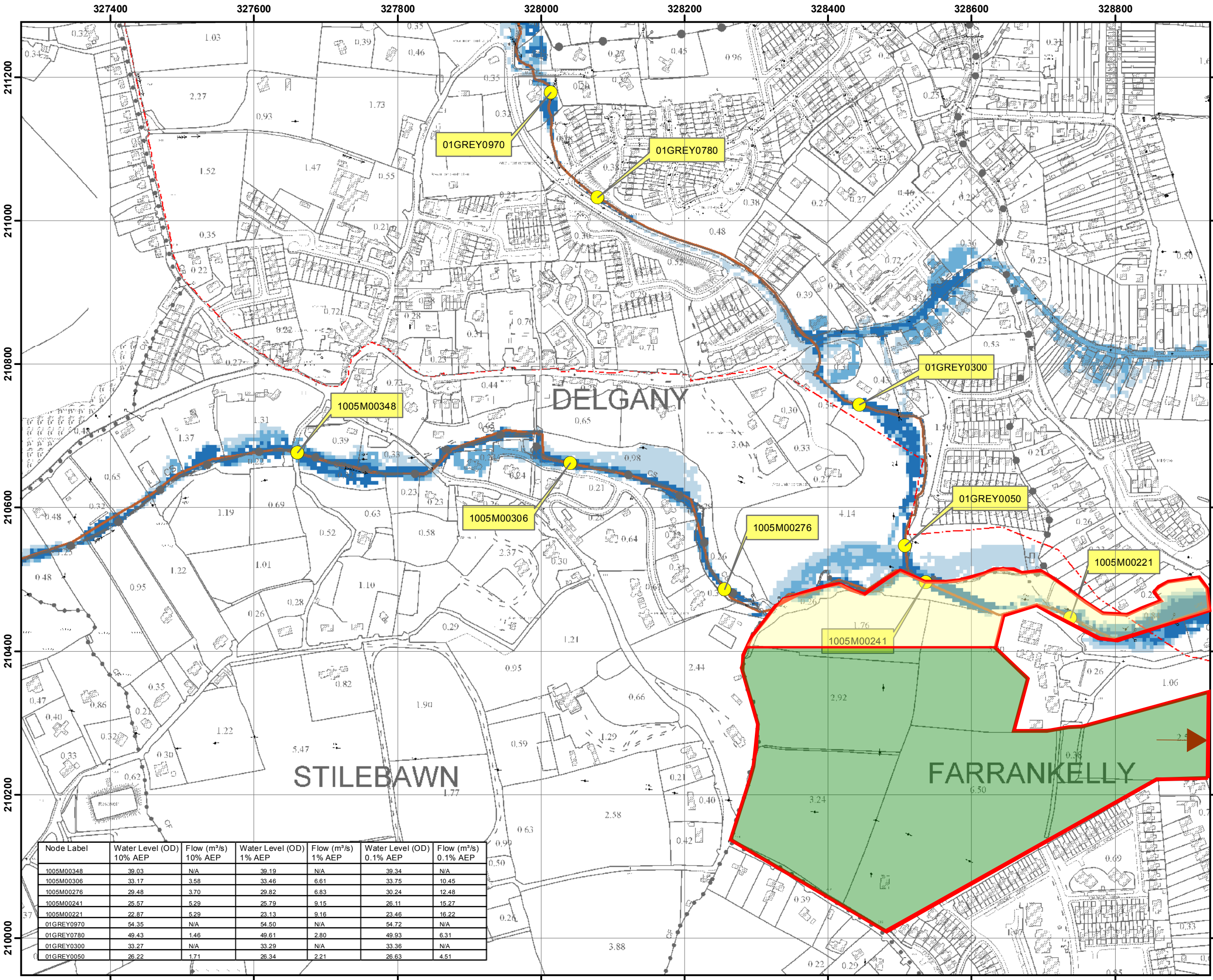
Project :
PRELIMINARY FLOOD RISK ASSESSMENT (PFRA)

Map :
PFRA Indicative extents and outcomes - Draft for Consultation

Figure By : PJW Date : July 2011
 Checked By : MA Date : July 2011

Figure No. :
2019 / MAP / 205 / A Revision
0

Drawing Scale : 1:50,000 Plot Scale : 1:1 @ A3



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

- Legend**
- 10% Fluvial AEP Event
 - 1% Fluvial AEP Event
 - 0.1% Fluvial AEP Event
 - Modelled River Centreline
 - AFA Extents
 - Embankment
 - Wall
 - Defended Area
 - 1% AEP Standard of Protection of Flood Defence (Walls / Embankments)
 - Node Point
 - Node ID Node Label

FINAL

REV:	NOTE:	DATE:
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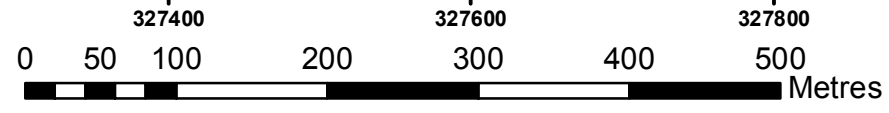


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Node Label	Water Level (OD)		Flow (m ³ /s)		Water Level (OD)		Flow (m ³ /s)	
	10% AEP	1% AEP	10% AEP	1% AEP	0.1% AEP	1% AEP	0.1% AEP	
1005M00348	39.03	N/A	39.19	N/A	39.34	N/A	N/A	
1005M00306	33.17	3.58	33.46	6.61	33.75	10.45		
1005M00276	29.48	3.70	29.82	6.83	30.24	12.48		
1005M00241	25.57	5.29	25.79	9.15	26.11	15.27		
1005M00221	22.87	5.29	23.13	9.16	23.46	16.22		
01GREY0970	54.35	N/A	54.50	N/A	54.72	N/A		
01GREY0780	49.43	1.46	49.61	2.80	49.93	6.31		
01GREY0300	33.27	N/A	33.29	N/A	33.36	N/A		
01GREY0050	26.22	1.71	26.34	2.21	26.63	4.51		



Map:
 Greystones Fluvial Flood Extents

Map Type: EXTENT

Source: FLUVIAL

Map Area: HPW

Scenario: CURRENT

Drawn By: F.M.C. **Date:** 15 December 2017

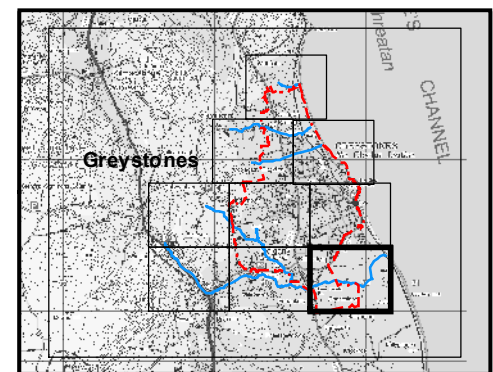
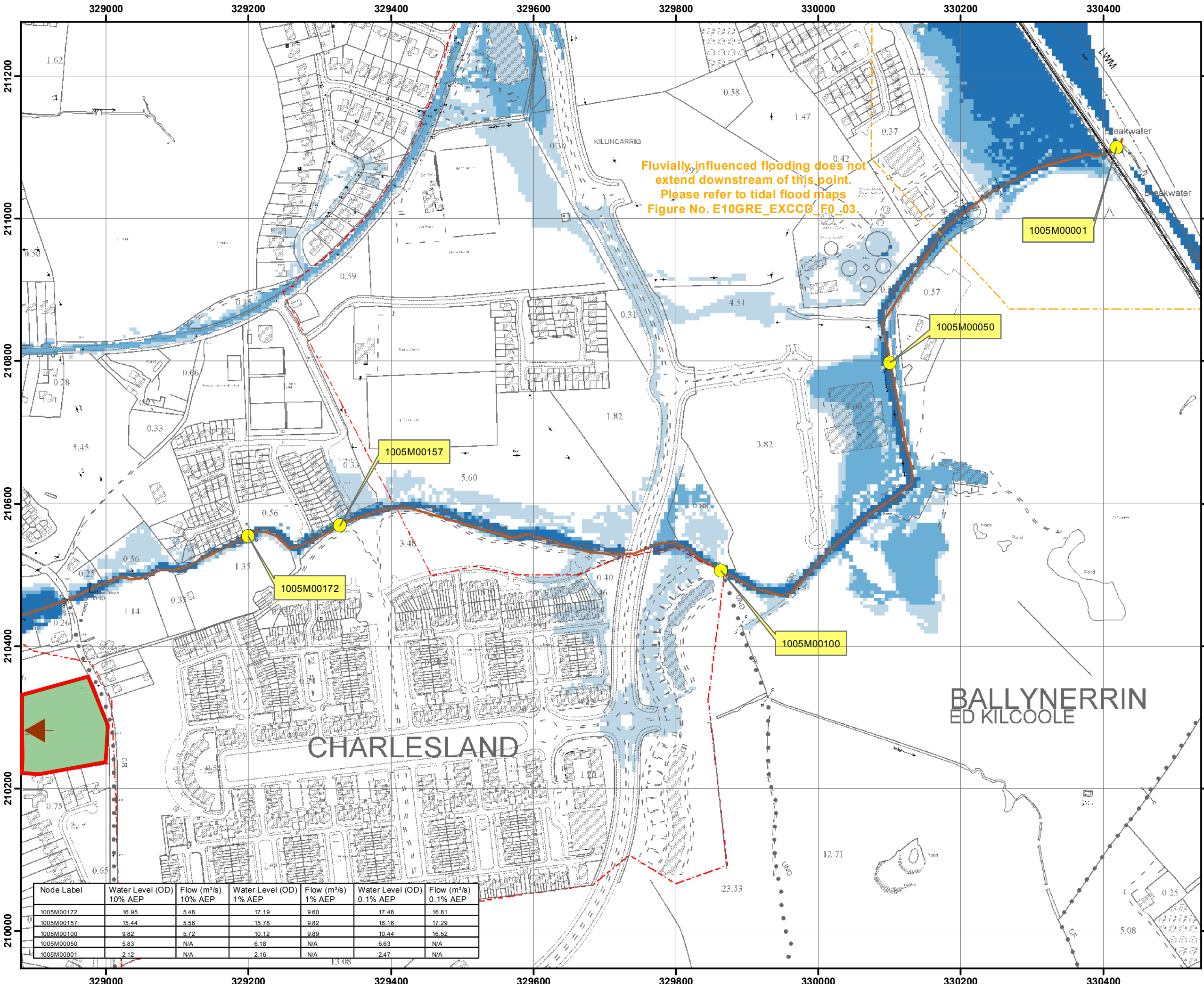
Checked By: J.D. **Date:** 15 December 2017

Approved By: S.P. **Date:** 15 December 2017

Drawing No.:
 E10GRE_EXFCD_F2_02

Map Series: Page 2 of 10

Drawing Scale: 1:5,000 @ A3



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

- Legend**
- 10% Fluvial AEP Event
 - 1% Fluvial AEP Event
 - 0.1% Fluvial AEP Event
 - Modelled River Centreline
 - AFA Extents
 - Embankment
 - Wall
 - Defended Area
 - 1% AEP Standard of Protection of Flood Defence (Walls / Embankments)
 - 0.1% AEP (Walls / Embankments)
 - Node Point
 - Node ID Node Label

FINAL

REV:	NOTE:	DATE:
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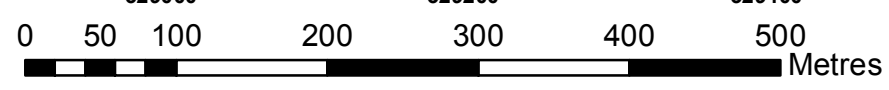
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 Co Meath

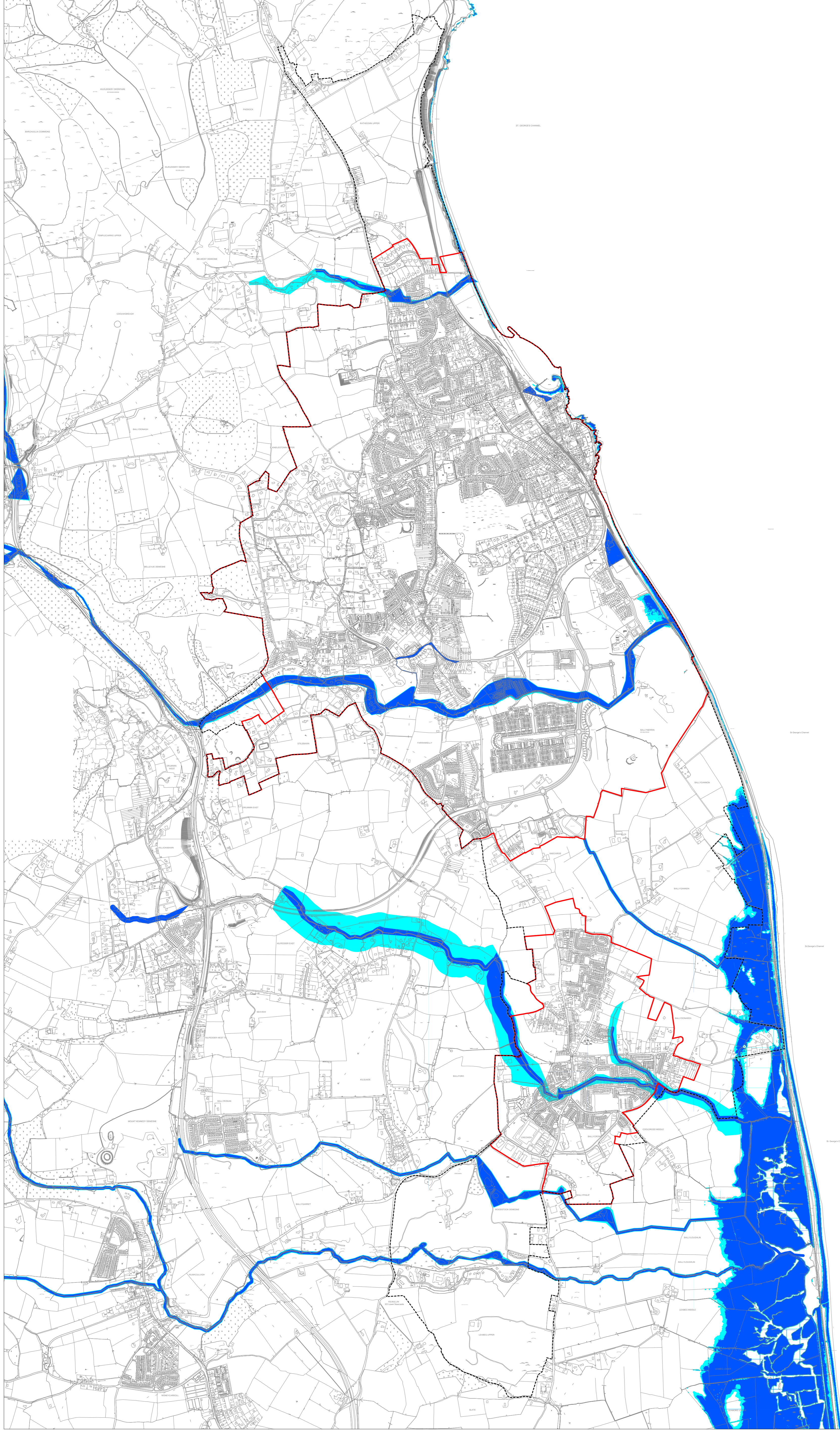
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Map:	
Greystones Fluvial Flood Extents	
Map Type: EXTENT	
Source: FLUVIAL	
Map Area: HPW	
Scenario: CURRENT	
Drawn By : F.M.C.	Date : 15 December 2017
Checked By : J.D.	Date : 15 December 2017
Approved By : S.P.	Date : 15 December 2017
Drawing No. :	
E10GRE_EXFCD_F2_03	
Map Series : Page 3 of 10	
Drawing Scale : 1:5,000 @ A3	

Node Label	Water Level (OD)		Flow (m³/s)		Water Level (OD)		Flow (m³/s)	
	10% AEP	0.1% AEP	10% AEP	0.1% AEP	1% AEP	0.1% AEP	1% AEP	0.1% AEP
1005M00172	16.95	17.19	5.48	9.60	17.19	9.60	17.46	16.81
1005M00157	15.44	15.78	5.56	9.82	15.78	9.82	16.16	17.29
1005M00100	9.82	10.12	5.72	9.89	10.12	9.89	10.44	16.52
1005M00050	5.83	6.18	N/A	N/A	6.18	N/A	6.63	N/A
1005M00001	2.12	2.16	N/A	N/A	2.16	N/A	2.47	N/A





Flood Zone A: High likelihood of flooding ■

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

Flood Zone B: Moderate likelihood of flooding ■

Where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)

Disclaimer

These Indicative Flood Zones are based on currently available information. All information may be substantially altered in light of future data and analysis. In particular, the assessment and mapping of areas of flood risk awaits the publication of the CFRAMS. Full Disclaimer is included in Section 3 of SFRA.

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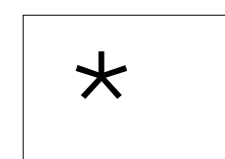


Indicative Flood Zones

Map C

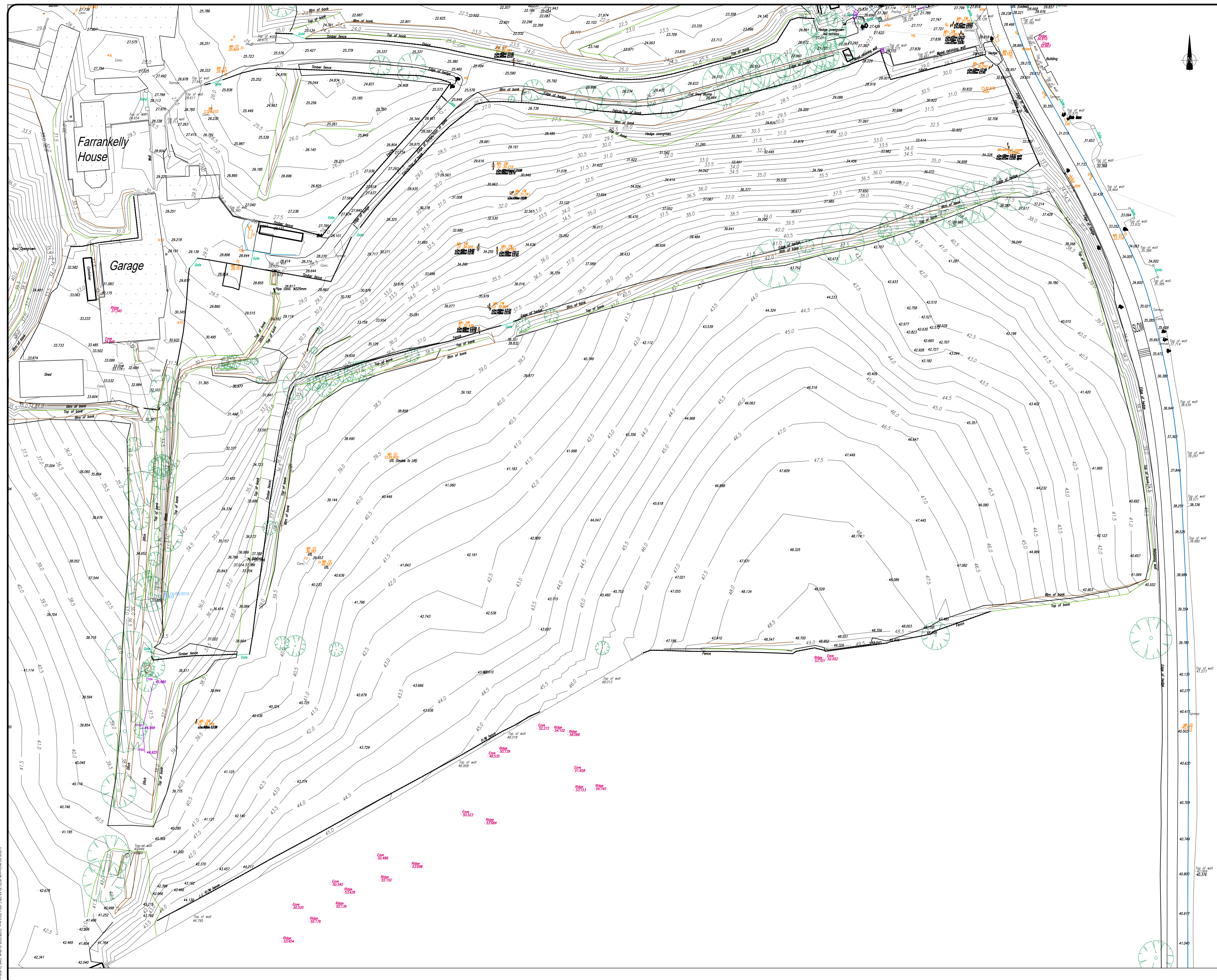
DRAFT GREYSTONES - DELGANY AND KILCOOLE LOCAL AREA PLAN (LAP) 2013-2019


Wicklow County Council
Planning Section
December 2012



Drawn by: AM
Checked by: AM
Scale: NTS

APPENDIX F
TOPOGRAPHY MAPPING



No.		Revision		Date	By	Chk'd	App'd
P1	ISSUED FOR INFORMATION			22.08.18	EK	AWT	-
Drawing Status							
PLANNING							
 FROD ROUGHAN & O'DONOVAN Consulting Engineers Civil - Structural - Environmental Arena House, Arena Road, Sandycove, Dublin 18. Tel: +353 1 2940500 e-mail: info@frod.ie www.frod.ie							
Client							
CAIRN HOMES							
Project Title							
PROPOSED HOUSING DEVELOPMENT AT FARRANKELLY, WICKLOW							
Drawing Title							
TOPOGRAPHY LAYOUT SHEET 1							
Drawing Number							Rev
FK-ROD-20-XX-DR-C-0011							P1
Scale:	1:500	Date:	AUG 19	Job No:	Cad File:		
Drawn:	EK	Checked:	AWT	Approved:	AWT		
16146				J:\2016\16146\DWG			

DO NOT SCALE USE FIGURED DIMENSIONS ONLY




No.		Revision		Date	By	Chk'd	App'd
P1		ISSUED FOR INFORMATION		22.08.18	EK	AWT	-
Drawing Status							
PLANNING							
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Client							
CAIRN HOMES							
Project Title							
PROPOSED HOUSING DEVELOPMENT AT FARRANKELLY, WICKLOW							
Drawing Title							
TOPOGRAPHY LAYOUT SHEET 2							
Drawing Number							
FK-ROD-Z0-XX-DR-C-0012							
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P1							



No.		Revision		Date	By	Chk'd	App'd
P1	ISSUED FOR INFORMATION		22.08.18	AWT	-	-	-
Drawing Status							
PLANNING							
FROD ROUGHAN & O'DONOVAN							
Consulting Engineers Civil - Structural - Environmental Arena House, Arena Road, Sandyford, Dublin 18. Tel: +353 1 9040500 e-mail: info@rod.ie www.rod.ie							
Client CAIRN HOMES							
Project Title PROPOSED HOUSING DEVELOPMENT AT FARRANKELLY, WICKLOW							
Drawing Title TOPOGRAPHY LAYOUT SHEET 3							
Drawing Number FK-ROD-Z0-XX-DR-C-0013 Rev: P1							
Scale:	1:500	Date:	AUG 18	Job No:	16146	Cad File:	J:\2016\16146\DWG
Drawn:	EK	Checked:	AWT	Approved:	AWT	16146	

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No.	Revision	Date	By	Chk'd	App'd
Drawing Status					
PLANNING					
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Client					
CAIRN HOMES					
Project Title					
PROPOSED HOUSING DEVELOPMENT AT FARRANKELLY, WICKLOW					
Drawing Title					
TOPOGRAPHY LAYOUT SHEET 4					
Drawing Number					
FK-ROD-20-XX-DR-C-0014					
Rev					
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