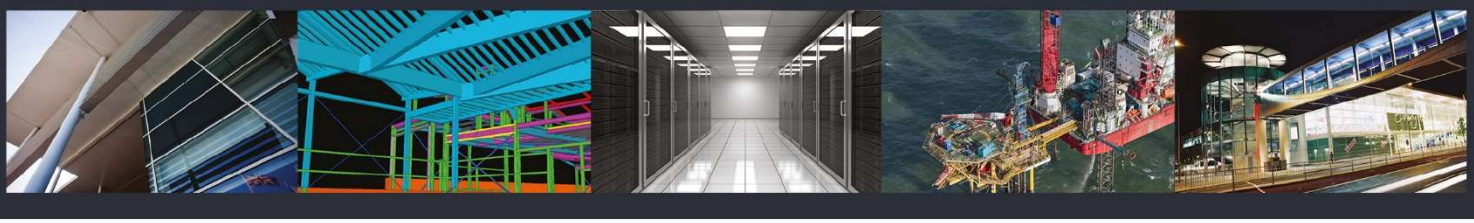
PINNACLE
CONSULTING ENGINEERS



Rycroft Homes Ltd.
Lands in the Townlands of Commons West, Boycetown & Kilcock, (adjacent to the existing Brayton Park Estate), Kilcock, Co. Kildare

November 2019

P180307

STRUCTURAL • CIVIL • DUE DILIGENCE • ENGINEERING MASTERPLANNING
FLOOD MANAGEMENT • INFRASTRUCTURE DESIGN
PRE-DEVELOPMENT ENGINEERING • BIM • TRANSPORTATION

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Reviewed by	J. Mayer		Director	06/09/2019
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REVISIONS

Revision By	Date	Context

VERSIONS

Number	By	Date	Context
1	S. O'Reilly	08/09/2018	ABP Pre-planning
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Google	

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Executive Summary

This report was prepared for An Bord Pleanala in connection with the planning application for a mixed use residential development and addresses the existing and proposed civil infrastructure, for the proposed development, located adjacent to the existing Brayton Park residential development in Kilcock, Co. Kildare.

Rycroft Homes Limited intends to apply to An Bord Pleanála for a 10 year planning permission for a Strategic Housing Development on lands at the townlands of Commons West, Boycetown and Kilcock, (all adjoining the existing Brayton Park Estate), Kilcock, Co. Kildare on a site of approximately 11.56 ha.

The site is generally bound by undeveloped agricultural land to the north west, to the north east by the Dublin-Sligo railway line, open space at Bawnogues/Commons West to the south west, the Brayton Park residential development to the east and the M4 to the west.

The development will consist of:

345 no. residential units (69 no. Duplex Type Units, 182 no. Houses and 94 no. Apartments) ranging from 2 to 5 storeys, a standalone creche facility (approximately 466.76 sqm) with an overall height of 2 storeys, an associated external play area (approximately 277.67 sqm), associated ancillary surface car parking spaces and bicycle parking spaces, a link street, internal roads, pedestrian paths, cycle paths, public and private open spaces.

The proposed housing mix is comprised of 13 no. 1 bed units, 136 no. 2 bed units, 158 no. 3 bed units and 38 no. 4 bed units.

Out of the 345 no. residential units, 35 no. units are put forward to meet the applicant's obligations under Part V of the Planning & Development Act 2000 (as amended).

Each residential unit has associated private open space, in the form of either gardens, terraces or balconies in addition to access to the proposed public open space (including 3 no. playground areas) with hard and soft landscaping treatment.

A total of 650 no. surface car parking spaces are provided for the residential development including visitor parking. 280 no. bicycle spaces are proposed for the proposed apartments and duplexes and bicycle spaces for the proposed houses are provided on curtilage. In addition, the crèche will be provided with 34 no. surface car parking spaces and 30 no. bicycle parking spaces.

The proposed development provides for 1 no. vehicular access and associated pedestrian and cycle paths via a new link street connecting from the Brayton Park Road and 1 no. vehicular access and associated pedestrian path providing a link into the existing Brayton Park Estate.

The proposed development makes provision for future linkages to adjoining lands; including undeveloped lands to the north-west, the adjoining undeveloped educational zoned lands to the north, as part of this application land is reserved for access to a potential future pedestrian/cycle bridge over the railway line to the north-east of the site (to be delivered by others).

In addition, the proposed development provides for pedestrian and cycle paths connection to the north east of the site, as well as 4 no. pedestrian access points and 1 no. gated vehicular (for Kildare County Council maintenance use only) and pedestrian access point to the open space at Bawnogues/Commons West along the southern boundary of the site.

Bin storage is provided either on curtilage and or in communal storage. The associated site and infrastructural works include foul and surface water drainage, attenuation tanks, SuDs arrangements, hard and soft landscaping, permeable paving, boundary walls, fences and noise buffers, 3 no. substations (approximately 20 sqm each), public lighting, a link street, internal roads, cycle paths, pedestrian paths and all associated ancillary site development works.

The proposed development is bounded to the north by the Dublin – Sligo Intercity railway line; the west by greenfield sites; the eastern boundary of the site is formed by the adjacent Brayton Park residential development and the M4 Dublin – Galway motorway, is adjacent to the southern boundary of the site.

The report should be read in conjunction with our engineering planning drawings, and deals with existing foul, surface water and water mains present within the surrounding area, and the proposals for the site with regards to these services.

The report also discusses the ground conditions present on the site, the current proposals for achieving the development plateau and sustainability measures incorporated with the development.

The following engineering drawings have been prepared for the proposed development:-

P180307-200 Rev. 5	Proposed Surface Water & Foul Sewer Layout – Sh 1 of 2
P180307-201 Rev. 5	Proposed Surface Water & Foul Sewer Layout – Sh 2 of 2
P180307-202 Rev. 6	Watermain & Levels Layout – Sh 1 of 2
P180307-203 Rev. 6	Watermain & Levels Layout – Sh 2 of 2
P180307-204	Standard Wastewater Infrastructure Details
P180307-205	Standard Water Infrastructure Details
P180307-210 Rev. 1	Proposed Foul Sewer Longitudinal Sections – Sh 1
P180307-211 Rev. 1	Proposed Foul Sewer Longitudinal Sections – Sh 2
P180307-212 Rev. 1	Proposed Foul Sewer Longitudinal Sections – Sh 3
P180307-215 Rev. 1	Proposed Surface Water Sewer Longitudinal Sections – Sh 1
P180307-216 Rev. 1	Proposed Surface Water Sewer Longitudinal Sections – Sh 2
P180307-217 Rev. 1	Proposed Surface Water Sewer Longitudinal Sections – Sh 3
P180307-218 Rev. 1	Proposed Surface Water Sewer Longitudinal Sections – Sh 4

Consultation with KCC

1 No. joint meeting was held with David Hall (Snr. Executive Engineer – Water Services) & Jonathan Deane (Maynooth Municipal Engineer) on the 5th December 2018, with a further meeting held with David Hall on the 21st March 2019, with the following being discussed:-.

- Wastewater: KCC stated that even though constraints existed in the Lower Liffey Catchment areas, this will ultimately be an issue for Irish Water to comment on - Pinnacle stated that they had received a favourable response from IW (in principle) for a lesser number of units, at that particular juncture in the process
- Water Supply: KCC stated that the Kilcock Ring Main scheme remains incomplete, however, again, this will ultimately be an issue for Irish Water to comment on. Obviously new development increases demand on the existing system, thereby increasing the risk of unplanned supply interruptions.
- KCC stated that water conservation measures, including rainwater harvesting or butts and dual flush toilets shall be considered – Pinnacle agreed to incorporate measures as appropriate.
- KCC stated that in general, where it is proposed to connect to existing services in Brayton Park or elsewhere, the issues of capacity, condition & consent shall be addressed in the planning submission. Likewise where future development will access the proposed site or existing services, adequate capacity shall be provided for this – Pinnacle stated that no consents were required, as no 3rd party lands were being transgressed and capacity was not considered an issue. It was stated that a CCTV survey of the receiving foul sewer outfall would be carried out to confirm the condition of the network.
- Surface Water: KCC stated that the drainage provision shall be in accordance with the requirements of GDSDS with a 20% climate change factor applied to attenuation storage volume and pipe network calculations – Pinnacle agreed to comply.
- KCC - Preferably run-off will discharge to ground where a preliminary site investigation report confirms that prevailing sub-soils are permeable and the existing groundwater regime is favourable. Otherwise discharge will be to a surface water sewer or suitable watercourse subject to flood levels and shall be restricted to the pre-existing greenfield rate or Q_{bar} – Pinnacle agreed to comply
- KCC - Attenuation storage up to 100 year storm event plus 20% climate change factor shall be provided on-site preferably underground – Pinnacle agreed to comply
- KCC - The Kilcock LAP identifies the subject site as a flood zone therefore a site specific flood risk assessment (SSFRA) will be required. The SSFRA shall be in accordance with the requirements of the Planning System and Flood Risk Management Guidelines and have regard to the accepted flood risk identifying sources including OPW flood history website, OPW PFRA pluvial & groundwater and CFRAMS fluvial flood mapping – Pinnacle agreed to comply
- KCC – Drainage longitudinal sections are to be submitted – Pinnacle agreed to comply

1 Introduction

The applicant proposes to construct 345 No. residential units & 1 No. creche facility, which will be accessed off the existing Brayton Park distributor road to the south-east of the site. The purpose of this report is to address the civil infrastructural aspects of the proposed mixed-use residential development, situated on the Kilcock LAP Lands.

The total subject site area extends to circa 28.55 acres (11.56 ha) and is currently a greenfield site. There are no known public sewer drainage pipes or watermains, presently located on the subject site.

This report has been prepared to outline the existing and proposed drainage, pollution control measures and water main infrastructure, in order to support the proposed development application.

The location of the site is indicated on the map extract below - Figure 1.



FIGURE 1 - Site Location (Source Google Maps)

2 Existing Drainage & Watermain Services

2.1 Existing Foul Drainage Networks

Kildare County Council record drawings have identified a network of 225mm Ø connections, located within the existing Brayton Park development, adjacent to the eastern boundary of the subject site. This network discharges, via a 225mm Ø gravity sewer, parallel to the railway line, prior to crossing Bridge Street, which is then piped in a 375mm Ø line beneath the Royal Canal and ultimately via a 600mm Ø pipe into the Kilcock Pumping Station – refer Appendix D.

The existing foul sewer reticulation network has adequate capacity to cater for the proposed effluent discharge from the subject site and there are no known issues noted with the sewer reticulation network, as confirmed by Irish Water.

2.2 Existing Surface Water Drainage Networks

Kildare County Council record drawings have identified a 375mm Ø pipe located along the distributor road, serving the existing Brayton Park development. This gravity sewer then runs in a southerly direction, down to the roundabout on the Courtown Road. This outfall ultimately connects into the Rye Water, to the east, via a syphon below the Royal Canal. KCC have requested that we do not make a connection into this network, as it is not their preferred option.

The record drawings have also identified a network of pipes in excess of 300mm Ø, as potential connections, located within the existing Brayton Park development, adjacent to the eastern boundary of the subject site. This network discharges, initially via a 300mm Ø gravity sewer, parallel to the railway line, prior to the pipe being upsized, before crossing Bridge Street, where it is then passes beneath the Royal Canal and ultimately into the Rye Water to the east – refer Appendix D.

The above sewers / culvert, have been identified by KCC, as having capacity to accommodate the proposed restricted discharge from the subject site and is the preferred option.

2.3 Existing Water Main Network

Kildare County Council record drawings have identified an existing 14” (350mm) Ø Upvc main capped with a sluice valve, located in the footpath at the access to the existing Brayton Park development. There is also an internal feed into the existing housing development from the above location.

The aforementioned existing watermain is ultimately fed off the existing infrastructure located down on the Courtown Road – refer Appendix D.

From discussions with the Kildare County Council, as part of pre-planning consultations, it is understood that there is adequate capacity within the existing watermain network to supply the proposed development, also confirmed by Irish Water.

3 Proposed Site Drainage & Water Supply

3.1 Proposed Foul Water Drainage

It is proposed to discharge foul water from the proposed development, via 2 No. 225mm Ø gravity foul sewer outfall connections, into the existing infrastructure within the Brayton Park residential development.

The 2 proposed connections are located to the west and east of the aforementioned existing residential development, at existing manholes, EX FW MHA & EX MH FW1 respectively – refer Drawing No.'s P180307–201 Rev. 5.

The invert levels of each of the 2 No. outfall connections are 77.35mOD for EX FW MHA, and 73.44mOD for EX MH FW1.

The estimated Foul Discharge Rate, based on Irish Water's criteria, i.e. the total number of dwellings @ 600 litres/per dwelling/per day = 345 dwellings x 600 litres/day:-

Dry Weather Flow (DWF)	=	207,000 litres/day
	=	2.396 litres/sec (DWF – Avg. Demand)
Design Peak Flow	=	14.376 litres/sec (6xDWF – Peak Demand)

Foul sewers have been designed as being 225mm diameter, with a general fall of 1:100/1:150, throughout the site (refer Drawing No.'s P180307-200 Rev. 5 & 201 Rev. 5). All on-site foul sewers have also been designed with gradients to achieve self-cleansing velocities.

The total predicted peak foul water run-off rate @ 6DWF, based on the above, from the development is estimated at 14.376l/s.

It should be further noted that a Pre-Connection Enquiry was initially submitted to Irish Water and a response was received, dated 25th June 2019, indicating that a connection to the existing network could be facilitated, for both Water & Wastewater, subject to a valid connection agreement being put in place, with associated conditions. A Statement of Design Acceptance, relating to the proposed development, was then received by Irish Water on the 12th July 2019 – both of these letters are contained within Appendix E.

3.2 Proposed Surface Water Drainage

Storm water from the proposed development has been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) and ensures that Best Management Practice has been incorporated into the design.

It should be noted that the subject site currently comprises a greenfield site and the proposed surface water measures are aimed at improving the general surface water management of the site, by introducing interceptors, attenuation measures and by restricting the ultimate discharge, etc. to the greenfield Q-Bar run-off rate, i.e. 58.1 l/s.

Refer Appendix B for Surface Water Calculations.

Site investigations have been carried out and the results have shown that the existing sub-soil provides adequate soil infiltration rates in some parts of the site and thus these areas have been utilised to install soakaway systems. Where the ground conditions have precluded the use of soakaways, it is proposed to install attenuation systems, i.e. Stormtech (or similar approved).

Storm water from the roof areas of the some of the proposed residential units, will be directed via rain water pipes into an on-site reticulation system, via an adequately designed permeable paving sub-base, only within in-curtilage areas. The outflow from this system will be connected into the surface water drainage network collecting run-off from the road areas and will ultimately be discharged into the aforementioned stormwater attenuation systems / soakaways, located in landscaped areas - refer Drawing No.'s P180307–200 Rev. 5 & 201 Rev. 5.

By way of complying with sustainability elements i.e. SuDS, the surface water run-off from the entire development, has been attenuated within the methods as described above, catering for a 1:100yr storm event + 20% climate change. These systems cater for all the main roads drainage, which also includes the outlets from the tanked permeable paving systems located in the driveways of some of the units. The permeable systems for selective individual units also cater for the roof drainage of the respective units. It should be noted that the permeable paving elements will only be utilised in the areas which are considered to be in-curtilage, i.e. that will not be taken-in-charge by the Local Authority.

Storm water from all car park areas and access roads will be drained as follows:-

- All private driveways, apartment parking and creche parking, to incorporate permeable paving, to include for discharge from the roof areas via rain water down pipes
- A series of on-site gullies draining into a separate system of below ground gravity storm water sewers

Prior to discharging into the proposed attenuation / soakaway areas, the storm water from the car park and access roads, which is drained via the methods as described above, will be directed through appropriately sized Conder Separator(s), (or similar approved) petrol interceptors - refer Appendix A for Interceptor Details.

Generic details pertaining to the aforementioned permeable paving system can be found contained within Appendix C of this report.

The outlets from the attenuation systems will contain flow restricting mechanisms, i.e. hydrobrakes or similar, in order to limit the discharge to the specified greenfield run-off rate.

The proposed discharge from the 6 No. attenuation systems / soakaways have been limited to the Q-bar 100yr run- off rate and are as follows:-

Catchment No.	Catchment Area (hectares)	Qbar (l/s)	Attenuation Provided (m3)	Attenuation Required (m3)
1	1.45	9.3	220	218
2	2.52	16.1	405	399
Comb 3&4	1.78	11.4	500	470
5	1.07	6.8	155	150
6	1.39	8.9	160	157
7	0.88	5.6	85	75
Total	**9.09**	**58.1**	**1525**	**1469**

It should be further noted that circa 45% of the outflow / overflow discharges from the proposed on-site attenuation systems / soakaways, are directed into the natural on-site ditch / watercourse network, i.e. Catchments 1 & 2, providing a wholly sustainable element to the surface water management of the proposed development.

Additionally, the majority of the existing ditch / watercourse networks, have been left in their natural state, as far as is practical.

The attenuated run-off draining the western portion of the site adjacent to the M4 Motorway, outfalls in to the existing ditch network, which then flows beneath the M4 Motorway. The remainder of the site outfalls into the existing reticulation serving the adjoining residential development Brayton Park, which ultimately drains adjacent to the railway line and is discharged beneath the Royal Canal, in the vicinity of the Bridge Street bridge crossing, as described under Section 2.2.

Further to the above, in essence it means that the surface water outfalls are split into 2 No. separate catchments, which is in response to a request from Kildare County Council and is also in keeping with the existing greenfield drainage patterns.

The 2 proposed connections into mains drainage are located to the west and east of the aforementioned existing residential development, at existing manholes, EX SW MHA & EX SWMHB respectively – refer Drawing No. P180307–201 Rev. 5.

The invert levels of each of the 2 No. outfall connections are 76.90mOD for EX SW MHA, and 73.50mOD for EX SWMHB.

The co-efficients for the various surface types are as follows:-

- Roof 0.85
- Concrete (Footpath) 0.80
- Asphalt (Road) 0.85
- Landscaping 0.25
- Permeable Paving 30% voids ratio : hydraulic conductivity equates to 1,800l/s/ha = 1.8m^3/s/ha = 6480m^3/hr/ha. In essence, this means that the hydraulic capacity of a permeable block surface is circa 6.5 times greater than a maximum rainfall event for a 1:100yr storm return period (based on a rainfall intensity of 100mm/hr/m^2)

It is also proposed to install rain water harvesting systems, for use at both the apartment block and the creche facility, in order to promote the re-use of grey water – refer Appendix F for generic details of this type of system.

The following is a summary of the SuDS measures proposed:-

- Surface water attenuation storage tanks & soakaways
- Restricted outflows via Hydrobrake mechanisms (or similar)
- Permeable paving systems
- Petrol / oil Interceptors
- Rain water harvesting (apartments / creche)
- Rain water butts (houses)

A Flood Risk Assessment for the proposed development has been prepared by Kilgallen & Partners and is submitted as a stand-alone document as part of this application.

3.3 Proposed Water Mains

It is intended to serve the proposed development off the aforementioned existing (14") 350mm Ø water main, located in the footpath at the access to the existing Brayton Park development - refer Dwg No.'s P180307-202 Rev.6 & 203 Rev. 6.

Hydrants will be installed in accordance with the Requirements of the Building Regulations and in accordance with the recommendations contained in the Technical Guidance Documents, Section B – Fire Safety, dated 2006, and these are detailed on our engineering drawings.

Water demand for the development, based on Irish Water's criteria, i.e. number of units (345) x 2.7 PE x 150 litres/day = 139,725 litres/hd/day = 1.617 litres/second.

Avg. Demand = 1.617 l/s x 1.25 = 2.021 litres/second

Peak Demand = 2.021 l/s x 5 = 10.105 litres/second

Water meters, sluice valves and hydrants, in line with Irish Water requirements and specifications, will be installed at the connections onto the aforementioned existing water mains, as required.

3.4 Standard Drainage Details

All standard drainage details including manhole details, pipe bedding, channels, hydrants etc. are shown on Drawing No.'s P180307-204 and P180307-205. Details of the types and construction methods will be agreed with Irish Water and the Local Authority, prior to construction.

Drains generally will consist of PVC (to IS 123) or concrete spigot and socket pipes to (IS 6).

Drains shall be laid to comply with the Requirements of the Building Regulations and in accordance with the recommendations contained in the Technical Guidance Documents, Section H – Drainage & Wastewater Disposal, dated 2016.

Strict separation of surface water and foul sewerage will be imposed on the development. Drains will be laid out to minimise the risk of inadvertent connections of sinks, dishwashers etc. to the surface water system.

In order to minimise the risk of floating contamination of the surface water system, road gullies will be precast trapped gullies to BS5911:Part2:1982.

Concrete bed and surround to the pipe runs will be used where the cover to the pipes is less than 900mm, where the pipes are sufficiently close to the building, or where the pipe runs are below the ground floor slab.

All works are to be carried out in accordance with Irish Water's Code of Practice for Wastewater Infrastructure, dated December 2016 : Document IW-CDS-5030-03 & with Irish Water's Code of Practice for Water Infrastructure, dated December 2016 : Document IW-CDS-5020-03 and any subsequent revisions thereof.

4 Surface & Groundwater Impacts

4.1 Construction Phase

Water pollution will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel washers and dust suppression on site roads, and regular plant maintenance. The Construction Industry Research and Information Association provides guidance on the control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors – C532 CIRIA Report (Masters-Williams *et al*, 2001), which provides information on these issues.

Pollutants can commonly include suspended solids, oil, chemicals, cement, cleaning materials and paints. These can enter controlled waters in various ways:

- directly into a watercourse
- via drains or public sewers
- via otherwise dry ditches
- in old field drains
- by seepage into groundwater systems
- through excavations into underlying aquifers
- by disturbance of an already contaminated site

The proximity of the site to streams, aquifers and water abstractions; potential sources, pathways and impacts of pollution; and the historical uses of the site and nearby areas should be examined early in project planning and design, to ensure that suitable redesign and mitigation measures are undertaken as necessary.

During construction, careful management and planning will help minimise water pollution. This may include adequate bunding of all oil tanks, wheel washers and dust suppression on haul roads, particular care to be taken near watercourses, and regular plant maintenance.

A contingency plan for pollution emergencies should also be developed and regularly updated, which would identify the actions to be taken in the event of a pollution incident.

The CIRIA document (2001), recommends that a contingency plan for pollution emergencies should address the following:

- containment measures
- emergency discharge routes
- list of appropriate equipment and clean-up materials
- maintenance schedule for equipment
- details of trained staff, location, and provision for 24-hour cover
- details of staff responsibilities
- notification procedures to inform the relevant environmental protection authority
- audit and review schedule

- telephone numbers of statutory water undertakers and local water company
- list of specialist pollution clean-up companies and their telephone numbers

It should be noted that the applicant will comply with the recommendations as stipulated in CIRIA document, where required.

4.2 Operational Phase

The sources of pollution that could potentially have an effect on surface or groundwater during the operational phase of the development will be oil and fuel leaks from parked cars, service vehicles, HGV delivery's etc. Hydrocarbon interceptors will be provided on storm water drainage sewers from car parking areas as required.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously.

It is not anticipated that flooding of the site will occur, due to the fact that there is no historical data, which refers to any past flooding on this site. In addition, refer to the SSFRA, as prepared by Kilgallen & Partners, enclosed as part of this planning application.

4.3 Mitigation Measures

The construction management of the building project will incorporate protection measures to minimise as far as possible the risk of spillage that could lead to surface and groundwater contamination.

All appropriate methods will be utilised to ensure that surface water arising during the course of construction activities will contain minimum sediment, prior to the ultimate discharge to the 2 existing 300mm Ø surface water pipe networks, attenuation systems, soakaways and the existing ditch network.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously. Hydrocarbon interceptors will be provided on storm water drainage sewers as required. Grease traps will be installed on foul sewers where necessary.

Best practice in design and construction will be employed for the installation of surface water and sanitary drainage.

5 Sustainability

5.1 Site Development

In order to minimize material export and import to the site and the impact of this on the surrounding road network, the applicant is proposing to maintain existing on-site levels as far as is practical. Where this is not feasible, a terrain model has been produced, which will indicate the volumes of cut/fill material, based on the proposed levels and a levels balance will be struck across the site, thereby mitigating any import/export of material for site development.

5.2 Site Drainage

Storm water drainage proposals for the site have been designed in accordance with the GDSDS and incorporate on site storm water attenuation in order to limit discharge of storm water from the developed site to the equivalent Q-bar run-off rates.

The attenuation system proposed is in keeping with other developments of this type and nature within Kildare County. The proposed soakaways, attenuation systems, permeable paving and rain water harvesting, are wholly sustainable and in accordance with current guidelines and design criteria, i.e. SuDS etc.

6 Conclusion

In conclusion, the proposed development of the site by the applicant, for use as a mixed use residential development, is considered a suitable use of the site and is in accordance with the Kilcock LAP. The proposed drainage and water arrangements set out in this report and associated drawings, have been the subject of discussions and agreement with Kildare County Council, in advance of submission of this planning application to An Bord Pleanala. Local infrastructure has the capacity to serve the proposed development.

The site will be developed in a sustainable manner, in order to minimise the impact of the development during construction and throughout the lifespan of the proposed store.

It should be further noted that all drainage elements have been discussed and agreed with both Kildare County Council (as noted) and Irish Water, through the PCE and Design Acceptance stages of the process, as per the attached documentation.

Accordingly, there are no reasons in relation to the drainage elements, as to why this scheme should not be granted planning permission, and with this in mind, An Bord Pleanala is respectfully requested to recommend a grant of planning permission.

Appendix A

Conder Petrol Interceptor Details

Conder® OIL/WATER SEPARATORS



40 years OF PASSION

CONDER AQUA SOLUTIONS
A PREMIER TECH AND EPS JOINT COMPANY

THE PARTNER OF CHOICE

A4 Conder Separator Brochure 8pp-2.indd 1 27/08/2014 19:21



The Conder Range of Oil Separators are for installation on surface water drainage systems and are designed to prevent hydrocarbons (e.g. diesel, petrol, engine oil) from mixing with surface water and entering our drainage systems.

Pollution prevention is a critical part of sustainable drainage systems and statutory regulations are in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance.

A4 Conder Separator Brochure 8pp-2.indd 2 27/08/2014 19:21

Compliance

The Conder Range of Oil Separators fully conform to both the Environment Agency's latest PPG guidelines and European standard BSEN-858-1-2 and are proven to effectively separate oil and water. Under test, the Conder Bypass performed to less than 1 mg/l and in doing so guarantees minimal environmental impact and ensures public safety.

Classes of Separator

There are two classes of separator which are defined by performance.

Class 1

Class 1 Separators are designed to achieve a concentration of less than 5mg/l of oil under standard test conditions. These conditions are required for discharges to surface water drains and the water environment.

Class 2*

Class 2 Separators are designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies such as discharges to the foul sewer.

*Class 2 available in forecourt separators only.

Selecting the Right Separator

Conder offers a full range of Separators for varying use and application:

- Bypass Separator
- Full Retention Separator
- Forecourt Separator
- Wash Down and Silt Separators

If you're unsure of what type of Conder Oil Separator you require please use the below chart to help you identify the most suitable product for your project.

The guidance given is for the use of separators in surface water drainage systems that discharge to rivers and soakways.

Is there a risk of oil contaminating the drainage from the site?

YES	YES	YES	YES	NO
Risk of infrequent light contamination and potential for small spills only e.g. car park.	Risk of regular contamination of surface water run off with oil and/ or risk of larger spills e.g. vehicle maintenance area, goods vehicle parking or vehicle manoeuvring.	Risk of regular Drainage will also contain dissolved oils, detergents or degreasers such as vehicle wash water and trade effluents e.g. industrial sites.	Fuel oils are delivered to and dispensed on site e.g. retail fuel forecourts.	Very low risk of oil contamination e.g. roofwater.
YES				YES
Source control SUDS must be considered and incorporated where suitable.				Separator not required.
IF NOT SUITABLE	YES	YES	YES	
By-pass separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Full retention separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Trade effluents must be directed to the foul sewer. It may need to pass through a separator before discharge to sewer to remove.	Full retention 'forecourt' separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Clean water should not be passed through the separator unless the size of the unit increased accordingly.

The use of SUDS should be considered at all sites and they should be incorporated where suitable. SUDS can be used to polish the effluent from these separators before it enters the environment.

Source control SUDS should be considered where possible.

Separator Alarms

All oil separators are required by legislation to be fitted with an oil level alarm system with recommendations that the alarm is installed, tested, commissioned and regularly serviced by a qualified technician.

The alarm indicates when the separator is in need of immediate maintenance in order for it to continue to work effectively. Conder Aqua Solutions can offer a full technical and service package for a variety of alarm options.

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The Conder Range of Bypass Separators

The Conder Range of Bypass Separators are used to fully treat all flows generated by rainfall rates of up to 6.5mm/hr. Bypass Separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where only small spillages occur and the risk of spillage is small.



Typical Application

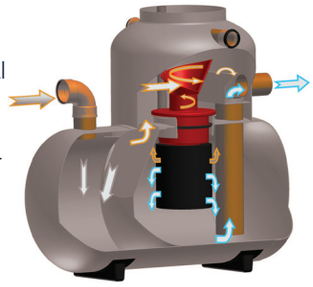
- Car parks
- Roadways and major trunk roads
- Light industrial and goods yards

Features and Benefits

- Innovative design
- Compact and easy to handle/install
- Fully compliant to the Environment Agency's PPG3 guidelines
- Low product and install costs
- Full BSI certification
- Exceeds industry standards
- Easy to service
- Fully tested and verified with a range from CNSB 3 to CNSB 1000 (Class 1)

Performance

Conder Bypass Separators have been designed to treat all flow up to the designed nominal size. Any flow in excess of the nominal size is allowed to bypass the separation chamber thereby keeping the separated and trapped oil safe.



How it Works

Step 1

During the early part of a rain storm, which is a time of high oil contamination, all of the contaminated water flow passes through the sediment collection chamber and enters the separation chamber through a patented oil skimming and filter device.

Step 2

All of the oil then proceeds to the separation chamber where it is separated to the Class 1 standard of 5 mg/l and safely trapped.

Step 3

As the rainstorm builds up to its maximum and the level of oil contamination reduces significantly, the nominal size flow continues to pass through the separation chamber and any excess flow of virtually clean water is allowed to bypass directly to the outlet.

Specification Larger models up to CNSB 1000 are available.

Area Drained (m^2)	Tank Code including Silt	Length including Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)	Access (mm)
1667	CNSB3s/21	1400	300	45	1026	2200	1730	1680	750
2500	CNSB4.5s/21	1785	450	67.5	1026	1875	1270	1220	600
3333	CNSB6s/21	1975	600	90	1026	1875	1270	1220	600
4444	CNSB8s/21	2165	800	120	1026	1875	1270	1220	600
5555	CNSB10s/21	2485	1000	150	1026	1875	1270	1220	600
8333	CNSB15s/21	2670	1500	225	1210	2150	1450	1400	600
11111	CNSB20s/21	3115	2000	300	1210	2150	1450	1400	600
13889	CNSB25s/21	3555	2500	375	1210	2150	1450	1400	600
16667	CNSB30s/21	3470	3000	450	1510	2690	1770	1720	750
22222	CNSB40s/21	4040	4000	600	1510	2690	1770	1720	750
27778	CNSB50s/21	4655	5000	750	1510	2690	1770	1720	750
33333	CNSB60s/21	4415	6000	900	1880	3300	2025	1975	2 x 600
44444	CNSB80s/21	5225	8000	1200	1880	3300	2025	1975	2 x 600
55556	CNSB100s/21	6010	10,000	1500	1880	3300	2025	1975	2 x 600

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

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The Conder Range of Full Retention Separators

The Conder Range of Full Retention Separators are designed to treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr. Full Retention Separators are used where there is a risk of regular contamination with oil and a foreseeable risk of significant spillages.



Typical Application

- Sites with hi-risk of oil contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops
- Where discharge is to a sensitive environment

Features and Benefits

- All surface water is treated
- Automatic closure device (ACD) fitted as standard

Performance

All Conder Full Retention Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification Larger models available upon request.

Area Drained (m^2)	Tank code Incl. Silt	Length including Silt (mm)	Slit Capacity (L)	Oil Storage Capacity	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)
222	CNS4s/11	2319	400	40	1026	1655	1295	1245
333	CNS6s/11	3414	600	60	1026	1655	1295	1245
444	CNS8s/11	3197	800	80	1210	1855	1480	1430
556	CNS10s/11	3957	1000	100	1210	1855	1480	1430
833	CNS15s/11	3870	1500	150	1510	2180	1780	1730
1111	CNS20s/11	5060	2000	200	1510	2180	1780	1730
1667	CNS30s/11	5369	3000	300	1880	2560	2030	1980
2222	CNS40s/11	7059	4000	400	1880	2560	2030	1980
2778	CNS50s/11	4080	5000	500	2600	3315	2730	2680
3333	CNS60s/11	4805	6000	600	2600	3315	2730	2680
3889	CNS70s/11	5529	7000	700	2600	3315	2730	2680
4444	CNS80s/11	6254	8000	800	2600	3315	2730	2680
5556	CNS100s/11	6751	10,000	1,000	2600	3315	2730	2680

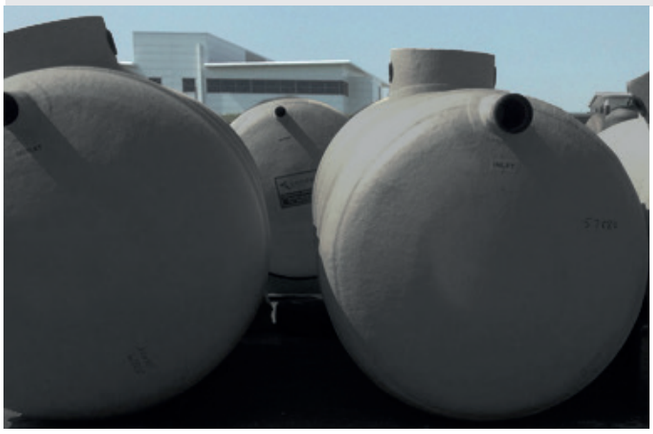
Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

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Conder Range of Forecourt Separators

Conder Forecourt Separators have been designed for specific use in petrol filling stations and other similar applications. The size of this separator has been specifically increased in order to retain the possible loss of the contents from one compartment of a road tanker, which could be up to 7,600 litres.

Forecourt separators are an essential infrastructure requirement for all forecourts so as to ensure compliance with both health and safety and environmental legislation.



Application Areas

- Petrol forecourts
- Refuelling facilities
- Fuel storage depot

Features and Benefits

- All surface water is treated
- Available in Class 1 and Class 2
- Automatic Closure Device (ACD) fitted as standard
- Includes 2000L silt capacity

Performance

All Conder Forecourt Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification

Tank Code	Volume (L)	Length (mm)	Diameter (mm)	Height (mm)	Base to inlet (mm)	Base to outlet (mm)	Access (mm)
ANO/11*	10000	4250	1800	2100	1600	1550	750
ANT/12**	10000	4250	1800	2100	1600	1550	750
LNO/11***	10000	4250	1800	2100	1600	1550	750

*Class 1 Forecourt Separator suitable for discharging to surface water drains

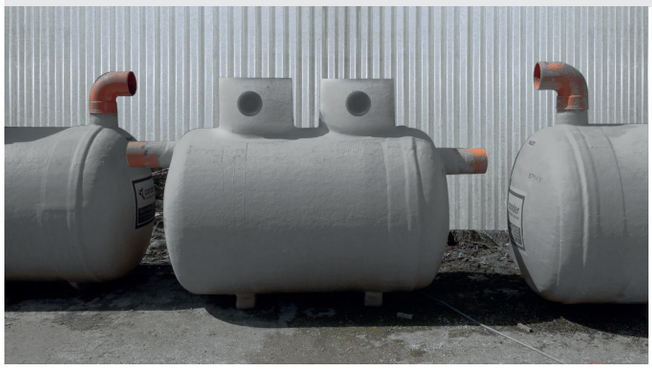
**Class 2 Forecourt Separator suitable for discharging to foul drains only

*** Class 1 Forecourt Separator suitable for installation in granular materials

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Conder Range of Washdown and Silt Separators

Conder Washdown and Silt Separators are for use in areas such as car washes, pressure wash facilities or other cleaning facilities and must be discharged to the foul water drainage system in accordance with PPG13.



Application Areas

- Car wash facilities
- Tool hire depots
- Pressure washer facilities

Features and Benefits

- Available in 1,2 and 3 stage options
- Efficient silt and hydrocarbon removal

Performance

The Environment Agency's PPG13 requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catchpit for disposal by a licenced waste contractor.

Silt build-up is the primary concern with washdown facilities and so the Conder range of washdown and silt separators are used to remove the silt and will allow some separation of hydrocarbons.

Detergents that are used in wash down areas will break down and disperse hydrocarbons (hindering the separation process). Therefore it is important to remember the main function of wash down separators is to remove silt.

How it Works

Step 1

Contaminated wash down water enters the unit where the heavier solids, silts, settle to the bottom of the tank.

Step 2

The lighter liquids, hydrocarbons, will rise to the surface and be retained within the tank.

Step 3

Treated water will exit the separator via the dipped outlet.

Specification

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber Conder Washdown and Silt Separators are available on request.

Tank Code	Capacity (L)	Silt Storage	Diameter (mm)	Length (mm)	Access Diameter (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
CWS2/12	2000	1000	1000	2713	600	1290	1240
CWS3/12	3000	1500	1200	2853	600	1475	1425
CWS4/12	4000	2000	1200	3737	600	1475	1425
CWS6/12	6000	3000	1500	3636	600	1775	1725
CWS8/12	8000	4000	1800	3443	600	2030	1980
CWS10/12	10000	5000	1800	4250	600	2030	1980

FST Silt Trap

Large quantities of silt can be associated with washdown areas. The Conder FST silt trap is ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of covers from B125 up to E600 to allow installation in all types of vehicle or plant washdown facilities.



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Conder Range of Alarm Systems

All separators must be fitted with an alarm in order to provide visual and audible warning when the level of oil reaches 90% of its storage volume, as required by The Environment Agency's PPG3.

The alarm system will then be triggered to indicate that the separator is in need of immediate emptying, in order to continue effective operation.



Features and Benefits

- Option for installation at a remote supervisory point
- Audible and visual
- Eliminates unnecessary waste management visits
- Easy installation
- Audible, visual and text message alert alarm systems available

Mains Powered System

Mains powered alarm systems are best suited to new build situations or sites where installation of the necessary cabling and ducting is straight forward and economical. The probe located in the separator will, when surrounded by floating hydrocarbons, activate an alarm condition on the remote panel to advise that the unit requires emptying.

Solar Powered System (Flashing Beacon)



This option requires no mains power supply or any significant cabling and ducting, making it extremely economical for large sites and retro fitting alarms to existing oil separators. A High Intensity Beacon will flash when a problem is detected.

Solar GSM Alarm

The Solar GSM alarm sends a status report on your separator to a mobile phone number of your choice. The status of the GSM alarm can also be tested at any time by simply sending a pre-recorded text message, via your directed mobile phone, for added peace of mind.

Peripherals

Coalescing Filters

The Conder Coalescing Filter is designed to separate residual oil in already separated oil/water and ensures a discharge quality of less than 5mg/litre of oil in water.

Features and Benefits

- Handle for easy removal and cleaning
- Flashing beacons (with option of siren kit)
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

Servicing

The Environmental Agency's PPG3 guidelines stipulate that every 6 months, and in accordance with manufacturer's instructions, experienced personnel should carry out maintenance to both the separator and alarm.

Conder and our service partners can offer a full technical and service package including separator and alarm installation, commissioning, oil and silt removal and route service contracts.

CONDER AQUA SOLUTIONS
A PREMIER TECH AND EPS JOINT COMPANY

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Appendix B

Surface Water Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	2.520	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	5.4
QBAR Urban	16.1
Q100 years	30.7
Q1 year	13.7
Q30 years	28.4
Q100 years	30.7

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.450	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	3.1
QBAR Urban	9.3
Q100 years	17.7
Q1 year	7.9
Q30 years	16.4
Q100 years	17.7

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.780	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	3.8
QBAR Urban	11.4
Q100 years	21.7
Q1 year	9.7
Q30 years	20.1
Q100 years	21.7

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.880	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	1.9
QBAR Urban	5.6
Q100 years	10.7
Q1 year	4.8
Q30 years	9.9
Q100 years	10.7

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.390	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	3.0
QBAR Urban	8.9
Q100 years	17.0
Q1 year	7.5
Q30 years	15.7
Q100 years	17.0

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.070	Urban	0.750
SAAR (mm)	800	Region Number	Ireland Greater Dublin

Results l/s

QBAR Rural	2.3
QBAR Urban	6.8
Q100 years	13.1
Q1 year	5.8
Q30 years	12.1
Q100 years	13.1

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

Half Drain Time : 194 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	79.073	0.473	2.4	15.9	18.2	181.3	O K
30 min Summer	79.236	0.636	2.4	15.9	18.2	243.8	O K
60 min Summer	79.382	0.782	2.5	15.9	18.2	299.8	O K
120 min Summer	79.480	0.880	2.5	15.9	18.2	337.4	O K
180 min Summer	79.502	0.902	2.5	15.9	18.2	345.8	O K
240 min Summer	79.506	0.906	2.5	15.9	18.2	347.6	O K
360 min Summer	79.495	0.895	2.5	15.9	18.2	343.4	O K
480 min Summer	79.473	0.873	2.5	15.9	18.2	335.0	O K
600 min Summer	79.446	0.846	2.5	15.9	18.2	324.6	O K
720 min Summer	79.417	0.817	2.5	15.9	18.2	313.3	O K
960 min Summer	79.354	0.754	2.5	15.9	18.2	289.2	O K
1440 min Summer	79.223	0.623	2.4	15.9	18.2	239.0	O K
2160 min Summer	79.034	0.434	2.4	15.9	18.2	166.5	O K
2880 min Summer	78.888	0.288	2.3	15.9	18.2	110.4	O K
4320 min Summer	78.746	0.146	2.3	15.0	17.3	55.9	O K
5760 min Summer	78.693	0.093	2.2	12.8	15.1	35.5	O K
7200 min Summer	78.663	0.063	2.2	11.0	13.2	24.3	O K
8640 min Summer	78.646	0.046	2.0	9.7	11.7	17.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	33
60 min Summer	36.249	62
120 min Summer	22.886	120
180 min Summer	17.345	160
240 min Summer	14.210	192
360 min Summer	10.701	258
480 min Summer	8.738	328
600 min Summer	7.462	398
720 min Summer	6.557	468
960 min Summer	5.344	606
1440 min Summer	4.003	868
2160 min Summer	2.999	1236
2880 min Summer	2.441	1584
4320 min Summer	1.825	2248
5760 min Summer	1.483	2944
7200 min Summer	1.262	3672
8640 min Summer	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	78.636	0.036	1.6	9.0	10.5	13.7	O K
15 min Winter	79.134	0.534	2.4	15.9	18.2	204.9	O K
30 min Winter	79.321	0.721	2.5	15.9	18.2	276.5	O K
60 min Winter	79.491	0.891	2.5	15.9	18.2	341.8	O K
120 min Winter	79.618	1.018	2.6	16.2	18.7	390.5	O K
180 min Winter	79.654	1.054	2.6	16.4	19.0	404.2	O K
240 min Winter	79.654	1.054	2.6	16.4	19.0	404.3	O K
360 min Winter	79.637	1.037	2.6	16.3	18.9	397.8	O K
480 min Winter	79.601	1.001	2.5	16.1	18.6	384.0	O K
600 min Winter	79.556	0.956	2.5	15.9	18.4	366.7	O K
720 min Winter	79.507	0.907	2.5	15.9	18.2	347.9	O K
960 min Winter	79.403	0.803	2.5	15.9	18.2	308.1	O K
1440 min Winter	79.188	0.588	2.4	15.9	18.2	225.4	O K
2160 min Winter	78.896	0.296	2.3	15.9	18.2	113.6	O K
2880 min Winter	78.756	0.156	2.3	15.3	17.5	59.6	O K
4320 min Winter	78.673	0.073	2.2	11.6	13.9	28.0	O K
5760 min Winter	78.643	0.043	1.9	9.5	11.4	16.5	O K
7200 min Winter	78.629	0.029	1.3	8.5	9.8	11.1	O K
8640 min Winter	78.619	0.019	0.9	7.7	8.5	7.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5136
15 min Winter	80.190	18
30 min Winter	55.522	32
60 min Winter	36.249	60
120 min Winter	22.886	118
180 min Winter	17.345	172
240 min Winter	14.210	220
360 min Winter	10.701	276
480 min Winter	8.738	354
600 min Winter	7.462	432
720 min Winter	6.557	506
960 min Winter	5.344	654
1440 min Winter	4.003	926
2160 min Winter	2.999	1260
2880 min Winter	2.441	1556
4320 min Winter	1.825	2244
5760 min Winter	1.483	2936
7200 min Winter	1.262	3640
8640 min Winter	1.106	4408

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	78.612	0.012	0.5	7.1	7.7	4.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5136

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 1.310

Time (mins)	Area (ha)
0-4	1.310

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

Half Drain Time : 188 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	79.600	0.500	1.3	8.7	9.9	99.5	O K
30 min Summer	79.773	0.673	1.3	8.7	9.9	134.0	O K
60 min Summer	79.928	0.828	1.4	8.7	10.0	164.8	O K
120 min Summer	80.033	0.933	1.4	9.1	10.5	185.8	O K
180 min Summer	80.061	0.961	1.4	9.2	10.6	191.3	O K
240 min Summer	80.070	0.970	1.4	9.2	10.6	193.2	O K
360 min Summer	80.065	0.965	1.4	9.2	10.6	192.1	O K
480 min Summer	80.044	0.944	1.4	9.1	10.5	187.9	O K
600 min Summer	80.016	0.916	1.4	9.0	10.4	182.5	O K
720 min Summer	79.986	0.886	1.4	8.9	10.3	176.5	O K
960 min Summer	79.922	0.822	1.3	8.7	10.0	163.8	O K
1440 min Summer	79.794	0.694	1.3	8.7	9.9	138.1	O K
2160 min Summer	79.607	0.507	1.3	8.7	9.9	100.9	O K
2880 min Summer	79.445	0.345	1.2	8.7	9.9	68.7	O K
4320 min Summer	79.291	0.191	1.2	8.3	9.5	38.0	O K
5760 min Summer	79.242	0.142	1.2	7.1	8.3	28.4	O K
7200 min Summer	79.217	0.117	1.2	6.0	7.2	23.3	O K
8640 min Summer	79.200	0.100	1.2	5.2	6.4	20.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	33
60 min Summer	36.249	62
120 min Summer	22.886	120
180 min Summer	17.345	154
240 min Summer	14.210	186
360 min Summer	10.701	254
480 min Summer	8.738	324
600 min Summer	7.462	392
720 min Summer	6.557	462
960 min Summer	5.344	598
1440 min Summer	4.003	866
2160 min Summer	2.999	1236
2880 min Summer	2.441	1584
4320 min Summer	1.825	2244
5760 min Summer	1.483	2944
7200 min Summer	1.262	3672
8640 min Summer	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	79.188	0.088	1.2	4.6	5.7	17.5	O K
15 min Winter	79.664	0.564	1.3	8.7	9.9	112.2	O K
30 min Winter	79.861	0.761	1.3	8.7	9.9	151.4	O K
60 min Winter	80.040	0.940	1.4	9.1	10.5	187.2	O K
120 min Winter	80.173	1.073	1.4	9.7	11.1	213.6	O K
180 min Winter	80.210	1.110	1.4	9.8	11.2	220.9	O K
240 min Winter	80.216	1.116	1.4	9.8	11.3	222.0	O K
360 min Winter	80.203	1.103	1.4	9.8	11.2	219.5	O K
480 min Winter	80.166	1.066	1.4	9.6	11.0	212.3	O K
600 min Winter	80.120	1.020	1.4	9.4	10.8	203.1	O K
720 min Winter	80.070	0.970	1.4	9.2	10.6	193.2	O K
960 min Winter	79.966	0.866	1.4	8.8	10.2	172.5	O K
1440 min Winter	79.759	0.659	1.3	8.7	9.9	131.3	O K
2160 min Winter	79.453	0.353	1.2	8.7	9.9	70.2	O K
2880 min Winter	79.297	0.197	1.2	8.4	9.6	39.2	O K
4320 min Winter	79.225	0.125	1.2	6.4	7.6	24.8	O K
5760 min Winter	79.197	0.097	1.2	5.0	6.2	19.3	O K
7200 min Winter	79.180	0.080	1.2	4.1	5.3	15.9	O K
8640 min Winter	79.168	0.068	1.2	3.5	4.6	13.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5136
15 min Winter	80.190	18
30 min Winter	55.522	32
60 min Winter	36.249	60
120 min Winter	22.886	118
180 min Winter	17.345	170
240 min Winter	14.210	194
360 min Winter	10.701	272
480 min Winter	8.738	350
600 min Winter	7.462	426
720 min Winter	6.557	500
960 min Winter	5.344	646
1440 min Winter	4.003	924
2160 min Winter	2.999	1276
2880 min Winter	2.441	1556
4320 min Winter	1.825	2208
5760 min Winter	1.483	2944
7200 min Winter	1.262	3672
8640 min Winter	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	79.159	0.059	1.2	3.0	4.1	11.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5136

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 0.710

Time (mins)	Area (ha)
0-4	0.710

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

Half Drain Time : 310 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	77.407	0.407	2.7	10.0	12.6	182.7	O K
30 min Summer	77.554	0.554	2.8	10.0	12.6	249.0	O K
60 min Summer	77.697	0.697	2.8	10.0	12.6	313.2	O K
120 min Summer	77.820	0.820	2.9	10.2	13.1	368.5	O K
180 min Summer	77.871	0.871	2.9	10.5	13.4	391.6	O K
240 min Summer	77.893	0.893	2.9	10.6	13.5	401.3	O K
360 min Summer	77.913	0.913	2.9	10.7	13.6	410.2	O K
480 min Summer	77.917	0.917	2.9	10.7	13.7	412.0	O K
600 min Summer	77.912	0.912	2.9	10.7	13.6	410.0	O K
720 min Summer	77.902	0.902	2.9	10.7	13.6	405.5	O K
960 min Summer	77.874	0.874	2.9	10.5	13.4	393.0	O K
1440 min Summer	77.807	0.807	2.9	10.1	13.0	362.9	O K
2160 min Summer	77.705	0.705	2.8	10.0	12.6	316.7	O K
2880 min Summer	77.607	0.607	2.8	10.0	12.6	272.7	O K
4320 min Summer	77.415	0.415	2.7	10.0	12.6	186.7	O K
5760 min Summer	77.260	0.260	2.7	10.0	12.6	116.9	O K
7200 min Summer	77.205	0.205	2.7	9.3	12.0	92.3	O K
8640 min Summer	77.179	0.179	2.7	8.3	10.9	80.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	33
60 min Summer	36.249	62
120 min Summer	22.886	122
180 min Summer	17.345	180
240 min Summer	14.210	222
360 min Summer	10.701	284
480 min Summer	8.738	348
600 min Summer	7.462	416
720 min Summer	6.557	488
960 min Summer	5.344	626
1440 min Summer	4.003	906
2160 min Summer	2.999	1300
2880 min Summer	2.441	1700
4320 min Summer	1.825	2424
5760 min Summer	1.483	3056
7200 min Summer	1.262	3680
8640 min Summer	1.106	4408

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	77.161	0.161	2.6	7.3	10.0	72.2	O K
15 min Winter	77.457	0.457	2.8	10.0	12.6	205.6	O K
30 min Winter	77.623	0.623	2.8	10.0	12.6	280.1	O K
60 min Winter	77.786	0.786	2.9	10.0	12.8	353.3	O K
120 min Winter	77.931	0.931	2.9	10.8	13.8	418.5	O K
180 min Winter	77.996	0.996	3.0	11.2	14.2	447.9	O K
240 min Winter	78.028	1.028	3.0	11.4	14.3	461.9	O K
360 min Winter	78.044	1.044	3.0	11.5	14.4	469.1	O K
480 min Winter	78.046	1.046	3.0	11.5	14.5	470.3	O K
600 min Winter	78.036	1.036	3.0	11.4	14.4	465.7	O K
720 min Winter	78.018	1.018	3.0	11.3	14.3	457.6	O K
960 min Winter	77.970	0.970	2.9	11.1	14.0	436.1	O K
1440 min Winter	77.860	0.860	2.9	10.4	13.3	386.6	O K
2160 min Winter	77.698	0.698	2.8	10.0	12.6	313.6	O K
2880 min Winter	77.541	0.541	2.8	10.0	12.6	243.1	O K
4320 min Winter	77.238	0.238	2.7	9.9	12.6	107.1	O K
5760 min Winter	77.177	0.177	2.7	8.2	10.9	79.6	O K
7200 min Winter	77.150	0.150	2.6	6.7	9.3	67.5	O K
8640 min Winter	77.133	0.133	2.6	5.6	8.2	59.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5144
15 min Winter	80.190	18
30 min Winter	55.522	33
60 min Winter	36.249	62
120 min Winter	22.886	118
180 min Winter	17.345	176
240 min Winter	14.210	230
360 min Winter	10.701	298
480 min Winter	8.738	370
600 min Winter	7.462	448
720 min Winter	6.557	526
960 min Winter	5.344	676
1440 min Winter	4.003	970
2160 min Winter	2.999	1404
2880 min Winter	2.441	1816
4320 min Winter	1.825	2336
5760 min Winter	1.483	3000
7200 min Winter	1.262	3680
8640 min Winter	1.106	4408

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	77.120	0.120	2.6	4.7	7.4	54.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 1.270

Time (mins)	Area (ha)
0-4	1.270

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Model Details

Storage is Online Cover Level (m) 80.000

Cellular Storage Structure

Invert Level (m) 77.000 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01350 Porosity 0.65
Infiltration Coefficient Side (m/hr) 0.01350

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	691.5	691.5	1.200	0.0	807.3
1.100	691.5	807.3			

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md4 Invert Level (m) 77.000
Design Flow (l/s) 11.4 Diameter (mm) 120

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	12.2	3.000	19.3	7.000	29.5
0.200	9.1	1.400	13.2	3.500	20.9	7.500	30.6
0.300	9.5	1.600	14.1	4.000	22.3	8.000	31.6
0.400	8.3	1.800	15.0	4.500	23.7	8.500	32.6
0.500	8.2	2.000	15.8	5.000	25.0	9.000	33.5
0.600	8.7	2.200	16.6	5.500	26.2	9.500	34.4
0.800	10.0	2.400	17.3	6.000	27.4		
1.000	11.2	2.600	18.0	6.500	28.5		

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

Half Drain Time : 122 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.406	0.476	0.5	4.5	5.0	38.6	O K
30 min Summer	74.563	0.633	0.6	4.5	5.0	51.3	O K
60 min Summer	74.690	0.760	0.6	4.8	5.4	61.6	O K
120 min Summer	74.756	0.826	0.6	5.0	5.6	66.9	O K
180 min Summer	74.771	0.841	0.6	5.0	5.6	68.1	O K
240 min Summer	74.769	0.839	0.6	5.0	5.6	68.0	O K
360 min Summer	74.744	0.814	0.6	5.0	5.6	65.9	O K
480 min Summer	74.708	0.778	0.6	4.9	5.5	63.1	O K
600 min Summer	74.670	0.740	0.6	4.8	5.3	59.9	O K
720 min Summer	74.630	0.700	0.6	4.7	5.2	56.7	O K
960 min Summer	74.551	0.621	0.6	4.5	5.0	50.3	O K
1440 min Summer	74.400	0.470	0.5	4.5	5.0	38.1	O K
2160 min Summer	74.203	0.273	0.5	4.5	5.0	22.2	O K
2880 min Summer	74.108	0.178	0.5	4.5	4.9	14.4	O K
4320 min Summer	74.051	0.121	0.5	3.6	4.1	9.8	O K
5760 min Summer	74.028	0.098	0.5	2.9	3.4	7.9	O K
7200 min Summer	74.014	0.084	0.5	2.4	2.9	6.8	O K
8640 min Summer	74.005	0.075	0.5	2.1	2.5	6.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	32
60 min Summer	36.249	60
120 min Summer	22.886	102
180 min Summer	17.345	134
240 min Summer	14.210	168
360 min Summer	10.701	238
480 min Summer	8.738	308
600 min Summer	7.462	378
720 min Summer	6.557	444
960 min Summer	5.344	578
1440 min Summer	4.003	836
2160 min Summer	2.999	1168
2880 min Summer	2.441	1500
4320 min Summer	1.825	2204
5760 min Summer	1.483	2936
7200 min Summer	1.262	3664
8640 min Summer	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	73.997	0.067	0.5	1.8	2.3	5.4	O K
15 min Winter	74.467	0.537	0.6	4.5	5.0	43.5	O K
30 min Winter	74.647	0.717	0.6	4.7	5.3	58.1	O K
60 min Winter	74.797	0.867	0.6	5.1	5.7	70.3	O K
120 min Winter	74.880	0.950	0.6	5.4	6.0	77.0	O K
180 min Winter	74.893	0.963	0.6	5.4	6.0	78.0	O K
240 min Winter	74.886	0.956	0.6	5.4	6.0	77.5	O K
360 min Winter	74.841	0.911	0.6	5.2	5.9	73.8	O K
480 min Winter	74.781	0.851	0.6	5.1	5.7	68.9	O K
600 min Winter	74.718	0.788	0.6	4.9	5.5	63.8	O K
720 min Winter	74.654	0.724	0.6	4.7	5.3	58.7	O K
960 min Winter	74.530	0.600	0.6	4.5	5.0	48.6	O K
1440 min Winter	74.278	0.348	0.5	4.5	5.0	28.2	O K
2160 min Winter	74.085	0.155	0.5	4.3	4.8	12.5	O K
2880 min Winter	74.047	0.117	0.5	3.5	4.0	9.5	O K
4320 min Winter	74.018	0.088	0.5	2.5	3.0	7.1	O K
5760 min Winter	74.002	0.072	0.5	2.0	2.4	5.9	O K
7200 min Winter	73.993	0.063	0.5	1.6	2.1	5.1	O K
8640 min Winter	73.986	0.056	0.5	1.4	1.8	4.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5136
15 min Winter	80.190	18
30 min Winter	55.522	32
60 min Winter	36.249	60
120 min Winter	22.886	114
180 min Winter	17.345	142
240 min Winter	14.210	182
360 min Winter	10.701	258
480 min Winter	8.738	334
600 min Winter	7.462	406
720 min Winter	6.557	478
960 min Winter	5.344	616
1440 min Winter	4.003	866
2160 min Winter	2.999	1144
2880 min Winter	2.441	1476
4320 min Winter	1.825	2200
5760 min Winter	1.483	2936
7200 min Winter	1.262	3616
8640 min Winter	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	73.980	0.050	0.5	1.2	1.6	4.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5088

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 0.280

Time (mins)	Area (ha)
0-4	0.280

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

Half Drain Time : 152 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	74.269	0.439	1.1	8.0	9.0	75.0	O K
30 min Summer	74.419	0.589	1.1	8.0	9.0	100.7	O K
60 min Summer	74.550	0.720	1.1	8.0	9.0	123.0	O K
120 min Summer	74.630	0.800	1.2	8.0	9.1	136.7	O K
180 min Summer	74.651	0.821	1.2	8.0	9.2	140.4	O K
240 min Summer	74.656	0.826	1.2	8.0	9.2	141.3	O K
360 min Summer	74.644	0.814	1.2	8.0	9.1	139.1	O K
480 min Summer	74.617	0.787	1.2	8.0	9.0	134.6	O K
600 min Summer	74.586	0.756	1.2	8.0	9.0	129.2	O K
720 min Summer	74.552	0.722	1.1	8.0	9.0	123.4	O K
960 min Summer	74.482	0.652	1.1	8.0	9.0	111.4	O K
1440 min Summer	74.342	0.512	1.1	8.0	9.0	87.5	O K
2160 min Summer	74.163	0.333	1.1	8.0	9.0	56.9	O K
2880 min Summer	74.062	0.232	1.0	7.9	8.9	39.7	O K
4320 min Summer	73.989	0.159	1.0	6.6	7.7	27.2	O K
5760 min Summer	73.959	0.129	1.0	5.4	6.4	22.1	O K
7200 min Summer	73.941	0.111	1.0	4.5	5.5	18.9	O K
8640 min Summer	73.928	0.098	1.0	3.8	4.8	16.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	32
60 min Summer	36.249	62
120 min Summer	22.886	114
180 min Summer	17.345	144
240 min Summer	14.210	176
360 min Summer	10.701	246
480 min Summer	8.738	316
600 min Summer	7.462	386
720 min Summer	6.557	454
960 min Summer	5.344	588
1440 min Summer	4.003	848
2160 min Summer	2.999	1188
2880 min Summer	2.441	1524
4320 min Summer	1.825	2204
5760 min Summer	1.483	2936
7200 min Summer	1.262	3672
8640 min Summer	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	73.918	0.088	1.0	3.3	4.3	15.1	O K
15 min Winter	74.325	0.495	1.1	8.0	9.0	84.6	O K
30 min Winter	74.496	0.666	1.1	8.0	9.0	113.9	O K
60 min Winter	74.648	0.818	1.2	8.0	9.2	139.9	O K
120 min Winter	74.751	0.921	1.2	8.4	9.6	157.4	O K
180 min Winter	74.770	0.940	1.2	8.5	9.7	160.8	O K
240 min Winter	74.774	0.944	1.2	8.5	9.7	161.4	O K
360 min Winter	74.749	0.919	1.2	8.4	9.6	157.1	O K
480 min Winter	74.704	0.874	1.2	8.2	9.4	149.4	O K
600 min Winter	74.652	0.822	1.2	8.0	9.2	140.5	O K
720 min Winter	74.596	0.766	1.2	8.0	9.0	131.0	O K
960 min Winter	74.482	0.652	1.1	8.0	9.0	111.5	O K
1440 min Winter	74.250	0.420	1.1	8.0	9.0	71.9	O K
2160 min Winter	74.043	0.213	1.0	7.8	8.8	36.5	O K
2880 min Winter	73.988	0.158	1.0	6.6	7.6	27.0	O K
4320 min Winter	73.946	0.116	1.0	4.8	5.8	19.8	O K
5760 min Winter	73.925	0.095	1.0	3.7	4.7	16.3	O K
7200 min Winter	73.912	0.082	1.0	3.0	4.0	14.0	O K
8640 min Winter	73.902	0.072	1.0	2.5	3.5	12.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5136
15 min Winter	80.190	18
30 min Winter	55.522	32
60 min Winter	36.249	60
120 min Winter	22.886	116
180 min Winter	17.345	164
240 min Winter	14.210	188
360 min Winter	10.701	266
480 min Winter	8.738	342
600 min Winter	7.462	416
720 min Winter	6.557	490
960 min Winter	5.344	634
1440 min Winter	4.003	882
2160 min Winter	2.999	1172
2880 min Winter	2.441	1500
4320 min Winter	1.825	2208
5760 min Winter	1.483	2936
7200 min Winter	1.262	3672
8640 min Winter	1.106	4408

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	73.895	0.065	1.0	2.2	3.2	11.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5120

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 0.540

Time (mins)	Area (ha)
0-4	0.540

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

Half Drain Time : 187 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	79.344	0.474	0.9	5.8	6.7	69.0	O K
30 min Summer	79.508	0.638	1.0	5.8	6.7	92.8	O K
60 min Summer	79.655	0.785	1.0	6.0	7.0	114.3	O K
120 min Summer	79.755	0.885	1.0	6.3	7.3	128.8	O K
180 min Summer	79.783	0.913	1.0	6.4	7.4	132.9	O K
240 min Summer	79.793	0.923	1.0	6.4	7.5	134.3	O K
360 min Summer	79.790	0.920	1.0	6.4	7.4	133.8	O K
480 min Summer	79.771	0.901	1.0	6.4	7.4	131.1	O K
600 min Summer	79.746	0.876	1.0	6.3	7.3	127.4	O K
720 min Summer	79.718	0.848	1.0	6.2	7.2	123.4	O K
960 min Summer	79.659	0.789	1.0	6.0	7.0	114.8	O K
1440 min Summer	79.542	0.672	1.0	5.8	6.7	97.7	O K
2160 min Summer	79.374	0.504	0.9	5.8	6.7	73.3	O K
2880 min Summer	79.220	0.350	0.9	5.8	6.7	51.0	O K
4320 min Summer	79.060	0.190	0.9	5.6	6.5	27.6	O K
5760 min Summer	79.012	0.142	0.9	4.9	5.7	20.7	O K
7200 min Summer	78.989	0.119	0.9	4.1	5.0	17.4	O K
8640 min Summer	78.974	0.104	0.9	3.5	4.4	15.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	80.190	18
30 min Summer	55.522	33
60 min Summer	36.249	62
120 min Summer	22.886	120
180 min Summer	17.345	152
240 min Summer	14.210	184
360 min Summer	10.701	252
480 min Summer	8.738	322
600 min Summer	7.462	392
720 min Summer	6.557	462
960 min Summer	5.344	598
1440 min Summer	4.003	866
2160 min Summer	2.999	1252
2880 min Summer	2.441	1588
4320 min Summer	1.825	2248
5760 min Summer	1.483	2944
7200 min Summer	1.262	3672
8640 min Summer	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	78.963	0.093	0.9	3.1	3.9	13.6	O K
15 min Winter	79.404	0.534	0.9	5.8	6.7	77.7	O K
30 min Winter	79.590	0.720	1.0	5.8	6.8	104.8	O K
60 min Winter	79.761	0.891	1.0	6.3	7.3	129.6	O K
120 min Winter	79.887	1.017	1.1	6.7	7.8	147.9	O K
180 min Winter	79.922	1.052	1.1	6.8	7.9	153.0	O K
240 min Winter	79.929	1.059	1.1	6.9	7.9	154.1	O K
360 min Winter	79.919	1.049	1.1	6.8	7.9	152.6	O K
480 min Winter	79.885	1.015	1.1	6.7	7.8	147.7	O K
600 min Winter	79.843	0.973	1.0	6.6	7.6	141.5	O K
720 min Winter	79.796	0.926	1.0	6.4	7.5	134.8	O K
960 min Winter	79.701	0.831	1.0	6.1	7.1	120.9	O K
1440 min Winter	79.515	0.645	1.0	5.8	6.7	93.9	O K
2160 min Winter	79.236	0.366	0.9	5.8	6.7	53.2	O K
2880 min Winter	79.067	0.197	0.9	5.7	6.6	28.7	O K
4320 min Winter	78.996	0.126	0.9	4.4	5.2	18.3	O K
5760 min Winter	78.971	0.101	0.9	3.4	4.3	14.7	O K
7200 min Winter	78.956	0.086	0.9	2.8	3.6	12.5	O K
8640 min Winter	78.946	0.076	0.9	2.3	3.2	11.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.989	5136
15 min Winter	80.190	18
30 min Winter	55.522	32
60 min Winter	36.249	60
120 min Winter	22.886	116
180 min Winter	17.345	170
240 min Winter	14.210	194
360 min Winter	10.701	270
480 min Winter	8.738	348
600 min Winter	7.462	424
720 min Winter	6.557	498
960 min Winter	5.344	644
1440 min Winter	4.003	924
2160 min Winter	2.999	1296
2880 min Winter	2.441	1556
4320 min Winter	1.825	2208
5760 min Winter	1.483	2936
7200 min Winter	1.262	3672
8640 min Winter	1.106	4400

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	78.938	0.068	0.9	2.0	2.9	9.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.989	5136

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.280	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time / Area Diagram

Total Area (ha) 0.490

Time (mins)	Area (ha)
0-4	0.490

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw7.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw7.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	57.638	0.280	205.9	0.122	4.00	0.0	0.600	o	300
S1.001	66.972	0.330	202.9	0.160	0.00	0.0	0.600	o	300
S1.002	6.369	0.030	212.3	0.000	0.00	0.0	0.600	o	300
S1.003	13.815	0.060	230.3	0.000	0.00	0.0	0.600	o	300
S1.004	49.089	0.190	258.4	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	46.84	4.88	74.970	0.122	0.0	0.0	3.1	1.09	77.2	18.6
S1.001	43.58	5.89	74.690	0.282	0.0	0.0	6.7	1.10	77.8	39.9
S1.002	43.29	5.99	74.360	0.282	0.0	0.0	6.7	1.08	76.0	39.9
S1.003	42.66	6.22	73.990	0.282	0.0	0.0	6.7	1.03	72.9	39.9
S1.004	40.47	7.06	73.930	0.282	0.0	0.0	6.7	0.97	68.8	39.9

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Manhole Schedules for sw7.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW100	76.099	1.129	1200	S1.000	74.970	300				
SSW101	77.648	2.958	1200	S1.001	74.690	300	S1.000	74.690	300	
SSW102	78.931	4.571	1200	S1.002	74.360	300	S1.001	74.360	300	
SSW103	78.711	4.721	1200	S1.003	73.990	300	S1.002	74.330	300	340
SSW104	78.092	4.162	1200	S1.004	73.930	300	S1.003	73.930	300	
SSW105.	78.235	4.495	1200		OUTFALL		S1.004	73.740	300	

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PIPELINE SCHEDULES for sw7.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	300	SSW100	76.099	74.970	0.829	1200
S1.001	o	300	SSW101	77.648	74.690	2.658	1200
S1.002	o	300	SSW102	78.931	74.360	4.271	1200
S1.003	o	300	SSW103	78.711	73.990	4.421	1200
S1.004	o	300	SSW104	78.092	73.930	3.862	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	57.638	205.9	SSW101	77.648	74.690	2.658	1200
S1.001	66.972	202.9	SSW102	78.931	74.360	4.271	1200
S1.002	6.369	212.3	SSW103	78.711	74.330	4.081	1200
S1.003	13.815	230.3	SSW104	78.092	73.930	3.862	1200
S1.004	49.089	258.4	SSW105.	78.235	73.740	4.195	1200

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw6.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw6.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	53.410	0.650	82.2	0.100	4.00	0.0	0.600	o	225
S2.000	29.247	0.190	153.9	0.080	4.00	0.0	0.600	o	225
S1.001	21.644	0.130	166.5	0.000	0.00	0.0	0.600	o	225
S1.002	43.471	0.240	181.1	0.000	0.00	6.8	0.600	o	225
S1.003	16.871	0.070	241.0	0.000	0.00	0.0	0.600	o	225
S3.000	37.269	1.240	30.1	0.070	4.00	0.0	0.600	o	225
S3.001	57.177	0.370	154.5	0.135	0.00	0.0	0.600	o	225
S3.002	44.865	0.290	154.7	0.090	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	46.04	4.62	79.600	0.100	0.0	0.0	2.5	1.44	57.4	15.0
S2.000	46.60	4.46	79.140	0.080	0.0	0.0	2.0	1.05	41.8	12.1
S1.001	44.81	4.97	78.950	0.180	0.0	0.0	4.4	1.01	40.2	26.2
S1.002	42.48	5.72	75.070	0.180	6.8	0.0	5.5	0.97	38.5	33.0
S1.003	41.53	6.06	74.300	0.180	6.8	0.0	5.5	0.84	33.3	33.0
S3.000	47.36	4.26	79.690	0.070	0.0	0.0	1.8	2.40	95.2	10.8
S3.001	44.18	5.17	78.370	0.205	0.0	0.0	4.9	1.05	41.7	29.4
S3.002	42.03	5.88	77.490	0.295	0.0	0.0	6.7	1.05	41.7	40.3

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Network Design Table for sw6.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S4.000	21.929	0.230	95.3	0.054	4.00	0.0	0.600	o	225
S3.003	6.518	0.050	130.4	0.000	0.00	0.0	0.600	o	300
S3.004	14.085	0.070	201.2	0.000	0.00	0.0	0.600	o	300
S1.004	4.402	0.010	440.2	0.000	0.00	0.0	0.600	o	375
S5.000	33.666	0.320	105.2	0.095	4.00	0.0	0.600	o	225
S1.005	20.230	0.080	252.9	0.000	0.00	0.0	0.600	o	375
S1.006	60.240	0.240	251.0	0.000	0.00	5.6	0.600	o	375

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.000	47.31	4.27	76.700	0.054	0.0	0.0	1.4	1.34	53.3	8.3
S3.003	41.80	5.96	74.450	0.349	0.0	0.0	7.9	1.38	97.2	47.4
S3.004	41.22	6.17	74.300	0.349	0.0	0.0	7.9	1.10	78.1	47.4
S1.004	40.99	6.26	74.230	0.529	6.8	0.0	13.1	0.86	94.7	78.6
S5.000	46.68	4.44	77.560	0.095	0.0	0.0	2.4	1.27	50.7	14.4
S1.005	40.22	6.55	74.220	0.624	6.8	0.0	15.0	1.13	125.3	89.7
S1.006	38.12	7.44	73.740	0.624	12.4	0.0	15.4	1.14	125.8	92.2

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Manhole Schedules for sw6.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW80	81.745	2.145	1200	S1.000	79.600	225				
SSW81	80.030	0.890	1200	S2.000	79.140	225				
SSW82	80.628	1.678	1200	S1.001	78.950	225	S1.000	78.950	225	
							S2.000	78.950	225	
SSW83	80.324	5.254	1200	S1.002	75.070	225	S1.001	78.820	225	3750
SSW84	79.080	4.780	1200	S1.003	74.300	225	S1.002	74.830	225	530
SSW85	81.852	2.162	1200	S3.000	79.690	225				
SSW86	81.539	3.169	1200	S3.001	78.370	225	S3.000	78.450	225	80
SSW87	79.946	2.456	1200	S3.002	77.490	225	S3.001	78.000	225	510
SSW88	78.119	1.419	1200	S4.000	76.700	225				
SSW89	78.737	4.287	1200	S3.003	74.450	300	S3.002	77.200	225	2675
							S4.000	76.470	225	1945
SSW89A	78.756	4.456	1200	S3.004	74.300	300	S3.003	74.400	300	100
SSW91	78.654	4.424	1350	S1.004	74.230	375	S1.003	74.230	225	
							S3.004	74.230	300	
SSW90	78.854	1.294	1200	S5.000	77.560	225				
SSW92	78.610	4.390	1350	S1.005	74.220	375	S1.004	74.220	375	
							S5.000	77.240	225	2870
SSW105	78.235	4.495	1350	S1.006	73.740	375	S1.005	74.140	375	400
SEX SW MH	77.834	4.334	1200		OUTFALL		S1.006	73.500	375	

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PIPELINE SCHEDULES for sw6.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW80	81.745	79.600	1.920	1200
S2.000	o	225	SSW81	80.030	79.140	0.665	1200
S1.001	o	225	SSW82	80.628	78.950	1.453	1200
S1.002	o	225	SSW83	80.324	75.070	5.029	1200
S1.003	o	225	SSW84	79.080	74.300	4.555	1200
S3.000	o	225	SSW85	81.852	79.690	1.937	1200
S3.001	o	225	SSW86	81.539	78.370	2.944	1200
S3.002	o	225	SSW87	79.946	77.490	2.231	1200
S4.000	o	225	SSW88	78.119	76.700	1.194	1200
S3.003	o	300	SSW89	78.737	74.450	3.987	1200
S3.004	o	300	SSW89A	78.756	74.300	4.156	1200
S1.004	o	375	SSW91	78.654	74.230	4.049	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	53.410	82.2	SSW82	80.628	78.950	1.453	1200
S2.000	29.247	153.9	SSW82	80.628	78.950	1.453	1200
S1.001	21.644	166.5	SSW83	80.324	78.820	1.279	1200
S1.002	43.471	181.1	SSW84	79.080	74.830	4.025	1200
S1.003	16.871	241.0	SSW91	78.654	74.230	4.199	1350
S3.000	37.269	30.1	SSW86	81.539	78.450	2.864	1200
S3.001	57.177	154.5	SSW87	79.946	78.000	1.721	1200
S3.002	44.865	154.7	SSW89	78.737	77.200	1.312	1200
S4.000	21.929	95.3	SSW89	78.737	76.470	2.042	1200
S3.003	6.518	130.4	SSW89A	78.756	74.400	4.056	1200
S3.004	14.085	201.2	SSW91	78.654	74.230	4.124	1350
S1.004	4.402	440.2	SSW92	78.610	74.220	4.015	1350

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PIPELINE SCHEDULES for sw6.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S5.000	o	225	SSW90	78.854	77.560	1.069	1200
S1.005	o	375	SSW92	78.610	74.220	4.015	1350
S1.006	o	375	SSW105	78.235	73.740	4.120	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S5.000	33.666	105.2	SSW92	78.610	77.240	1.145	1350
S1.005	20.230	252.9	SSW105	78.235	74.140	3.720	1350
S1.006	60.240	251.0	SEX SW MH	77.834	73.500	3.959	1200

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw5.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw5.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	32.857	0.210	156.5	0.110	4.00	0.0	0.600	o	225
S2.000	27.373	0.180	152.1	0.056	4.00	0.0	0.600	o	225
S1.001	32.718	0.210	155.8	0.015	0.00	0.0	0.600	o	225
S3.000	27.514	0.150	183.4	0.056	4.00	0.0	0.600	o	225
S3.001	35.056	0.180	194.8	0.031	0.00	0.0	0.600	o	225
S1.002	57.030	0.280	203.7	0.162	0.00	0.0	0.600	o	300
S1.003	4.215	0.020	210.8	0.000	0.00	0.0	0.600	o	300
S1.004	5.954	0.030	198.5	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	48.13	4.53	80.580	0.110	0.0	0.0	2.9	1.04	41.5	17.2
S2.000	48.49	4.43	80.550	0.056	0.0	0.0	1.5	1.06	42.1	8.8
S1.001	46.26	5.05	80.370	0.181	0.0	0.0	4.5	1.04	41.5	27.2
S3.000	48.32	4.48	80.490	0.056	0.0	0.0	1.5	0.96	38.3	8.8
S3.001	46.07	5.10	80.340	0.087	0.0	0.0	2.2	0.93	37.1	13.0
S1.002	43.37	5.97	80.160	0.430	0.0	0.0	10.1	1.10	77.6	60.6
S1.003	43.18	6.03	79.880	0.430	0.0	0.0	10.1	1.08	76.3	60.6
S1.004	42.92	6.12	78.900	0.430	0.0	0.0	10.1	1.11	78.6	60.6

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Network Design Table for sw5.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.005	57.226	0.370	154.7	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.005	40.91	6.88	78.870	0.430	0.0	0.0	10.1	1.26	89.2	60.6

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Manhole Schedules for sw5.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW70	81.811	1.231	1200	S1.000	80.580	225				
SSW71	81.222	0.672	1200	S2.000	80.550	225				
SSW72	82.089	1.719	1200	S1.001	80.370	225	S1.000	80.370	225	
							S2.000	80.370	225	
SSW73	81.435	0.945	1200	S3.000	80.490	225				
SSW74	81.898	1.558	1200	S3.001	80.340	225	S3.000	80.340	225	
SSW75	82.366	2.206	1200	S1.002	80.160	300	S1.001	80.160	225	
							S3.001	80.160	225	
SSW76	81.902	2.022	1200	S1.003	79.880	300	S1.002	79.880	300	
SS76A	81.902	3.002	1200	S1.004	78.900	300	S1.003	79.860	300	960
SSW77	81.801	2.931	1200	S1.005	78.870	300	S1.004	78.870	300	
SSW83.	80.324	1.824	1200		OUTFALL		S1.005	78.500	300	

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PIPELINE SCHEDULES for sw5.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW70	81.811	80.580	1.006	1200
S2.000	o	225	SSW71	81.222	80.550	0.447	1200
S1.001	o	225	SSW72	82.089	80.370	1.494	1200
S3.000	o	225	SSW73	81.435	80.490	0.720	1200
S3.001	o	225	SSW74	81.898	80.340	1.333	1200
S1.002	o	300	SSW75	82.366	80.160	1.906	1200
S1.003	o	300	SSW76	81.902	79.880	1.722	1200
S1.004	o	300	SS76A	81.902	78.900	2.702	1200
S1.005	o	300	SSW77	81.801	78.870	2.631	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	32.857	156.5	SSW72	82.089	80.370	1.494	1200
S2.000	27.373	152.1	SSW72	82.089	80.370	1.494	1200
S1.001	32.718	155.8	SSW75	82.366	80.160	1.981	1200
S3.000	27.514	183.4	SSW74	81.898	80.340	1.333	1200
S3.001	35.056	194.8	SSW75	82.366	80.160	1.981	1200
S1.002	57.030	203.7	SSW76	81.902	79.880	1.722	1200
S1.003	4.215	210.8	SS76A	81.902	79.860	1.742	1200
S1.004	5.954	198.5	SSW77	81.801	78.870	2.631	1200
S1.005	57.226	154.7	SSW83.	80.324	78.500	1.524	1200

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw4.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw4.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	51.762	0.350	147.9	0.105	4.00	0.0	0.600	o	225
S1.001	31.067	0.120	258.9	0.040	0.00	0.0	0.600	o	225
S1.002	37.129	0.150	247.5	0.025	0.00	0.0	0.600	o	225
S2.000	63.070	0.310	203.5	0.146	4.00	0.0	0.600	o	225
S2.001	65.778	0.380	173.1	0.110	0.00	0.0	0.600	o	225
S1.003	32.828	0.110	298.4	0.022	0.00	0.0	0.600	o	300
S1.004	11.096	0.037	299.9	0.018	0.00	0.0	0.600	o	375
S1.005	25.582	0.083	308.2	0.040	0.00	0.0	0.600	o	375
S1.006	42.988	0.130	330.7	0.070	0.00	0.0	0.600	o	375

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	47.11	4.80	79.100	0.105	0.0	0.0	2.7	1.07	42.7	16.1
S1.001	44.95	5.44	78.680	0.145	0.0	0.0	3.5	0.81	32.1	21.2
S1.002	42.72	6.19	78.560	0.170	0.0	0.0	3.9	0.83	32.9	23.6
S2.000	45.91	5.15	79.100	0.146	0.0	0.0	3.6	0.91	36.3	21.8
S2.001	42.55	6.26	78.790	0.256	0.0	0.0	5.9	0.99	39.4	35.4
S1.003	40.95	6.86	78.260	0.448	0.0	0.0	9.9	0.90	64.0	59.6
S1.004	40.51	7.04	78.150	0.466	0.0	0.0	10.2	1.04	115.0	61.4
S1.005	39.52	7.46	78.113	0.506	0.0	0.0	10.8	1.03	113.4	65.0
S1.006	37.94	8.18	78.030	0.576	0.0	0.0	11.8	0.99	109.4	71.0

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Network Design Table for sw4.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S3.000	35.914	0.470	76.4	0.057	4.00	0.0	0.600	o	225
S4.000	26.051	0.220	118.4	0.072	4.00	0.0	0.600	o	225
S3.001	31.390	0.120	261.6	0.070	0.00	0.0	0.600	o	225
S3.002	67.132	0.700	95.9	0.105	0.00	0.0	0.600	o	225
S1.007	25.758	0.057	451.9	0.055	0.00	0.0	0.600	o	450
S5.000	40.708	0.271	150.2	0.065	4.00	0.0	0.600	o	225
S1.008	5.083	0.013	391.0	0.000	0.00	0.0	0.600	o	450

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	48.61	4.40	79.400	0.057	0.0	0.0	1.5	1.50	59.5	9.0
S4.000	48.76	4.36	79.150	0.072	0.0	0.0	1.9	1.20	47.7	11.4
S3.001	46.25	5.05	78.860	0.199	0.0	0.0	5.0	0.80	32.0	29.9
S3.002	43.60	5.89	78.670	0.304	0.0	0.0	7.2	1.34	53.1	43.1
S1.007	37.03	8.63	77.820	0.935	0.0	0.0	18.8	0.95	151.1	112.5
S5.000	47.72	4.64	78.883	0.065	0.0	0.0	1.7	1.06	42.3	10.1
S1.008	36.87	8.71	77.763	1.000	0.0	0.0	20.0	1.02	162.5	119.8

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Manhole Schedules for sw4.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW40	80.361	1.261	1200	S1.000	79.100	225				
SSW41	80.005	1.325	1200	S1.001	78.680	225	S1.000	78.750	225	70
SSW42	79.979	1.419	1200	S1.002	78.560	225	S1.001	78.560	225	
SSW43	80.048	0.948	1200	S2.000	79.100	225				
SSW44	79.518	0.728	1200	S2.001	78.790	225	S2.000	78.790	225	
SSW45	80.004	1.744	1200	S1.003	78.260	300	S1.002	78.410	225	75
							S2.001	78.410	225	75
SSW46	79.969	1.819	1350	S1.004	78.150	375	S1.003	78.150	300	
SSW47	80.009	1.896	1350	S1.005	78.113	375	S1.004	78.113	375	
SSW48	79.794	1.764	1350	S1.006	78.030	375	S1.005	78.030	375	
SSW50	80.769	1.369	1200	S3.000	79.400	225				
SSW49	80.853	1.703	1200	S4.000	79.150	225				
SSW51	80.001	1.141	1200	S3.001	78.860	225	S3.000	78.930	225	70
							S4.000	78.930	225	70
SSW52	79.751	1.081	1200	S3.002	78.670	225	S3.001	78.740	225	70
SSW53	80.173	2.353	1350	S1.007	77.820	450	S1.006	77.900	375	5
							S3.002	77.970	225	
SSW54	81.344	2.461	1200	S5.000	78.883	225				
SSW55	80.629	2.866	1350	S1.008	77.763	450	S1.007	77.763	450	
							S5.000	78.612	225	624
SSW56	80.626	2.876	1200		OUTFALL		S1.008	77.750	450	

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PIPELINE SCHEDULES for sw4.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW40	80.361	79.100	1.036	1200
S1.001	o	225	SSW41	80.005	78.680	1.100	1200
S1.002	o	225	SSW42	79.979	78.560	1.194	1200
S2.000	o	225	SSW43	80.048	79.100	0.723	1200
S2.001	o	225	SSW44	79.518	78.790	0.503	1200
S1.003	o	300	SSW45	80.004	78.260	1.444	1200
S1.004	o	375	SSW46	79.969	78.150	1.444	1350
S1.005	o	375	SSW47	80.009	78.113	1.521	1350
S1.006	o	375	SSW48	79.794	78.030	1.389	1350
S3.000	o	225	SSW50	80.769	79.400	1.144	1200
S4.000	o	225	SSW49	80.853	79.150	1.478	1200
S3.001	o	225	SSW51	80.001	78.860	0.916	1200
S3.002	o	225	SSW52	79.751	78.670	0.856	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	51.762	147.9	SSW41	80.005	78.750	1.030	1200
S1.001	31.067	258.9	SSW42	79.979	78.560	1.194	1200
S1.002	37.129	247.5	SSW45	80.004	78.410	1.369	1200
S2.000	63.070	203.5	SSW44	79.518	78.790	0.503	1200
S2.001	65.778	173.1	SSW45	80.004	78.410	1.369	1200
S1.003	32.828	298.4	SSW46	79.969	78.150	1.519	1350
S1.004	11.096	299.9	SSW47	80.009	78.113	1.521	1350
S1.005	25.582	308.2	SSW48	79.794	78.030	1.389	1350
S1.006	42.988	330.7	SSW53	80.173	77.900	1.898	1350
S3.000	35.914	76.4	SSW51	80.001	78.930	0.846	1200
S4.000	26.051	118.4	SSW51	80.001	78.930	0.846	1200
S3.001	31.390	261.6	SSW52	79.751	78.740	0.786	1200
S3.002	67.132	95.9	SSW53	80.173	77.970	1.978	1350

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PIPELINE SCHEDULES for sw4.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.007	o	450	SSW53	80.173	77.820	1.903	1350
S5.000	o	225	SSW54	81.344	78.883	2.236	1200
S1.008	o	450	SSW55	80.629	77.763	2.416	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.007	25.758	451.9	SSW55	80.629	77.763	2.416	1350
S5.000	40.708	150.2	SSW55	80.629	78.612	1.792	1350
S1.008	5.083	391.0	SSW56	80.626	77.750	2.426	1200

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw3.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw3.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	16.371	0.130	125.9	0.040	4.00	0.0	0.600	o	225
S1.001	90.386	0.360	251.1	0.142	0.00	0.0	0.600	o	225
S1.002	32.689	0.120	272.4	0.115	0.00	0.0	0.600	o	300
S1.003	26.045	0.100	260.5	0.055	0.00	0.0	0.600	o	300
S1.004	4.522	0.110	41.1	0.000	0.00	0.0	0.600	o	300
S1.005	6.547	0.050	130.9	0.000	0.00	0.0	0.600	o	300
S1.006	18.927	0.100	189.3	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	49.26	4.23	78.700	0.040	0.0	0.0	1.1	1.16	46.3	6.4
S1.001	43.07	6.07	78.490	0.182	0.0	0.0	4.2	0.82	32.6	25.5
S1.002	41.51	6.65	77.930	0.297	0.0	0.0	6.7	0.95	67.0	40.1
S1.003	40.38	7.09	77.810	0.352	0.0	0.0	7.7	0.97	68.5	46.2
S1.004	40.31	7.12	77.710	0.352	0.0	0.0	7.7	2.46	173.8	46.2
S1.005	40.12	7.20	77.050	0.352	0.0	0.0	7.7	1.37	97.0	46.2
S1.006	39.47	7.48	77.000	0.352	0.0	0.0	7.7	1.14	80.5	46.2

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Manhole Schedules for sw3.sws

	MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
	SSW60	79.718	1.018	1200	S1.000	78.700	225				
	SSW61	79.878	1.388	1200	S1.001	78.490	225	S1.000	78.570	225	80
	SSW62	79.081	1.151	1200	S1.002	77.930	300	S1.001	78.130	225	125
	SSW63	79.562	1.752	1200	S1.003	77.810	300	S1.002	77.810	300	
	SSW64	79.742	2.032	1200	S1.004	77.710	300	S1.003	77.710	300	
	SSW65	79.832	2.782	1200	S1.005	77.050	300	S1.004	77.600	300	550
	SSW66	79.953	2.953	1200	S1.006	77.000	300	S1.005	77.000	300	
SEX	SW MH	79.975	3.075	1200		OUTFALL		S1.006	76.900	300	

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PIPELINE SCHEDULES for sw3.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW60	79.718	78.700	0.793	1200
S1.001	o	225	SSW61	79.878	78.490	1.163	1200
S1.002	o	300	SSW62	79.081	77.930	0.851	1200
S1.003	o	300	SSW63	79.562	77.810	1.452	1200
S1.004	o	300	SSW64	79.742	77.710	1.732	1200
S1.005	o	300	SSW65	79.832	77.050	2.482	1200
S1.006	o	300	SSW66	79.953	77.000	2.653	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	16.371	125.9	SSW61	79.878	78.570	1.083	1200
S1.001	90.386	251.1	SSW62	79.081	78.130	0.726	1200
S1.002	32.689	272.4	SSW63	79.562	77.810	1.452	1200
S1.003	26.045	260.5	SSW64	79.742	77.710	1.732	1200
S1.004	4.522	41.1	SSW65	79.832	77.600	1.932	1200
S1.005	6.547	130.9	SSW66	79.953	77.000	2.653	1200
S1.006	18.927	189.3	SEX SW MH	79.975	76.900	2.775	1200

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw2.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw2.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	58.073	0.390	148.9	0.135	4.00	0.0	0.600	o	225
S1.001	72.244	0.290	249.1	0.135	0.00	0.0	0.600	o	300
S1.002	66.828	0.230	290.6	0.140	0.00	0.0	0.600	o	300
S1.003	49.921	0.240	208.0	0.060	0.00	0.0	0.600	o	300
S2.000	56.045	0.750	74.7	0.145	4.00	0.0	0.600	o	225
S3.000	29.639	0.200	148.2	0.090	4.00	0.0	0.600	o	225
S2.001	85.685	0.350	244.8	0.120	0.00	0.0	0.600	o	300
S2.002	14.915	0.170	87.7	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	46.75	4.91	80.400	0.135	0.0	0.0	3.4	1.07	42.5	20.5
S1.001	42.93	6.12	79.935	0.270	0.0	0.0	6.3	0.99	70.1	37.7
S1.002	39.81	7.33	79.645	0.410	0.0	0.0	8.8	0.92	64.8	53.0
S1.003	38.11	8.10	79.415	0.470	0.0	0.0	9.7	1.09	76.8	58.2
S2.000	47.79	4.62	80.450	0.145	0.0	0.0	3.8	1.51	60.2	22.5
S3.000	48.38	4.46	79.900	0.090	0.0	0.0	2.4	1.07	42.6	14.1
S2.001	43.15	6.04	79.625	0.355	0.0	0.0	8.3	1.00	70.7	49.8
S2.002	42.73	6.19	79.275	0.355	0.0	0.0	8.3	1.68	118.7	49.8

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Network Design Table for sw2.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.004	13.628	0.030	454.3	0.000	0.00	0.0	0.600	o	450
S1.005	70.924	0.158	448.9	0.115	0.00	0.0	0.600	o	450
S1.006	28.896	0.062	466.1	0.018	0.00	0.0	0.600	o	450
S4.000	58.627	0.390	150.3	0.123	4.00	0.0	0.600	o	225
S1.007	7.632	0.017	448.9	0.000	0.00	0.0	0.600	o	450
S1.008	40.000	0.088	454.5	0.000	0.00	0.0	0.600	o	450
S1.009	47.600	0.245	194.3	0.000	0.00	0.0	0.600	o	450

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.004	37.61	8.34	78.955	0.825	0.0	0.0	16.8	0.95	150.7	100.8
S1.005	35.28	9.58	78.925	0.940	0.0	0.0	18.0	0.95	151.6	107.8
S1.006	34.42	10.09	78.767	0.958	0.0	0.0	18.0	0.94	148.7	107.8
S4.000	46.71	4.92	80.450	0.123	0.0	0.0	3.1	1.06	42.3	18.7
S1.007	34.20	10.23	78.705	1.081	0.0	0.0	20.0	0.95	151.6	120.2
S1.008	33.12	10.93	78.688	1.081	0.0	0.0	20.0	0.95	150.6	120.2
S1.009	32.34	11.48	78.600	1.081	0.0	0.0	20.0	1.46	231.4	120.2

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Manhole Schedules for sw2.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW20	81.616	1.216	1200	S1.000	80.400	225				
SSW21	81.139	1.204	1200	S1.001	79.935	300	S1.000	80.010	225	
SSW22	80.981	1.336	1200	S1.002	79.645	300	S1.001	79.645	300	
SSW23	80.079	0.664	1200	S1.003	79.415	300	S1.002	79.415	300	
SSW25	81.576	1.126	1200	S2.000	80.450	225				
SSW24	80.781	0.881	1200	S3.000	79.900	225				
SSW26	81.086	1.461	1200	S2.001	79.625	300	S2.000	79.700	225	
							S3.000	79.700	225	
SSW27	80.520	1.245	1200	S2.002	79.275	300	S2.001	79.275	300	
SSW28	80.411	1.456	1350	S1.004	78.955	450	S1.003	79.175	300	70
							S2.002	79.105	300	
SSW29	80.578	1.653	1350	S1.005	78.925	450	S1.004	78.925	450	
SSW30	81.055	2.288	1350	S1.006	78.767	450	S1.005	78.767	450	
SSW31	81.659	1.209	1200	S4.000	80.450	225				
SSW32	81.267	2.562	1350	S1.007	78.705	450	S1.006	78.705	450	
							S4.000	80.060	225	1130
SSW33	81.174	2.486	1350	S1.008	78.688	450	S1.007	78.688	450	
SSW34	81.347	2.747	1350	S1.009	78.600	450	S1.008	78.600	450	
SHW2	79.586	1.230	0		OUTFALL		S1.009	78.355	450	

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PIPELINE SCHEDULES for sw2.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW20	81.616	80.400	0.991	1200
S1.001	o	300	SSW21	81.139	79.935	0.904	1200
S1.002	o	300	SSW22	80.981	79.645	1.036	1200
S1.003	o	300	SSW23	80.079	79.415	0.364	1200
S2.000	o	225	SSW25	81.576	80.450	0.901	1200
S3.000	o	225	SSW24	80.781	79.900	0.656	1200
S2.001	o	300	SSW26	81.086	79.625	1.161	1200
S2.002	o	300	SSW27	80.520	79.275	0.945	1200
S1.004	o	450	SSW28	80.411	78.955	1.006	1350
S1.005	o	450	SSW29	80.578	78.925	1.203	1350
S1.006	o	450	SSW30	81.055	78.767	1.838	1350
S4.000	o	225	SSW31	81.659	80.450	0.984	1200
S1.007	o	450	SSW32	81.267	78.705	2.112	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	58.073	148.9	SSW21	81.139	80.010	0.904	1200
S1.001	72.244	249.1	SSW22	80.981	79.645	1.036	1200
S1.002	66.828	290.6	SSW23	80.079	79.415	0.364	1200
S1.003	49.921	208.0	SSW28	80.411	79.175	0.936	1350
S2.000	56.045	74.7	SSW26	81.086	79.700	1.161	1200
S3.000	29.639	148.2	SSW26	81.086	79.700	1.161	1200
S2.001	85.685	244.8	SSW27	80.520	79.275	0.945	1200
S2.002	14.915	87.7	SSW28	80.411	79.105	1.006	1350
S1.004	13.628	454.3	SSW29	80.578	78.925	1.203	1350
S1.005	70.924	448.9	SSW30	81.055	78.767	1.838	1350
S1.006	28.896	466.1	SSW32	81.267	78.705	2.112	1350
S4.000	58.627	150.3	SSW32	81.267	80.060	0.981	1350
S1.007	7.632	448.9	SSW33	81.174	78.688	2.036	1350

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PIPELINE SCHEDULES for sw2.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.008	o	450	SSW33	81.174	78.688	2.036	1350
S1.009	o	450	SSW34	81.347	78.600	2.297	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.008	40.000	454.5	SSW34	81.347	78.600	2.297	1350
S1.009	47.600	194.3	SHW2	79.586	78.355	0.780	0

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for sw1.sws

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	20
M5-60 (mm)	15.300	Minimum Backdrop Height (m)	0.000
Ratio R	0.280	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for sw1.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.000	35.694	0.240	148.7	0.062	4.00	0.0	0.600	o	225
S2.000	28.959	0.190	152.4	0.087	4.00	0.0	0.600	o	225
S2.001	56.576	0.230	246.0	0.180	0.00	0.0	0.600	o	300
S2.002	22.102	0.090	245.6	0.031	0.00	0.0	0.600	o	300
S1.001	40.106	0.160	250.7	0.030	0.00	0.0	0.600	o	300
S1.002	38.276	0.160	239.2	0.046	0.00	0.0	0.600	o	300
S3.000	80.000	0.440	181.8	0.113	4.00	0.0	0.600	o	225
S3.001	53.749	0.220	244.3	0.172	0.00	0.0	0.600	o	300
S3.002	38.136	0.150	254.2	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	48.02	4.56	80.800	0.062	0.0	0.0	1.6	1.07	42.5	9.7
S2.000	48.39	4.46	80.600	0.087	0.0	0.0	2.3	1.06	42.0	13.7
S2.001	45.09	5.40	80.335	0.267	0.0	0.0	6.5	1.00	70.5	39.1
S2.002	43.95	5.77	80.105	0.298	0.0	0.0	7.1	1.00	70.6	42.6
S1.001	42.03	6.45	80.015	0.390	0.0	0.0	8.9	0.99	69.9	53.3
S1.002	40.42	7.08	79.855	0.436	0.0	0.0	9.5	1.01	71.5	57.3
S3.000	45.16	5.38	79.940	0.113	0.0	0.0	2.8	0.97	38.4	16.6
S3.001	42.50	6.27	79.425	0.285	0.0	0.0	6.6	1.00	70.8	39.4
S3.002	40.80	6.92	79.205	0.285	0.0	0.0	6.6	0.98	69.4	39.4

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Network Design Table for sw1.sws

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
S1.003	15.000	0.050	300.0	0.000	0.00	0.0	0.600	o	375
S1.004	66.023	0.800	82.5	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	39.85	7.32	78.980	0.721	0.0	0.0	15.6	1.04	115.0	93.4
S1.004	38.42	7.95	78.930	0.721	0.0	0.0	15.6	1.73	122.4	93.4

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Manhole Schedules for sw1.sws

MH Name	MH CL (m)	MH Depth (m)	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SSW1	82.417	1.617	1200	S1.000	80.800	225				
SSW4	81.882	1.282	1200	S2.000	80.600	225				
SSW5	82.127	1.792	1200	S2.001	80.335	300	S2.000	80.410	225	
SSW6	82.085	1.980	1200	S2.002	80.105	300	S2.001	80.105	300	
SSW2	82.278	2.263	1200	S1.001	80.015	300	S1.000	80.560	225	470
							S2.002	80.015	300	
SSW3	81.854	1.999	1200	S1.002	79.855	300	S1.001	79.855	300	
SSW7	81.699	1.759	1200	S3.000	79.940	225				
SSW8	81.002	1.577	1200	S3.001	79.425	300	S3.000	79.500	225	
SSW9	81.293	2.088	1200	S3.002	79.205	300	S3.001	79.205	300	
SSW10	81.602	2.622	1350	S1.003	78.980	375	S1.002	79.695	300	640
							S3.002	79.055	300	
SSW11	80.594	1.664	1350	S1.004	78.930	300	S1.003	78.930	375	
SHW1	79.586	1.455	0		OUTFALL		S1.004	78.130	300	

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PIPELINE SCHEDULES for sw1.sws

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	o	225	SSW1	82.417	80.800	1.392	1200
S2.000	o	225	SSW4	81.882	80.600	1.057	1200
S2.001	o	300	SSW5	82.127	80.335	1.492	1200
S2.002	o	300	SSW6	82.085	80.105	1.680	1200
S1.001	o	300	SSW2	82.278	80.015	1.963	1200
S1.002	o	300	SSW3	81.854	79.855	1.699	1200
S3.000	o	225	SSW7	81.699	79.940	1.534	1200
S3.001	o	300	SSW8	81.002	79.425	1.277	1200
S3.002	o	300	SSW9	81.293	79.205	1.788	1200
S1.003	o	375	SSW10	81.602	78.980	2.247	1350
S1.004	o	300	SSW11	80.594	78.930	1.364	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
S1.000	35.694	148.7	SSW2	82.278	80.560	1.493	1200
S2.000	28.959	152.4	SSW5	82.127	80.410	1.492	1200
S2.001	56.576	246.0	SSW6	82.085	80.105	1.680	1200
S2.002	22.102	245.6	SSW2	82.278	80.015	1.963	1200
S1.001	40.106	250.7	SSW3	81.854	79.855	1.699	1200
S1.002	38.276	239.2	SSW10	81.602	79.695	1.607	1350
S3.000	80.000	181.8	SSW8	81.002	79.500	1.277	1200
S3.001	53.749	244.3	SSW9	81.293	79.205	1.788	1200
S3.002	38.136	254.2	SSW10	81.602	79.055	2.247	1350
S1.003	15.000	300.0	SSW11	80.594	78.930	1.289	1350
S1.004	66.023	82.5	SHW1	79.586	78.130	1.155	0

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Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 2784 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	77.626	0.236	1.0	85.3	O K
30 min Summer	77.711	0.321	1.0	115.8	O K
60 min Summer	77.797	0.407	1.0	146.8	O K
120 min Summer	77.890	0.500	1.0	180.4	O K
180 min Summer	77.947	0.557	1.0	201.1	O K
240 min Summer	77.988	0.598	1.0	216.1	O K
360 min Summer	78.047	0.657	1.0	237.3	O K
480 min Summer	78.088	0.698	1.1	252.1	O K
600 min Summer	78.119	0.729	1.1	263.1	O K
720 min Summer	78.142	0.752	1.1	271.6	O K
960 min Summer	78.175	0.785	1.1	283.6	O K
1440 min Summer	78.210	0.820	1.1	296.0	O K
2160 min Summer	78.221	0.831	1.1	299.9	O K
2880 min Summer	78.215	0.825	1.1	297.8	O K
4320 min Summer	78.194	0.804	1.1	290.3	O K
5760 min Summer	78.170	0.780	1.1	281.7	O K
7200 min Summer	78.145	0.755	1.1	272.5	O K
8640 min Summer	78.118	0.728	1.1	262.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	85.387	27
30 min Summer	58.078	41
60 min Summer	37.062	72
120 min Summer	23.070	130
180 min Summer	17.345	190
240 min Summer	14.135	250
360 min Summer	10.568	368
480 min Summer	8.587	488
600 min Summer	7.306	608
720 min Summer	6.401	726
960 min Summer	5.193	966
1440 min Summer	3.866	1442
2160 min Summer	2.877	2104
2880 min Summer	2.331	2448
4320 min Summer	1.731	3204
5760 min Summer	1.400	4032
7200 min Summer	1.187	4832
8640 min Summer	1.037	5704

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Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
10080 min Summer	78.091	0.701	1.1	253.2	O K
15 min Winter	77.655	0.265	1.0	95.7	O K
30 min Winter	77.750	0.360	1.0	129.9	O K
60 min Winter	77.846	0.456	1.0	164.8	O K
120 min Winter	77.952	0.562	1.0	202.8	O K
180 min Winter	78.017	0.627	1.0	226.4	O K
240 min Winter	78.065	0.675	1.0	243.6	O K
360 min Winter	78.133	0.743	1.1	268.2	O K
480 min Winter	78.181	0.791	1.1	285.6	O K
600 min Winter	78.218	0.828	1.1	298.8	O K
720 min Winter	78.246	0.856	1.1	309.1	O K
960 min Winter	78.288	0.898	1.1	324.2	O K
1440 min Winter	78.336	0.946	1.1	341.5	O K
2160 min Winter	78.362	0.972	1.1	351.0	O K
2880 min Winter	78.360	0.970	1.1	350.3	O K
4320 min Winter	78.330	0.940	1.1	339.3	O K
5760 min Winter	78.296	0.906	1.1	326.9	O K
7200 min Winter	78.256	0.866	1.1	312.7	O K
8640 min Winter	78.214	0.824	1.1	297.5	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.926	6464
15 min Winter	85.387	27
30 min Winter	58.078	41
60 min Winter	37.062	70
120 min Winter	23.070	128
180 min Winter	17.345	188
240 min Winter	14.135	246
360 min Winter	10.568	362
480 min Winter	8.587	480
600 min Winter	7.306	598
720 min Winter	6.401	714
960 min Winter	5.193	948
1440 min Winter	3.866	1406
2160 min Winter	2.877	2080
2880 min Winter	2.331	2716
4320 min Winter	1.731	3416
5760 min Winter	1.400	4328
7200 min Winter	1.187	5264
8640 min Winter	1.037	6152

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Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
10080 min Winter	78.171	0.781	1.1	281.8	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.926	7064

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.200	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time / Area Diagram

Total Area (ha) 0.540

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.180	4-8	0.180	8-12	0.180

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Model Details

Storage is Online Cover Level (m) 80.500

Cellular Storage Structure

Invert Level (m) 77.390 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.01767 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01767

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	380.0	380.0	1.000	380.0	380.0

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BRE Digest 365 Test

		Revision	1.00
Job No:	606	Page:	C/01
Prepared By:	DR	Date:	05/09/2018

Section: **Brayton Park, Kilcock, Co. Kildare. Trial Hole 5**

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways		
width of trench *[mm]* :	450	600	900
required trench length *[m]* :	1564.57	1230.14	861.73
	ring soakaways		
diameter of ring *[mm]* :	1500	2100	2400
required pit diameter *[m]* :	6.03	6.03	6.03

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS

critical design rainfall duration 't_{crit}' =	600	*min*
required storage volume 'V_{req}' =	377.77	m^3
provided storage volume 'V_{prov}' =	384.75	m^3
utilisation factor =	**0.98**	***.OK***
required time to discharge 50% 't_{50}' =	18.20	*hours*
utilisation factor =	**0.76**	***.OK***

GENERAL DATA

site location: [redacted] **Ireland**
soakaway type: **infilled pit or trench**

impermeable area drained to soakaway 'A' *[m^2]* =	**8267**
60 min rainfall depth of 5 year return period 'R' *[mm]* =	**20**
M5-60 to M5-2d rainfall ratio 'r' =	**0.36**
allowance for climate change:	**10%**

SOAKAWAY DATA

soakaway width 'W' [m] =	**30.00**
soakaway length 'L' [m] =	**30.00**
total depth from ground level 'D_b' *[m]* =	**0.70**
depth to drain invert level 'D_d' *[m]* =	**0.25**
soakaway effective depth 'D_{eff}' *[m]* =	0.45
free volume in infill aggregate *[%]* =	**95**

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base: **60%**
available on-site infiltration test results: (●) Yes ( ) No
use soakage trial pit table below

internal surface area of trial pit 'a_{p50}' [m^2] =	1.94
storage volume between 75-25% 'V_p' [m^3] =	0.25
time for water to fall from 75-25% 't_p' [min] =	411.56
soil infiltration rate 'f' [m/s] =	5.18E-06

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W_t' *[m]* =	**0.60**
soakage trial pit length 'L_t' *[m]* =	**1.10**
total depth from ground level 'D_{tb}' *[m]* =	**1.10**
depth to pipe invert level 'D_{tp}' *[m]* =	**0.35**
soakage trial pit effective depth 'D_{teff}' *[m]* =	0.75
free volume in infill aggregate *[%]* =	**100**

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M30-D Z2	M30-D rainfalls *[mm]*	M30-D inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	outflow from soakaway *[m^3]*	required storage *[m^3]*
5	0.36	6.99	1.46	11.23	92.85							0.88	91.97
10	0.51	9.92	1.49	16.25	134.33							1.76	132.56
15	0.62	12.06	1.49	19.79	163.61							2.64	160.97
30	0.79	15.38	1.49	25.24	208.63							5.29	203.35
60	1.00	19.50	1.48	31.65	261.62							10.57	251.04
120	1.22	23.82	1.46	38.33	316.88							21.15	295.74
240	1.49	28.99	1.45	46.13	381.39							42.29	339.10
360	1.68	32.72	1.44	51.66	427.04							63.44	363.60
600	1.92	37.41	1.42	58.49	483.50							105.73	**377.77**
1440	2.44	47.66	1.38	72.49	599.25							253.75	345.50

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	1310																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 2	time *[min]* =	0	1315																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 3	time *[min]* =	0	1317																	
	depth to water *[m]* =	0.40	0.60																	

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BRE Digest 365 Test

		Revision	1.00
Job No:	606	Page:	C/01
Section: Brayton Park, Kilcock, Co. Kildare. Trial Hole 4	Prepared By:	DR	Date: 05/09/2018

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways		
width of trench *[mm]* :	450	600	900
required trench length *[m]* :	1475.15	1158.71	810.83
	ring soakaways		
diameter of ring *[mm]* :	1500	2100	2400
required pit diameter *[m]* :	5.84	5.84	5.84

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS

critical design rainfall duration 't_{crit}' =	600	*min*
required storage volume 'V_{req}' =	349.33	m^3
provided storage volume 'V_{prov}' =	384.75	m^3
utilisation factor =	**0.91**	***.OK***
required time to discharge 50% 't_{50}' =	18.72	*hours*
utilisation factor =	**0.78**	***.OK***

GENERAL DATA

site location: [redacted] **Ireland**
soakaway type: **infilled pit or trench**

impermeable area drained to soakaway 'A' *[m^2]* =	**7730**
60 min rainfall depth of 5 year return period 'R' *[mm]* =	**20**
M5-60 to M5-2d rainfall ratio 'r' =	**0.36**
allowance for climate change:	**10%**

SOAKAWAY DATA

soakaway width 'W' [m] =	**30.00**
soakaway length 'L' [m] =	**30.00**
total depth from ground level 'D_b' *[m]* =	**0.70**
depth to drain invert level 'D_d' *[m]* =	**0.25**
soakaway effective depth 'D_{eff}' *[m]* =	0.45
free volume in infill aggregate *[%]* =	**95**

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base: **60%**
available on-site infiltration test results: (●) Yes ( ) No
use soakage trial pit table below

internal surface area of trial pit 'a_{p50}' [m^2] =	1.94
storage volume between 75-25% 'V_p' [m^3] =	0.25
time for water to fall from 75-25% 't_p' [min] =	423.44
soil infiltration rate 'f' [m/s] =	5.03E-06

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W_t' *[m]* =	**0.60**
soakage trial pit length 'L_t' *[m]* =	**1.10**
total depth from ground level 'D_{tb}' *[m]* =	**1.10**
depth to pipe invert level 'D_{tp}' *[m]* =	**0.35**
soakage trial pit effective depth 'D_{teff}' *[m]* =	0.75
free volume in infill aggregate *[%]* =	**100**

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M30-D Z2	M30-D rainfalls *[mm]*	M30-D inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	outflow from soakaway *[m^3]*	required storage *[m^3]*
5	0.36	6.99	1.46	11.23	86.82							0.86	85.97
10	0.51	9.92	1.49	16.25	125.60							1.71	123.89
15	0.62	12.06	1.49	19.79	152.99							2.57	150.42
30	0.79	15.38	1.49	25.24	195.08							5.14	189.94
60	1.00	19.50	1.48	31.65	244.62							10.28	234.35
120	1.22	23.82	1.46	38.33	296.30							20.55	275.75
240	1.49	28.99	1.45	46.13	356.61							41.11	315.51
360	1.68	32.72	1.44	51.66	399.30							61.66	337.64
600	1.92	37.41	1.42	58.49	452.09							102.76	**349.33**
1440	2.44	47.66	1.38	72.49	560.32							246.63	313.69

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

water level measurement N°:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	1350																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 2	time *[min]* =	0	1350																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 3	time *[min]* =	0	1355																	
	depth to water *[m]* =	0.40	0.60																	

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BRE Digest 365 Test

		Revision	1.00
Job No:	606	Page:	C/01
Section: Brayton Park, Kilcock, Co. Kildare. Trial Hole 2	Prepared By:	DR	Date: 22/08/2018

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways		
width of trench *[mm]* :	450	600	900
required trench length *[m]* :	2606.40	2027.56	1414.50
	ring soakaways		
diameter of ring *[mm]* :	1500	2100	2400
required pit diameter *[m]* :	6.75	6.75	6.75

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS

critical design rainfall duration 't_{crit}' =	600	*min*
required storage volume 'V_{req}' =	609.69	m^3
provided storage volume 'V_{prov}' =	616.88	m^3
utilisation factor =	**0.99**	***.OK***
required time to discharge 50% 't_{50}' =	21.83	*hours*
utilisation factor =	**0.91**	***.OK***

GENERAL DATA

site location: [redacted] **Ireland**
soakaway type: **infilled pit or trench**

impermeable area drained to soakaway 'A' *[m^2]* = **12841**
60 min rainfall depth of 5 year return period 'R' *[mm]* = **20**
M5-60 to M5-2d rainfall ratio 'r' = **0.36**
allowance for climate change: **10%**

SOAKAWAY DATA

soakaway width 'W' [m] = **39.00**
soakaway length 'L' [m] = **37.00**

total depth from ground level 'D_b' *[m]* = **0.70**
depth to drain invert level 'D_d' *[m]* = **0.25**
soakaway effective depth 'D_{eff}' *[m]* = 0.45
free volume in infill aggregate *[%]* = **95**

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base: **70%**
available on-site infiltration test results: (●) Yes ( ) No
use soakage trial pit table below
internal surface area of trial pit 'a_{p50}' [m^2] = 1.64
storage volume between 75-25% 'V_p' [m^3] = 0.20
time for water to fall from 75-25% 't_p' [min] = 527.19
soil infiltration rate 'f' [m/s] = 3.76E-06

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W_t' *[m]* = **0.60**
soakage trial pit length 'L_t' *[m]* = **1.00**
total depth from ground level 'D_{tb}' *[m]* = **1.15**
depth to pipe invert level 'D_{tp}' *[m]* = **0.50**
soakage trial pit effective depth 'D_{teff}' *[m]* = 0.65
free volume in infill aggregate *[%]* = **100**
NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M30-D Z2	M30-D rainfalls *[mm]*	M30-D inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	outflow from soakaway *[m^3]*	required storage *[m^3]*
5	0.36	6.99	1.46	11.23	144.23							1.18	143.05
10	0.51	9.92	1.49	16.25	208.65							2.36	206.29
15	0.62	12.06	1.49	19.79	254.14							3.53	250.61
30	0.79	15.38	1.49	25.24	324.07							7.07	317.00
60	1.00	19.50	1.48	31.65	406.37							14.13	392.23
120	1.22	23.82	1.46	38.33	492.21							28.26	463.95
240	1.49	28.99	1.45	46.13	592.40							56.53	535.88
360	1.68	32.72	1.44	51.66	663.32							84.79	578.53
600	1.92	37.41	1.42	58.49	751.01							141.32	**609.69**
1440	2.44	47.66	1.38	72.49	930.80							339.17	591.63

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	1200																	
	depth to water *[m]* =	0.55	0.75																	
Soakage Trial 2	time *[min]* =	0	1200																	
	depth to water *[m]* =	0.55	0.75																	
Soakage Trial 3	time *[min]* =	0	1205																	
	depth to water *[m]* =	0.55	0.75																	

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BRE Digest 365 Test

		Revision	1.00
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Section: Brayton Park, Kilcock, Co. Kildare. Trial Hole 3	Prepared By:	DR	Date: 22/08/2018

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways		
width of trench *[mm]* :	450	600	900
required trench length *[m]* :	2272.38	1772.72	1241.58
	ring soakaways		
diameter of ring *[mm]* :	1500	2100	2400
required pit diameter *[m]* :	6.60	6.60	6.60

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS

critical design rainfall duration 't_{crit}' =	600	*min*
required storage volume 'V_{req}' =	539.03	m^3
provided storage volume 'V_{prov}' =	554.04	m^3
utilisation factor =	**0.97**	***.OK***
required time to discharge 50% 't_{50}' =	23.40	*hours*
utilisation factor =	**0.97**	***.OK***

GENERAL DATA

site location: [redacted] **Ireland**
soakaway type: **infilled pit or trench**

impermeable area drained to soakaway 'A' *[m^2]* = **11241**
60 min rainfall depth of 5 year return period 'R' *[mm]* = **20**
M5-60 to M5-2d rainfall ratio 'r' = **0.36**
allowance for climate change: **10%**

SOAKAWAY DATA

soakaway width 'W' [m] = **36.00**
soakaway length 'L' [m] = **36.00**

total depth from ground level 'D_b' *[m]* = **0.70**
depth to drain invert level 'D_d' *[m]* = **0.25**
soakaway effective depth 'D_{eff}' *[m]* = 0.45
free volume in infill aggregate *[%]* = **95**

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base: **60%**
available on-site infiltration test results: (●) Yes ( ) No
use soakage trial pit table below
internal surface area of trial pit 'a_{p50}' [m^2] = 1.94
storage volume between 75-25% 'V_p' [m^3] = 0.25
time for water to fall from 75-25% 't_p' [min] = 525.00
soil infiltration rate 'f' [m/s] = 4.06E-06

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W_t' *[m]* = **0.60**
soakage trial pit length 'L_t' *[m]* = **1.10**
total depth from ground level 'D_{tb}' *[m]* = **1.10**
depth to pipe invert level 'D_{tp}' *[m]* = **0.35**
soakage trial pit effective depth 'D_{teff}' *[m]* = 0.75
free volume in infill aggregate *[%]* = **100**
NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M30-D Z2	M30-D rainfalls *[mm]*	M30-D inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	outflow from soakaway *[m^3]*	required storage *[m^3]*
5	0.36	6.99	1.46	11.23	126.26							0.99	125.27
10	0.51	9.92	1.49	16.25	182.65							1.97	180.67
15	0.62	12.06	1.49	19.79	222.47							2.96	219.51
30	0.79	15.38	1.49	25.24	283.69							5.92	277.77
60	1.00	19.50	1.48	31.65	355.73							11.84	343.89
120	1.22	23.82	1.46	38.33	430.88							23.68	407.20
240	1.49	28.99	1.45	46.13	518.59							47.36	471.23
360	1.68	32.72	1.44	51.66	580.67							71.04	509.62
600	1.92	37.41	1.42	58.49	657.44							118.41	**539.03**
1440	2.44	47.66	1.38	72.49	814.82							284.17	530.65

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

water level measurement N°:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	1658																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 2	time *[min]* =	0	1660																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 3	time *[min]* =	0	1680																	
	depth to water *[m]* =	0.40	0.60																	

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BRE Digest 365 Test

		Revision	1.00
Job No:	606	Page:	C/01
Prepared By:	DR	Date:	22/08/2018

Section: **Brayton Park, Kilcock, Co. Kildare. Trial Hole 1**

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways		
width of trench *[mm]* :	450	600	900
required trench length *[m]* :	1674.98	1309.73	913.30
	ring soakaways		
diameter of ring *[mm]* :	1500	2100	2400
required pit diameter *[m]* :	6.11	6.11	6.11

** Based on effective depth and number of pits as in Soakaway Data table*

SUMMARY OF CALCULATIONS

critical design rainfall duration 't_{crit}' =	600	*min*
required storage volume 'V_{req}' =	398.71	m^3
provided storage volume 'V_{prov}' =	410.83	m^3
utilisation factor =	**0.97**	***.OK***
required time to discharge 50% 't_{50}' =	21.55	*hours*
utilisation factor =	**0.90**	***.OK***

GENERAL DATA

site location:	[redacted] Ireland
soakaway type:	infilled pit or trench
impermeable area drained to soakaway 'A' *[m^2]* =	8447
60 min rainfall depth of 5 year return period 'R' *[mm]* =	20
M5-60 to M5-2d rainfall ratio 'r' =	0.36
allowance for climate change:	10%

SOAKAWAY DATA

soakaway width 'W' [m] =	31.00
soakaway length 'L' [m] =	31.00
total depth from ground level 'D_b' *[m]* =	0.70
depth to drain invert level 'D_d' *[m]* =	0.25
soakaway effective depth 'D_{eff}' *[m]* =	0.45
free volume in infill aggregate *[%]* =	95

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base:	60%
available on-site infiltration test results:	(●) Yes ( ) No
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	2.09
storage volume between 75-25% 'V_p' [m^3] =	0.28
time for water to fall from 75-25% 't_p' [min] =	502.50
soil infiltration rate 'f' [m/s] =	4.38E-06

SOAKAGE TRIAL PIT DATA

soakage trial pit width 'W_t' *[m]* =	0.60
soakage trial pit length 'L_t' *[m]* =	1.15
total depth from ground level 'D_{tb}' *[m]* =	1.15
depth to pipe invert level 'D_{tp}' *[m]* =	0.35
soakage trial pit effective depth 'D_{teff}' *[m]* =	0.80
free volume in infill aggregate *[%]* =	100

NOTE: faces of excavation assumed to be vertical

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration *[min]*	rainfall factor Z1	M5-D rainfalls *[mm]*	M30-D Z2	M30-D rainfalls *[mm]*	M30-D inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	ignore Z2	ignore rainfalls *[mm]*	ignore inflow *[m^3]*	outflow from soakaway *[m^3]*	required storage *[m^3]*
5	0.36	6.99	1.46	11.23	94.88							0.79	94.08
10	0.51	9.92	1.49	16.25	137.25							1.59	135.66
15	0.62	12.06	1.49	19.79	167.18							2.38	164.79
30	0.79	15.38	1.49	25.24	213.18							4.77	208.41
60	1.00	19.50	1.48	31.65	267.31							9.53	257.78
120	1.22	23.82	1.46	38.33	323.78							19.06	304.72
240	1.49	28.99	1.45	46.13	389.69							38.13	351.57
360	1.68	32.72	1.44	51.66	436.34							57.19	379.15
600	1.92	37.41	1.42	58.49	494.03							95.32	**398.71**
1440	2.44	47.66	1.38	72.49	612.29							228.76	383.53

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	0	2000																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 2	time *[min]* =	0	2000																	
	depth to water *[m]* =	0.40	0.60																	
Soakage Trial 3	time *[min]* =	0	2010																	
	depth to water *[m]* =	0.40	0.60																	

Appendix C

Permeable Paving Details

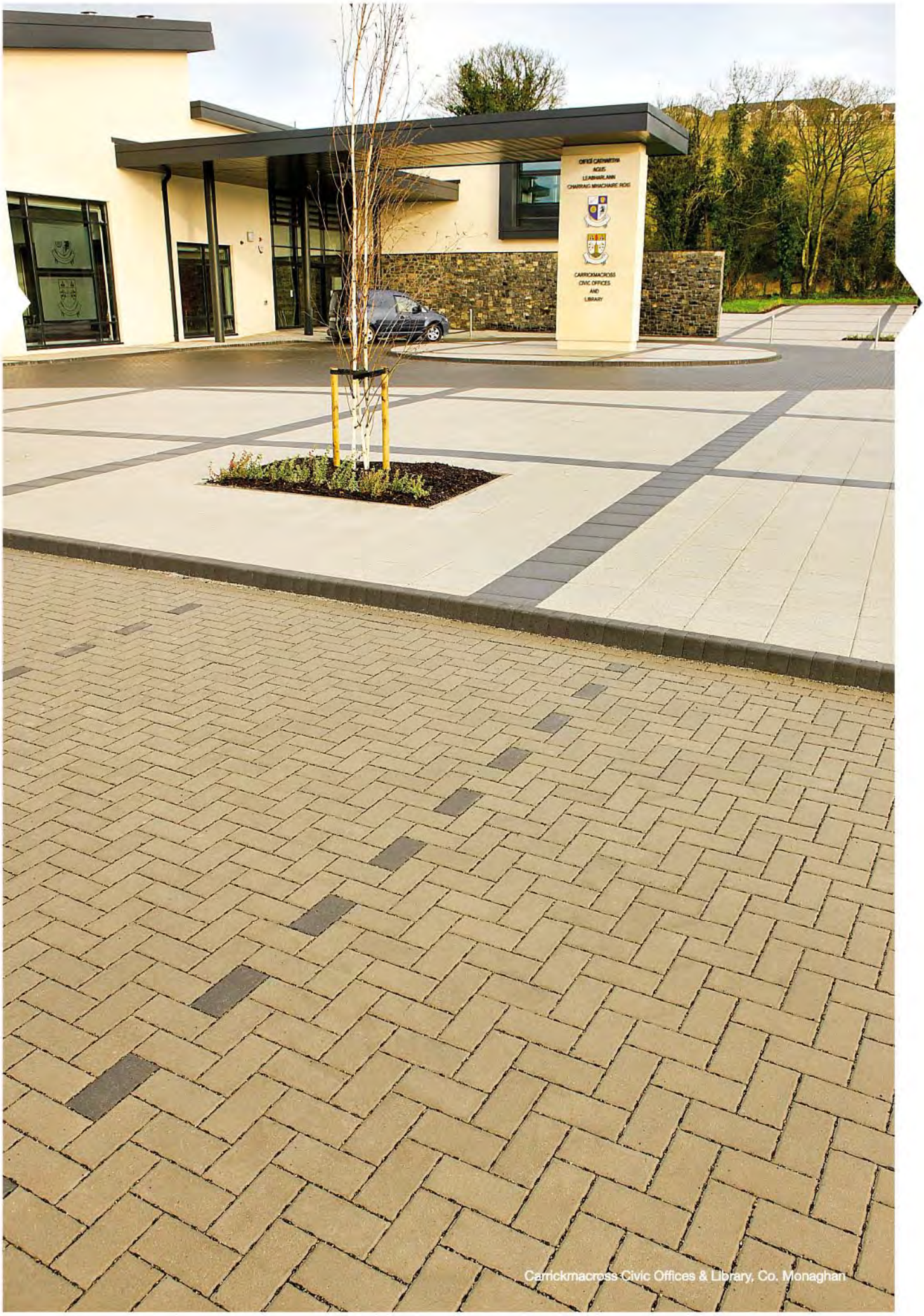
Clima-Pave™

Permeable Paving Solutions



Kilsaran

ideas taking shape



Carrickmacross Civic Offices & Library, Co. Monaghan

Clima-Pave™

The rapid development of previously green-field sites and the associated creation of impermeable areas such as roofs, car parks and footpaths will mean that at project conception stage there will be potentially large volumes of surface water to be dealt with. Traditionally this has been done by piping the surface water into storage tanks or discharging it into nearby streams or surface water drainage. This method of drainage is not currently favoured by planners and designers, as it simply moves the surface water downstream where it still has to be dealt with. This is especially important where large volumes of water need to be dealt with during heavy rainfall events. Piping large volumes of water into streams and rivers increases the risk of flooding and also allows for the potential pollution of local water courses and drinking water supplies.

Sustainable Urban Drainage Systems (SUDS) and Water Source Control

Planners are encouraging the use of Sustainable Urban Drainage Systems (SUDS) in all new developments, in particular the use of appropriate source control techniques is important as this allows for the containment of the surface water collected on the site and for this surface water to be dealt with on-site as opposed to traditionally draining it off-site. SUDS, as a sustainable development approach to Surface Water Design Techniques, has the aim of balancing the following:

1. **To manage water run-off from developed areas to similar quantities prior to development (Source Control)**
2. **Reduce and avoid incidences of downstream flooding**
3. **To protect or enhance water quality of the run-off**
4. **To improve or enhance the amenity where possible**

Advantages of Permeable Paving

- Permeable Paving is a 'source control' method. Water is managed and dealt with on-site without piping off to storage tanks or surface water treatment systems
- The Water Framework Directive (Directive 2000/60/EC) requires that surface water discharges are managed to ensure that risk of contamination or pollution are mitigated. Permeable paving systems filter contaminants by microbial action. There is no requirement for additional filtering/polishing with Permeable Paving in normal use
- Separate attenuation tank systems are not required
- No need for gullies or channels or conventional drainage
- Recharges ground water
- Roofs, roads and other non-permeable areas can be discharged into permeable paving (No gullies required)
- No ponding or surface water
- Collected water can potentially be re-used for non-potable purposes
- Improves water quality







Clima-Pave™, the permeable paving solution from Kilsaran, offers an advantage over traditional SUDS techniques, such as storm water attenuation tanks. This is because the stone based sub-base, which needs to be installed for any type of surfacing material, is adapted to an open graded material in permeable paving systems. This allows the water collected from the site to be stored in the pavement and either infiltrated back into the ground or discharged at a controlled rate into the surface water drainage system.

The Clima-Pave™ system is constructed using our specially engineered permeable paving block, which has enlarged joints on all sides, typically 4-8mm in width. When the blocks have been laid, a corresponding slot is formed between the paving blocks which are then filled with a clean 3mm aggregate. This allows water to rapidly drain from the surface down into the pavement.

Traditional block paving is laid on a sand bedding layer and a Type 1/CL. 804 sub-base. To allow for storage and infiltration of the surface water percolating through the block, permeable block paving is laid on a grit laying course instead of sand and an open-graded stone sub-base instead of Type 1/CL. 804.

Clima-Pave™
Permeable Paving Solutions



Advantages of Clima-Pave™ for your project

Clima-Pave™ from Kilsaran offers the widest range of permeable paving products for use in commercial, retail and civic projects.

Kilsaran can also offer a full site-specific permeable paving design for your project, taking into account the site ground conditions, drainage requirements and structural and traffic loading requirements for the site. This is a chargeable service and Kilsaran will provide an indemnified design provided by our nominated Consulting Engineer who will visit the site if required to appraise the installation.

Clima-Pave™
Technical Information

- Design Guidance
- Permeable Paving Aggregates
- Materials for HGV Trafficked Pavements
- Typical Design Diagrams
- Construction & Maintenance Guidelines

Design Guidance

Clima-Pave™ permeable paving provides a structural pavement suitable for both pedestrian and vehicular traffic depending on design. The water management and permeable functionality of the pavement is largely dependent on the correct specification and design of the pavement to meet the unique requirements of the individual site. The correct specification, testing and installation of aggregates is of paramount importance with any permeable paving system to ensure the finished pavement meets both initial and long term design requirements.

We advise that all permeable pavements require a site-specific design which should be carried out in accordance with BS 7533-13:2009 'Pavements constructed with clay, natural stone of concrete pavers. Part 13 Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers'.

We can provide a design service to customers who require a site specific design to be carried out for their project. In order to carry out this, we require a completed Clima-Pave™ Permeable Paving Design form available to download from our website, from our Sales team or can be requested by emailing technical@kilsaran.ie. This form should be returned via email with the supporting information about the site to enable a design to be carried out.

The information required includes:

- **Drawings of proposed site layout in AutoCad**
- **Full existing and proposed site levels for the pavement**
- **Full site investigation report to establish ground conditions and soaked CBR values of the sub-grade at formation level**
- **Infiltration values from soak-pit testing to BRE 365**
- **Overall drainage design strategy for the site**
- **Planning requirements or conditions for the site relating to paving and drainage (e.g. discharge limits)**
- **Any other pertinent site specific information or client / contractor requirements**

Design Guidance Basics

The below information is provided for guidance purposes only at project conception stage to allow appraisal of a permeable pavement system. Full independent advice should be sought from both the Consulting Engineer and the Contractor prior to the commencement of works. A full site-specific design will always be required in accordance with the above guidelines and BS 7533-13:2009.

The design information below is based on BS 7533-13:2009 which should also be consulted at project appraisal stage.

Types of Permeable Pavement

There are three main types of permeable pavement commonly used on sites:

System A – Full Infiltration: All water from the pavement is infiltrated to the ground

Suitable for sites with good ground conditions, higher CBR values and soils which will readily allow water to dissipate through the ground. These favourable conditions are rarely encountered on larger sites.

System B – Partial Infiltration: Most water infiltrated to ground with excess water piped off

Suitable for sites with medium ground conditions. The soil will infiltrate some of the water in the system. When storm events occur and water builds up in the system due to the soil being at capacity for drainage, perforated pipes are laid in the bottom of the sub-base to deal with the excess, taking it to the surface water drainage system. This is the most commonly used type of permeable pavement.

System C – Fully Tanked System: No water is allowed to infiltrate to ground

This type of system is used where poor sub-grade drainage conditions exist (heavy clays), where the stability of the sub-grade would diminish if extra surface water was introduced, or where ground water levels are within 1 metre of the formation level (system could gain water). In this system the sub-base acts essentially as an attenuation tank, wrapped in an impermeable polythene membrane and all water is piped out.

Selection of Pavement Type

The type of permeable pavement system to be adapted is based primarily on site ground conditions, site suitability and the permeability values of the sub-grade encountered on site from infiltration soak-pit testing. Table 1 gives guidance on the suitability of the three types of permeable pavement system.

Table 1: Guidance on selection of a pavement system

		System A - total infiltration	System B - partial infiltration	System C - no infiltration
Permeability of subgrade defined by coefficient of permeability, k (m/s)	10^{-6} to 10^{-3}	✓	✓	✓
	10^{-8} to 10^{-6}	✗	✓	✓
	10^{-10} to 10^{-8}	✗	✗	✓
Highest recorded water table within 1000mm of formation level		✗	✗	✓
Pollutants present in subgrade		✗	✗	✓

Selection of Pavement Sub-Base Thickness

The design of the sub-base for the permeable pavement should take into account the traffic loadings likely to use the pavement. It is essential to take into account any future increase in traffic volume and any HGV traffic which may use the pavement irrespective of how frequent. The correct loading category should be then selected from Table 2 taking into account the above considerations. It should be noted that no layers of the permeable pavement are designed for site traffic to use them and when finished the permeable pavement surface should not be trafficked by site traffic vehicles which are heavier than that for which the pavement was designed. It is advisable to complete paving works after all other work in the vicinity has been completed.

Typical build up details for each traffic category are illustrated on page 20 and 21 for guidance purposes.

Table 2: Loading Categories

1 DOMESTIC PARKING	2 CAR	3 PEDESTRIAN	4 SHOPPING	5 COMMERCIAL	6 HEAVY TRAFFIC
No Large Goods Vehicles	Emergency Large Goods Vehicles only	One Large Goods Vehicles per week	Ten Large Goods Vehicles per week	100 Large Goods Vehicles per week	1000 Large Goods Vehicles per week
Zero standard axles	**100 standard axles**	**0.015msa**	**0.15msa**	**1.5msa**	**15msa**
Patio	Car Parking Bays and Aisles	Town/city Pedestrian Street	Retail development delivery access route	Industrial Premises	Main road
Private Drive	Railway Station platform	Nursery Access	School/college access road	Lightly Trafficked Public Road	Distribution Centre
Decorative feature	External Car Showroom	Parking area to residential development	Office block delivery route	Light Industrial development	Bus Station (bus every 5 minutes)
Enclosed Playground	Sports Stadium Pedestrian route	Garden centre external display area	Deliveries to small residential development	Mixed retail/ industrial development	Motorway Truck Stop
Footway with zero vehicle overrun	Footway with occasional overrun	Cemetery Crematorium	Garden centre delivery route	Town Square	Bus Stop
	Private drive/ footway crossover	Hotel Parking	Fire Station Yard	Footway with regular overrrun	Roundabout
		Airport Car Park with no bus pickup	Airport Car Park with bus to terminal	Airport landside roads	Bus Lane
		Sports Centre	Sports Stadium access route/ forecourt		

msa = millions of standard 8,000 kg axles

Sub-Base Thickness For Water Storage

The sub base depth must also take into consideration the water storage requirements for the site. The depth of sub-base may have to be adjusted to allow for increased site specific water storage. Further guidance on hydraulic factors can be found in BS 7533-13:2009 section 5.4.

Adjustment To Pavement Design For Low CBR Sub-Grade

In the case of CBR values below 5%, either ground improvement work will be required for the site, or the thickness of the coarse graded aggregate sub-base will have to be adjusted in accordance with 5.6.3 and table 9 of BS 7533-13:2009

Permeable Paving Aggregates

All materials used as permeable paving aggregate must comply to the grading and physical requirements below, as well at the general requirements of BS EN 12620 and BS EN 13242. Sub-base laying course materials should be clean, sound, non-friable and sound crushed rock material. Rounded gravel materials are not recommended for sub-base layers. The jointing material may be either clean crushed material or clean gravel material. The materials should be tested to confirm that it meets the requirements below.

The contractor shall also ensure that on-going deliveries to site are checked frequently for grading, shape and inspected to ensure cleanliness.

During installation on site, great care and attention must be paid to ensure that the aggregates are kept free of contamination and deleterious matter. Construction traffic cannot be allowed to traverse the layers of permeable paving aggregates during installation.

4/40mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
80	100
63	98-100
40	90-99
31,5	-
20	25-70
10	-
4	0-15
2	0-5

4/20mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
40	100
31,5	98-100
20	90-99
10	25-70
4	0-15
2	0-5

2/6.3mm Laying Course Paving Aggregate

Sieve Size (mm)	Percentage Passing
14	100
10	98-100
6.3	80-99
2	0-20
1	0-5

3mm Jointing Grit

Sieve Size (mm)	Percentage Passing
40	100
8	100
6.3	95-100
4	85-99
2	15-35
1	0-10
0.063	0.0-1.5

Property	Category to BS EN 13242 or BS EN 12620
Grading	4/20 (preferred) or 4/40 as per table above
Fines Content	F4
Shape	FI20
Resistance to Fragmentation	LA30
Water Absorption to BS EN 1097-6:2000	WA2
For water absorption > 2% Magnesium Sulfate Soundness	MS18
Resistance to Wear	MDE20
Acid Soluble Sulfate Content	AS0.2
Total Sulfur	≤1% by mass
Recycled Aggregates	Seek guidance from Kilsaran Technical Department

Materials for HGV Trafficked Areas

For loading category 3 and above as detailed in Table 2 page 17, these pavement types are designed to accommodate HGV traffic either on an occasional or more frequent basis. The pavement structure therefore requires a 'stiffening layer' to accommodate the HGV traffic which exerts significantly increased loading on the pavement. This stiffening layer can be either a hydraulically-bound coarse graded aggregate (porous no fines concrete) as detailed below and shown on the section details on pages 20 and 21 or alternatively a 80mm thick layer of DBM macadam as detailed below.

DBM Macadam Material

The DBM material should be an AC 32 Dense Base complying with the requirements of BS EN 13108-1 and should be supplied and installed to meet the requirements of BS 594987:2010. The DBM should be punctured after installation at 750mm centres with 100mm diameter holes. The holes should be fully filled and compacted with the appropriate coarse graded permeable paving aggregate as used in the layer underneath.

Hydraulically-Bound Coarse Graded Aggregate (Porous No Fines Concrete)

Porous concrete provides a stiffening transfer layer in concrete block permeable pavements which are to receive heavier traffic loads. The lack of sand (fines) in the mixture allows the material to act as a transfer drainage layer, whereby the open-graded matrix of the material allows for 20%-30% voids within the compacted volume of the material. Special measures are to be taken in the production, installation and curing of this material. Kilsaran can provide information and guidance on this upon request.



Product Standard	BS EN 14227-1
Material Compositon	Hydraulically Bound Coarse Graded Aggregate is a mixture of a coarse aggregate (usually 20mm nominal size), cement and water.
Typical Compressive Strength	Class C5/6 in accordance with IS EN 14227-1,Table 2 Line 4. Other strength classes available upon request from supplier.

Typical Design Diagrams

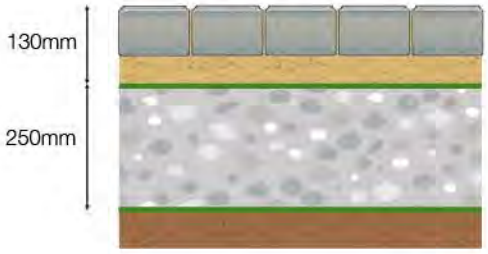
Below are typical build-up details for permeable pavement systems based on BS 7533-13:2009. These diagrams are based on ideal site conditions for drainage and CBR values of 5% or greater. The diagrams are for project appraisal purposes only and in all cases a site specific design in accordance with BS 7533-13:2009 will be required.

Key:

- 2 / 6.3mm Laying Course
- Hydraulically-Bound Coarse Graded Aggregate or 80mm of DBM Macadam
- 4 / 20mm Coarse Graded Aggregate and /or 4/40mm Coarse Graded Aggregate
- Capping Material
- Approved Geotextile
- Approved Impermeable Membrane

System A & B (Infiltrating & Partial Infiltration Systems)

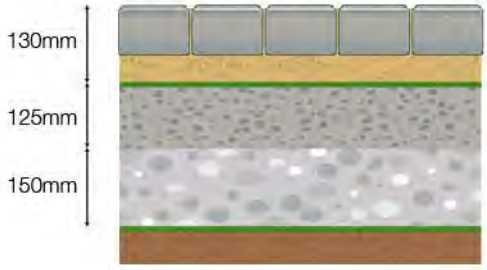
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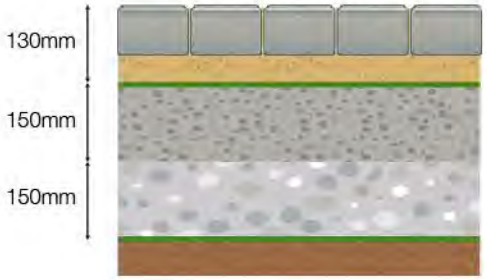
LOAD CATEGORY 2



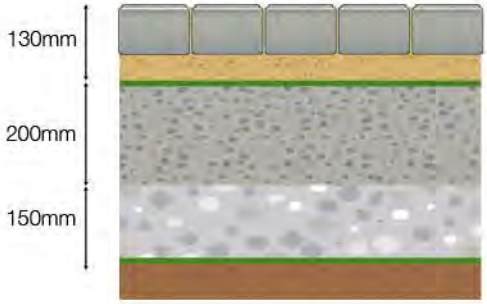
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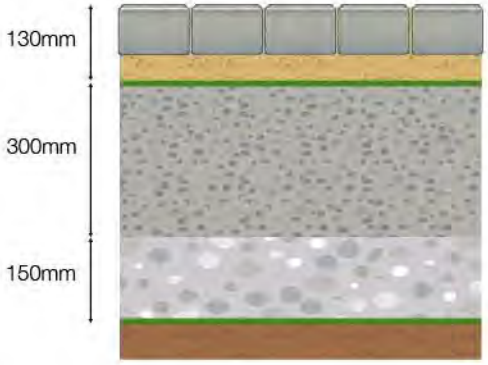
LOAD CATEGORY 4



LOAD CATEGORY 5



LOAD CATEGORY 6



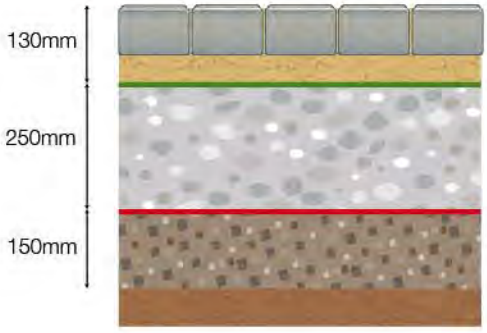
Alternative build up / materials may be used depending on project specific details.

For load categories 3-6 the hydraulically-bound coarse graded aggregate (porous no fines concrete) layer may be replaced with 80mm depth of DBM Macadam to act as a stiffening layer. The macadam layer should be punctured at 750mm centres on grid. Further details on the DBM macadam layer are given on page 19.

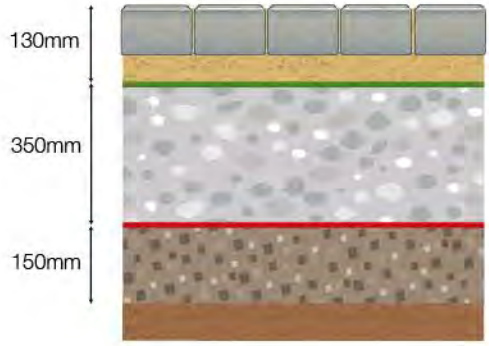
Where the depth of aggregate sub-base is in excess of 350mm for the given loading category, it may be possible to reduce the depth of aggregate required and provide a more cost effective design with the use of an appropriate and approved geo-grid. This can be appraised at design stage.

System C (Fully Tanked/Bunded)

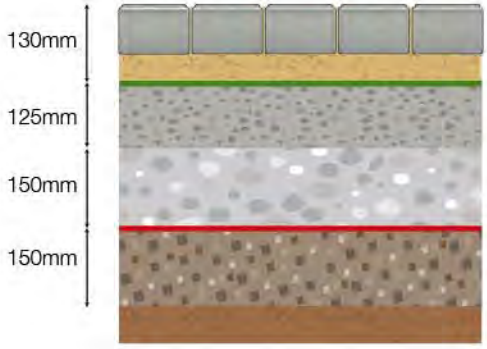
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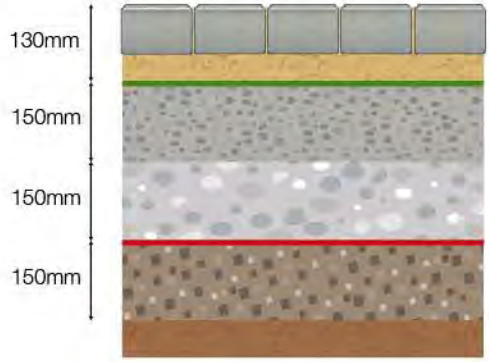
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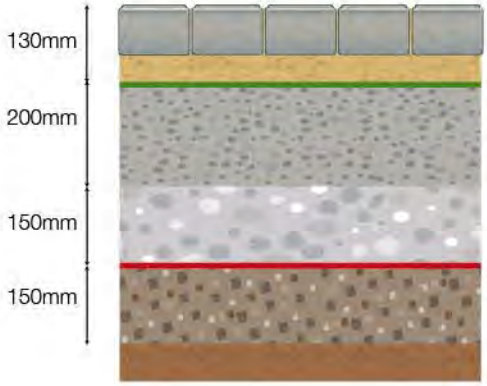
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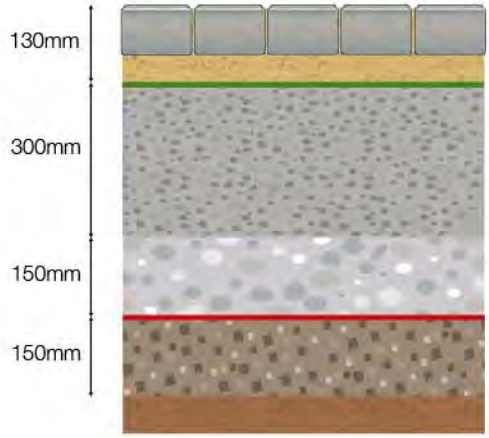
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LOAD CATEGORY 5



LOAD CATEGORY 6

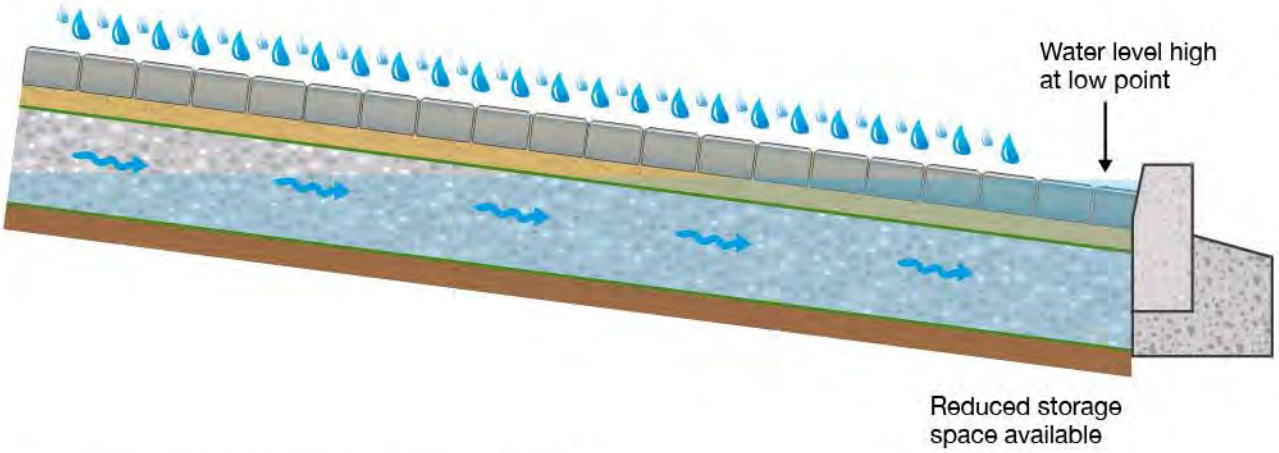


In the case of System C (fully tanked permeable pavements) there is always a requirement for 150mm depth of capping to be used beneath the impermeable membrane as shown above. The capping material should be approved by the Engineer and should comply with either the NRA Specification for Roadworks Series 600 or the Specification for Highway Works Series 600. The material should be tested before and during supply for full compliance, and should be compacted in accordance with the series 600 requirements. The capping layer should be blinded immediately before laying the impermeable membrane to prevent puncturing the membrane.

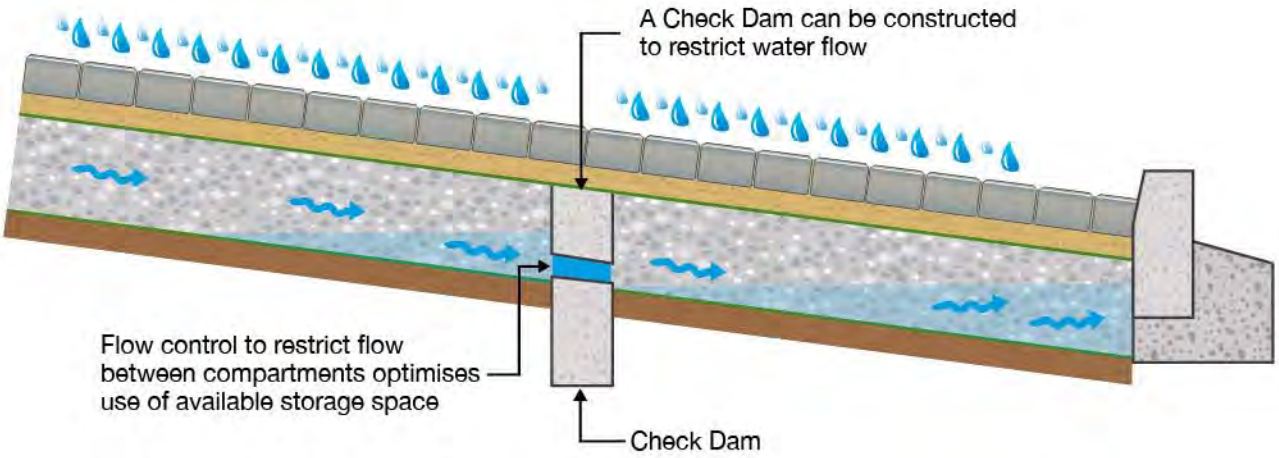
The requirement for using capping material may be eliminated by carrying out a design using an appropriate geo-grid which would negate the requirement for both the capping material and may also reduce the total depth of sub-base stone required.

Sloping Sites

On sloping sites water will naturally collect at the lowest point of the pavement. If sharp falls are allowed on site this will reduce the effective water storage capacity of the sub-base aggregate. In order to minimise this effect, gradients should be at a maximum 1 in 20 and preferably 1 in 30 or better.



Where sloping sites are unavoidable due to site layout, it will be necessary to reduce any sharp falls to maintain the water attenuation capacity of the system. This can be achieved by creating 'dams' in the sub-base of the pavement which will 'step' the pavement sub-base and reduce the overall falls. On extreme slopes, the pavement can be terraced with a step down and a dam between the two levels to restrict water flow.



Construction & Maintenance Guidelines

Construction

To ensure correct performance and durability of a permeable pavement, a fully detailed design should be carried out in accordance with BS 7533-13:2009 taking into account all site specific requirements for the project. Construction should be carried out strictly in accordance with BS 7533-13:2009 and BS 7533-3. All materials to be used shall be tested for full compliance to the above standard both before supply and during construction. It is also advised not to use any of the layers of permeable pavement construction for site traffic unless the build-up has been specifically designed to accommodate this. Additionally site equipment such as tele-handlers and forklifts should not be used on the paving surface after construction has been completed unless the pavement has been designed to accommodate this.

Maintenance

Permeable pavements should not be contaminated with soft landscaping materials, soil, detritus or general dirt as this may wash into the pavement. Also the pavement should not be trafficked by construction traffic or unsuitably heavy vehicles above that for which the pavement was designed.

To keep any growths or weeds to a minimum it is advised that the installed permeable paving be sealed with an appropriate sealer. Where the paved area is beneath overhanging trees or in a very damp area, an annual treatment of an environmentally friendly weed killer can be applied. Note the weed killer should be applied as directed by the supplier and only in very dry weather where rain is not expected, active weed killer could be washed into the sub-system otherwise. The manufacturer's instructions for all treatment products should be followed in detail.

The pavement should be inspected on a routine basis and carefully swept as required using a mechanical sweeper or by hand for smaller areas. The sweeping action may remove some of the jointing grit from the surface, the joints must be topped up after sweeping if required.

Should silting or blocking of the joints occur after a period of years, the use of a suitable jet wash and suction sweeper should be used to remove the defective material. It is likely that the jetting of the pavement will remove some grit. This grit should be replaced as required.

As with conventional block pavements, depressions, rutting and cracked or broken blocks which may be a structural concern or a hazard to users should be remedied as soon as possible. All joints must be maintained full at all times.

Permeable pavements will drain relatively quickly compared with other types of surfacing, and are not as liable to freezing over of standing water, hoar frosts may occur which can cause surface slip on any material. The use of de-icing salts on permeable pavements, as with any other concrete surface, should be kept to a minimum as the chlorides in the salt will penetrate the concrete and excessive use will damage the surface. Any de-icing material applied should not cause blockage or clogging of the permeable pavement joints (if blockage occurs in localised areas this will need to be removed by suction sweeper and joints topped up with appropriate jointing grit). It should also be considered that any de-icing material used will drain into either the sub-grade or the drainage system through the permeable pavement. Care should be taken to ensure no contamination of water courses or drainage systems. De-icing materials should be applied to the paving surface before ice or snow covers the surface to prevent damage.

get in touch

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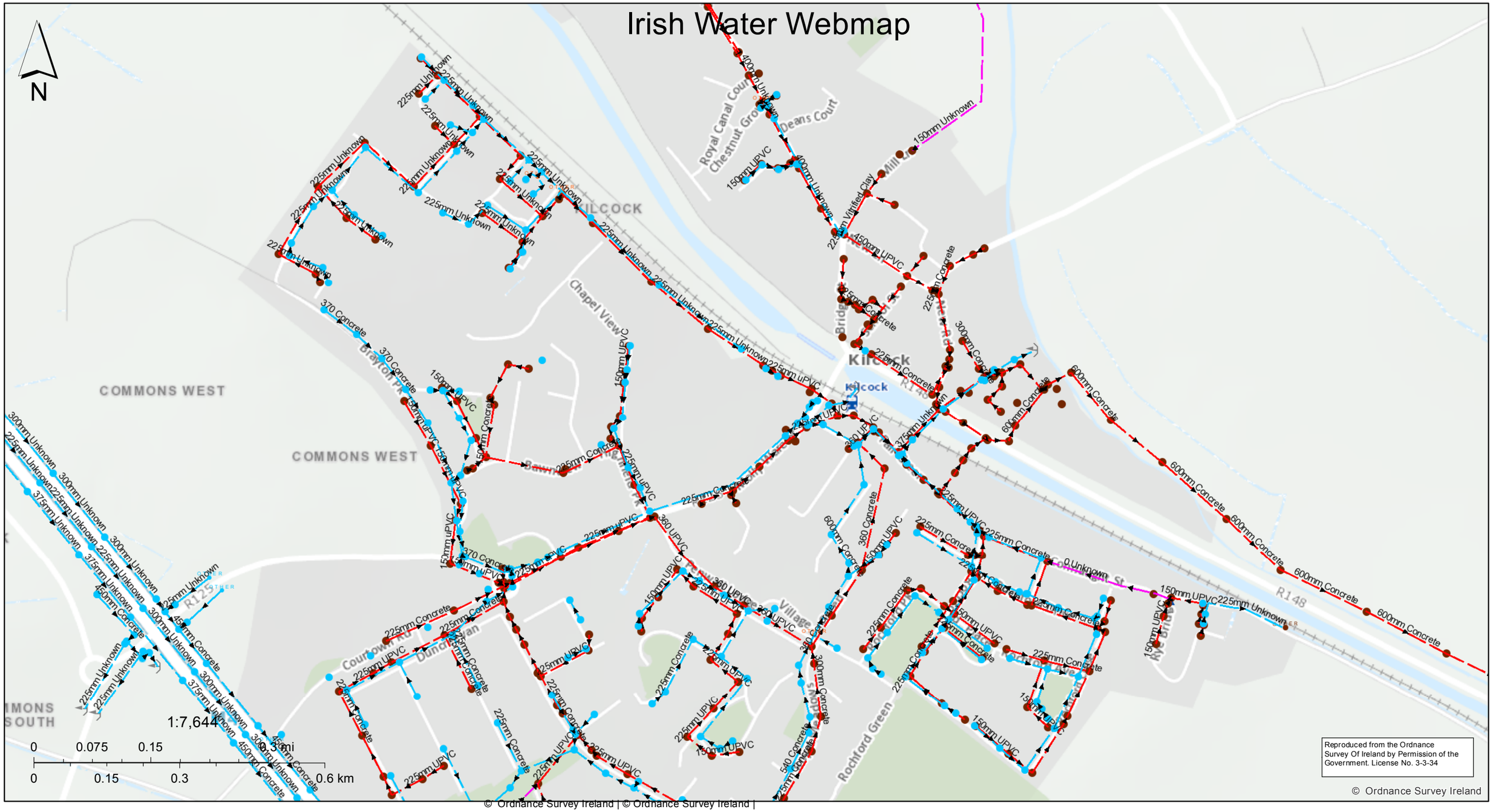
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Appendix D

Existing Drainage Records

Irish Water Webmap



© Ordnance Survey Ireland | © Ordnance Survey Ireland |

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Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

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

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

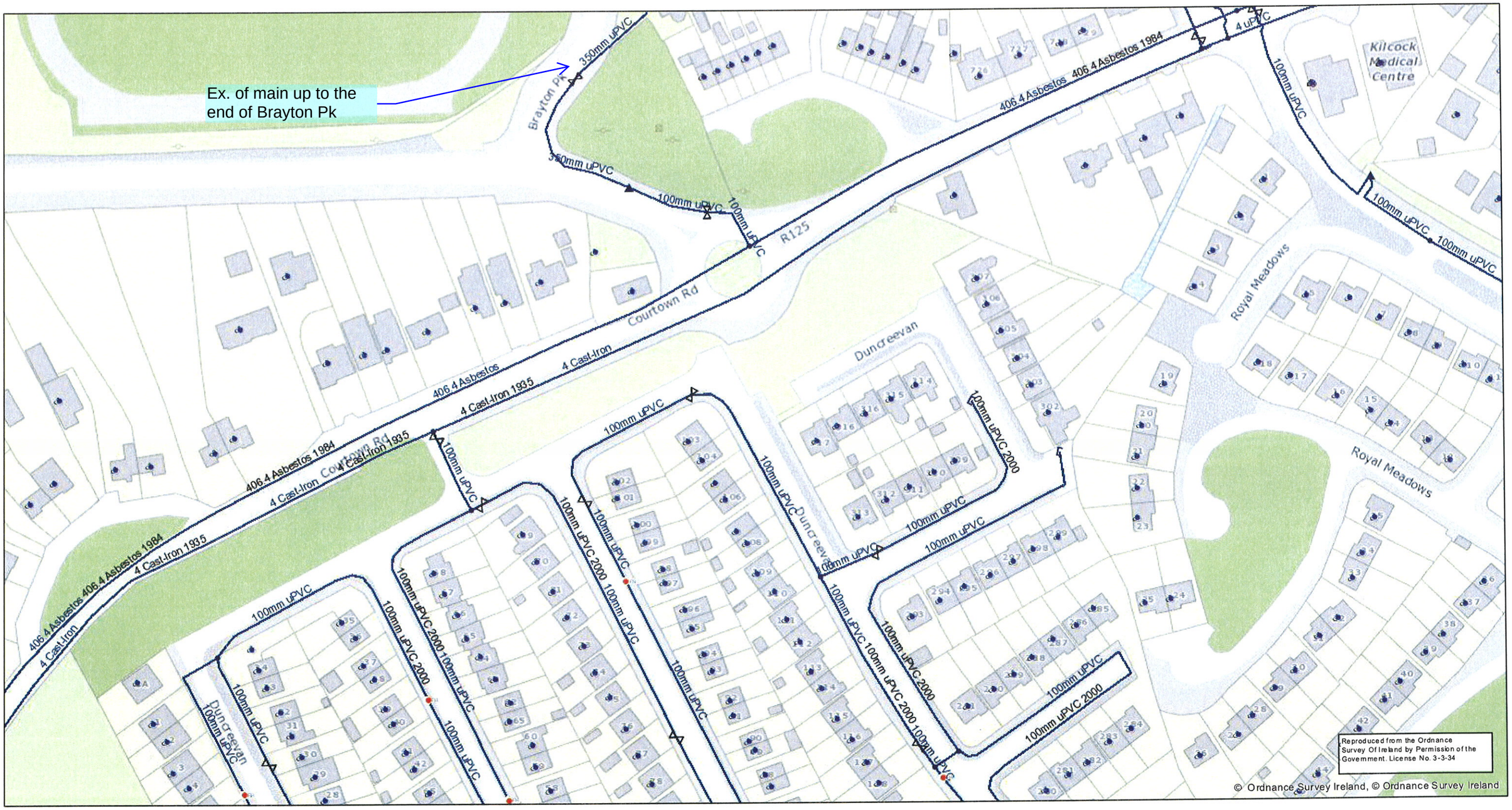
Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Irish Water Web Map



November 16, 2018

1:2,257

0 0.0275 0.055 0.11 mi

0 0.0425 0.085 0.17 km

Legend

Flow Control Valves
- Non-return
- Hydro
- Orifice Plate
- PRV
- PSV
- Other

Boundary Valves
- Open
- Closed
- Part Closed

Non Boundary Valves
- Open
- Closed
- Part Closed

- Air Control Valves
- Water Stop Valves

Non Boundary Meter
- Meter
- Group Scheme
- Source

Boundary Meter
- District (Boundary Meter)

Water Hydrants
- Fire Hydrant
- Fire Hydrant/Washout
- Washout
- Treatment Plant

Reservoir
- Potable
- Raw Water

- Pump Stations
- Water Network Structures
- Abstraction Point
- Kisok
- Water Service Connections

Water Fittings
- Cap
- Other Fitting

- Water Distribution Chambers
- Pressure Monitoring Point

Water Mains(Irish Water Owned)
- Untreated
- Potable Water

Water Mains(Non Irish Water Owned)
- Untreated
- Potable Water

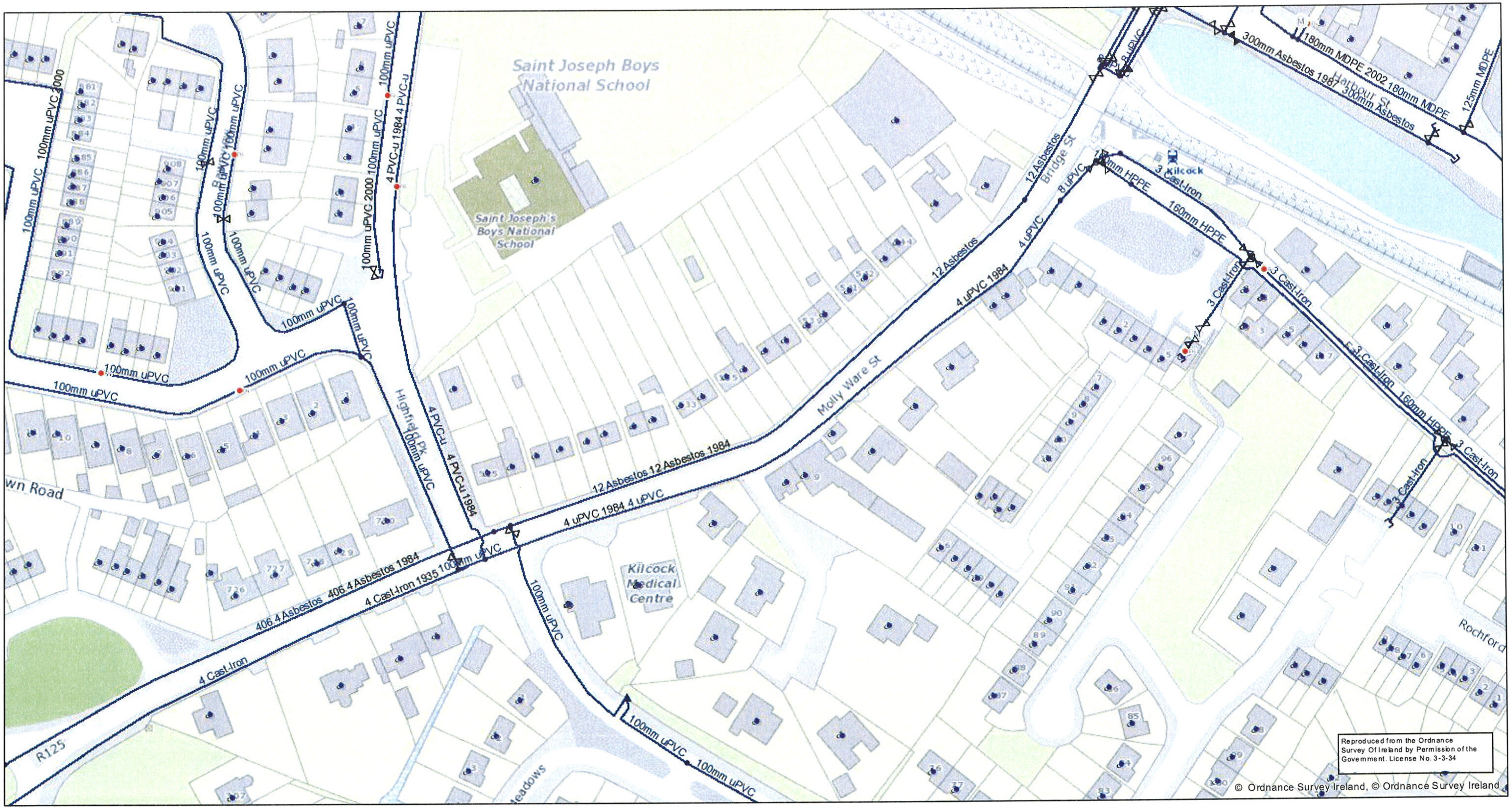
Water Lateral Lines
- Irish Water
- Non IW
- Water Abandoned Lines
- Water Casings

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.

© Copyright Irish Water

UISCE EIREANN : IRISH WATER

Irish Water Web Map



November 16, 2018

1:2,257

0 0.0275 0.055 0.11 mi

0 0.0425 0.085 0.17 km

Legend

Flow Control Valves
- Non-return
- Hydro
- Orifice Plate
- PRV
- PSV
- Other

Boundary Valves
- Open
- Closed
- Part Closed

Non Boundary Valves
- Open
- Closed
- Part Closed

- Air Control Valves
- Water Stop Valves

Non Boundary Meter
- Meter
- Group Scheme
- Source

Boundary Meter
- District (Boundary Meter)

Water Hydrants
- Fire Hydrant
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Reservoir
- Potable
- Raw Water

- Pump Stations
- Water Network Structures
- Abstraction Point
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- Water Service Connections

Water Fittings
- Cap
- Other Fitting

- Water Distribution Chambers
- Pressure Monitoring Point

Water Mains(Irish Water Owned)
- Untreated
- Potable Water

Water Mains(Non Irish Water Owned)
- Untreated
- Potable Water

Water Lateral Lines
- Irish Water
- Non IW
- Water Abandoned Lines
- Water Casings

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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UISCE EIREANN : IRISH WATER

Appendix E

Irish Water Pre-Connection &

Design Acceptance Responses

Rycroft Homes Limited c/o Shaun O'Reilly
Pinnacle Engineers,
Grosvenor Court,
67A Patrick Street,
Dun Laoghaire,
Co. Dublin

25 June 2019

Dear Sir/Madam,

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

Re: Customer Reference No 1923439420 pre-connection enquiry - Subject to contract | Contract denied
Connection for 345 units at Brayton Park, Kilcock, Co. Kildare.

Irish Water has reviewed your pre-connection enquiry in relation to
water and wastewater connections at Greenfield Site, Ext of Brayton Park, Bawnogues, Kilcock, Co. Kildare
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 and the conditions listed below, 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 Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.
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.

Drinking Water
Irish Water has a project on the current investment plan which will improve security of supply in Kilcock by linking strategic water mains, which is currently programmed for 2021 (Subject to statutory processes and change). The development will be supplied by an existing 350mm diameter water main which will provide capacity for the development.

Waste Water
This development proposes to connect via gravity to the adjacent Brayton Park foul network. There are constraints in the Lower Liffey Valley Sewerage Scheme catchment which are being addressed via Capital Investmment Programme projects in Maynooth, Celbridge and a Draninage Area Plan for the entire catchment. A waste water connection for this development is feasible in the interim based on remediation works being carried out on a backfalling section of sewer in the existing 225mm waste water network to the South of the rail line flowing towards Bridge Street. These remediation works are to be carried out on the local network prior to connection.

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 Energy Regulation.

Should you wish to have any of the above progressed by Irish Water or if you have any further questions, please contact Dermot Phelan from the design team on 01 8925466 or email dphelan@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 Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill 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

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

Rycroft Homes Ltd c/o Shaun O'Reilly,
Pinnacle Consulting Engineers,
Grosvenor Court,
67A Patrick Street,
Dun Laoghaire,
Co. Dublin

12 July 2019

Re: Design Submission for Development at Brayton Park, Kilcock, Co. Kildare (the "Development") (the "Design Submission") / 1923439420.

Dear Shaun,

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: Dermot Phelan
Phone: 01 8925466
Email: dphelan@water.ie

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Stiúrthóirí / Directors: Mike Quinn (Chairman), Eamon Gallen, Cathal Marley, Brendan Murphy, Michael G. O'Sullivan
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill 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

Appendix A

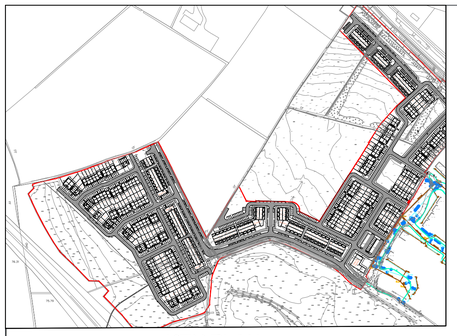
Document Title & Revision

• 200-3	Proposed Surface Water and Foul Sewer Layout Sheet 1 of 2
• 201-3	Proposed Surface Water and Foul Sewer Layout Sheet 2 of 2
• 202-4	Water Main and Levels Layout Sheet 1 of 2
• 203-4	Water Main and Levels Layout Sheet 2 of 2
• 210-1	Proposed Foul Sewer Longitudinal Sections Sheet 1
• 211-1	Proposed Foul Sewer Longitudinal Sections Sheet 2
• 212-1	Proposed Foul Sewer Longitudinal Sections Sheet 3

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.



KEY PLAN
SCALE 1:5000

DRAINAGE NOTES:
1. ALL FOUL SEWERS, MANHOLES AND CONNECTIONS TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE AND IRISH WATER WASTEWATER INFRASTRUCTURE STANDARD DETAILS.
2. ALL FOUL SEWER HOUSE CONNECTIONS TO BE MIN 100mmØ UPVC TO IS EN 1401 2009/2012. STIFFNESS CLASS 8KN/M2 IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
3. ALL PUBLIC FOUL SEWERS TO BE MINIMUM 225mm DIAMETER THERMOPLASTIC STRUCTURED WALL PIPES TO IS EN 13476 (2007/2009). TYPE SN8 AND WIS 4-35-01 (2008) AND COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER CODE OF PRACTICE.
4. ALL PUBLIC SURFACE WATER SEWERS TO BE MINIMUM 225 DIA. CLASS H CONCRETE TO EN1916 & IS 6 2004 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
5. ALL SURFACE WATER CONNECTIONS TO BE MINIMUM 150mmØ UPVC TO IS EN 1401 2009/2012 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
6. LOCATION AND INVERT LEVELS OF EXISTING MANHOLES OR OUTFALL POINTS, WHERE APPLICABLE TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT OF DRAINAGE WORKS.
7. ALL FOUL CONNECTIONS TO COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER.
8. ALL FOUL SEWERS TO BE AIR TESTED IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
9. ALL COVER LEVELS TO MATCH FINISHED ROAD/VERGE/FOOTPATH/CYCLETRACK LEVELS UNLESS OTHERWISE STATED.
10. CONTRACTOR TO INCLUDE FOR CCTV SURVEY OF ALL SEWERS UPON COMPLETION OF SAME.

LEGEND
- PROPOSED FOUL SEWER
- PROPOSED FOUL SEWER WITH 150MM CONCRETE ENCASEMENT
- PROPOSED FOUL INSPECTION CHAMBER AND SERVICE CONNECTION AS PER IRISH WATER STANDARD DETAIL STD-WW-03
- PROPOSED SURFACE WATER SEWER
- PROPOSED STORM ARMSTRONG JOINT (HOUSE CONNECTION DIRECT TO MAINS DRAINAGE)
- PROPOSED BACKDROP MANHOLE
- PROPOSED ROAD GULLY
- PROPOSED ATTENUATION FACILITY
- EXISTING PUBLIC SURFACE
- EXISTING PUBLIC FOUL SEWER
- SITE BOUNDARY

BLOCK A
BLOCK B
BLOCK C
BLOCK D
BLOCK E

TANK 1
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 220M³ FOR THE 100YR STORM EVENT
IL = 79.30
TWL = 80.26

HYDROBRAKE MANHOLE LIMITING FLOWS TO 9.3L/S

PETROL INTERCEPTOR

DISCHARGE TO EXISTING DITCH IL 78.28

HYDROBRAKE MANHOLE LIMITING FLOWS TO 16.1L/S

PETROL INTERCEPTOR

DISCHARGE TO EXISTING DITCH IL 78.28

TANK 2
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 405M³ FOR THE 100YR STORM EVENT
IL = 78.60
TWL = 79.66

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
3	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19
2	LEVELS/SERVICES UPDATED	PC	SO'R	15.06.19
1	LEVELS/SERVICES UPDATED	PC	SO'R	15.03.19

CLIENT
RYCROFT HOMES LTD.

PROJECT
LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE
PROPOSED SURFACE WATER AND FOUL SEWER LAYOUT
SHEET 1 OF 2

PINNACLE CONSULTING ENGINEERS
GROSVENOR COURT,
67A PATRICK STREET,
DUN LAOGHAIRE,
COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041
NORWICH | WELWYN GARDEN CITY LONDON | BRISTOL

DRAWING STATUS			
PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
1:500	Feb'19	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
200		3	A1

COPYRIGHT PINNACLE

REF: P180307

DRAINAGE NOTES:
1. ALL FOUL SEWERS, MANHOLES AND CONNECTIONS TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE AND IRISH WATER WASTEWATER INFRASTRUCTURE STANDARD DETAILS.
2. ALL FOUL SEWER HOUSE CONNECTIONS TO BE MIN 100mmØ UPVC TO IS EN 1401 2009/2012, STIFFNESS CLASS 8KN/M2 IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
3. ALL PUBLIC FOUL SEWERS TO BE MINIMUM 225mm DIAMETER THERMOPLASTIC STRUCTURED WALL PIPES TO IS EN 13476 (2007/2009). TYPE SN8 AND WIS 4-35-01 (2008) AND COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER CODE OF PRACTICE.
4. ALL PUBLIC SURFACE WATER SEWERS TO BE MINIMUM 225 DIA. CLASS H CONCRETE TO EN1916 & IS 6 2004 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
5. ALL SURFACE WATER CONNECTIONS TO BE MINIMUM 150mmØ UPVC TO IS EN 1401 2009/2012 IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
6. LOCATION AND INVERT LEVELS OF EXISTING MANHOLES OR OUTFALL POINTS, WHERE APPLICABLE TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT OF DRAINAGE WORKS.
7. ALL FOUL CONNECTIONS TO COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER.
8. ALL FOUL SEWERS TO BE AIR TESTED IN ACCORDANCE WITH IRISH WATER SPECIFICATIONS.
9. ALL COVER LEVELS TO MATCH FINISHED ROAD/VERGE/FOOTPATH/CYCLETRACK LEVELS UNLESS OTHERWISE STATED.
10. CONTRACTOR TO INCLUDE FOR CCTV SURVEY OF ALL SEWERS UPON COMPLETION OF SAME.

LEGEND
- PROPOSED FOUL SEWER
- PROPOSED FOUL SEWER WITH 150mm CONCRETE ENCASEMENT
- PROPOSED FOUL INSPECTION CHAMBER AND SERVICE CONNECTION AS PER IRISH WATER STANDARD DETAIL STD-WW-03
- PROPOSED SURFACE WATER SEWER
- PROPOSED STORM ARMSTRONG JOINT (HOUSE CONNECTION DIRECT TO MAINS DRAINAGE)
- PROPOSED BACKDROP MANHOLE
- PROPOSED ROAD GULLY
- PROPOSED ATTENUATION FACILITY
- EXISTING PUBLIC SURFACE
- EXISTING PUBLIC FOUL SEWER
- SITE BOUNDARY

KEY PLAN
SCALE 1:5000

TANK 7
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 85M³ FOR THE 100YR STORM EVENT
IL = 73.93
TWL = 74.99

HYDROBRAKE MANHOLE LIMITING FLOWS TO 5.6L/s

TANK 6
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 160M³ FOR THE 100YR STORM EVENT
IL = 74.23
TWL = 75.29

HYDROBRAKE MANHOLE LIMITING FLOWS TO 8.9L/s

TANK 5
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 155M³ FOR THE 100YR STORM EVENT
IL = 78.87
TWL = 79.93

HYDROBRAKE MANHOLE LIMITING FLOWS TO 6.8L/s

TANK 3
STORMTECH SC740 ATTENUATION FACILITY PROVIDING 500M³ FOR THE 100YR STORM EVENT
IL = 77.00
TWL = 78.06

HYDROBRAKE MANHOLE LIMITING FLOWS TO 4.4L/s

RAINWATER HARVESTING FACILITY FITTED WITH UPSTREAM LEAF FILTER AND OVERFLOW TO SURFACE WATER NETWORK

CRECHE FACILITY

PETROL INTERCEPTOR

SEE INSERT 1

INSERT 1

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
3	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19
2	LEVELS/SERVICES UPDATED	PC	SO'R	15.06.19
1	LEVELS/SERVICES UPDATED	PC	SO'R	15.03.19

CLIENT
RYCROFT HOMES LTD.

PROJECT
LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

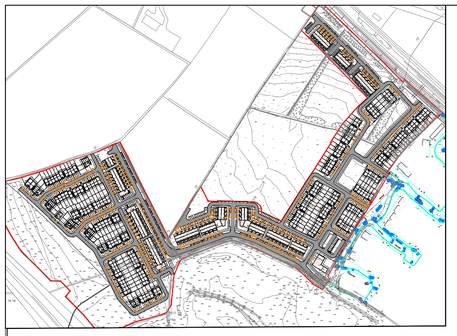
DRAWING TITLE
PROPOSED SURFACE WATER AND FOUL SEWER LAYOUT SHEET 2 OF 2

PINNACLE CONSULTING ENGINEERS
GROSVENOR COURT,
67A PATRICK STREET,
DUN LAOGHAIRE,
COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041
NORWICH | WELWYN GARDEN CITY | LONDON | BRISTOL

DRAWING STATUS			
PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
1:500	Feb'19	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
201		3	A1

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REF: P180307



KEY PLAN
SCALE 1:5000

LEGEND

- EXISTING WATERMAIN
- PROPOSED 160mm ø HDPE, PE100, SDR17 WATERMAIN
- PROPOSED 100mm ø HDPE, PE100, SDR17 WATERMAIN
- BOUNDARY BOX AND 25mm OD PE80 SERVICE CONNECTION AS PER IRISH WATER STANDARD STD-W-03
- FFL 100.200 — PROPOSED FFL
- +79.88 — PROPOSED LEVEL
- +67.72 — EXISTING LEVEL
- 1:66 — PROPOSED GRADIENT
- SLV — SLUICE VALVES AS PER IRISH WATER STANDARD DETAIL STD-W-14/15
- AV — AIR VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-20/22
- SCV — SCOUR VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-30/30A
- SVC — SCOUR VALVE CHAMBER AS PER IRISH WATER STANDARD DETAIL STD-W-30
- H — HYDRANTS AS PER IRISH WATER STANDARD DETAIL STD-W-16/18
- WH — WASH OUT HYDRANT CHAMBER AS PER IRISH WATER STANDARD STD-W-30A
- M — METER CHAMBER AS PER IRISH WATER STANDARD STD-W-26
- SITE BOUNDARY

WATERMAIN NOTES:

1. ALL WATERMAINS VALVES AND FITTINGS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE IRISH WATER STANDARD DETAILS AND IRISH WATER CODE OF PRACTICE FOR WATER INFRASTRUCTURE.
2. ALL WATERMAINS SHALL BE HDPE, PE100, SDR17 TO IS EN 12201 PART 2:2011 AND IS EN 12201-3:2011.
3. CONNECTION BETWEEN EXISTING AND PROPOSED WATERMAINS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER STANDARD DETAILS STD-W-03 TO STD-W-10.
4. ANCHOR BLOCKS TO BE POSITIONED AT DEAD ENDS, TEES, BENDS AND AT EACH SIDE OF HYDRANTS AND VALVES IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER STANDARD DETAIL STD-W-28 (WATER MAIN THRUST AND SUPPORT BLOCKS).DISMANTLING JOINTS TO BE INSTALLED AT EACH SLUICE VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-15.
5. CONNECTION TO INDIVIDUAL HOUSES IN ACCORDANCE WITH IRISH WATER STD-W-03.
6. INSTALLATION OF SLUICE VALVES, AIR VALVES AND HYDRANTS SHALL BE IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS STD-W-16 TO STD-W-23.
7. MARKER POSTS AND PLATES ARE TO BE PROVIDED IN ACCORDANCE WITH IRISH WATER STANDARD DETAIL STD-W-27.
12. CONNECTION TO INDIVIDUAL HOUSES IN ACCORDANCE WITH IRISH WATER STD-W-03.
13. CONNECTION TO EXISTING WATERMAINS TO BE COORDINATED BY THE CONTRACTOR WITH IRISH WATER AND/OR THE LOCAL AUTHORITY.
14. CONTRACTOR TO LIAISE WITH IRISH WATER AND / OR THE LOCAL AUTHORITY AS REQUIRED REGARDING TESTING, CLEANSING AND STERILISATION OF WATERMAINS
15. WATERMAINS TO BE PRESSURE TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER AND IGN 4-0-03, GUIDE TO TESTING OF PRESSURE PIPES AND FITTINGS FOR USE BY PUBLIC WATER SUPPLIERS, OCTOBER 2015. A FORMAL TEST REPORT SHALL BE SUBMITTED TO THE ENGINEER DETAILING THE TEST CARRIED OUT.

METERS FOR APARTMENTS OR SIMILAR PROPERTIES WILL BE INSTALLED INTERNALLY WITHIN THE PREMISES IN ACCORDANCE WITH THE BUILDING CONTROLS AUTHORITY REQUIREMENTS AND SUBJECT TO REVIEW BY IRISH WATER

BLOCK A
BLOCK B
BLOCK C
BLOCK D
BLOCK E

SCOUR CHAMBER TO DISCHARGE TO PROPOSED SURFACE WATER MANHOLE

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
4	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19
3	LEVELS/SERVICES UPDATED	PC	SO'R	15.06.19
2	LEVELS/SERVICES UPDATED	PC	SO'R	15.03.19
1	FINISHED FLOOR LEVELS REVISED	KR	SO'R	11.09.18

CLIENT

RYCROFT HOMES LTD.

PROJECT

LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE

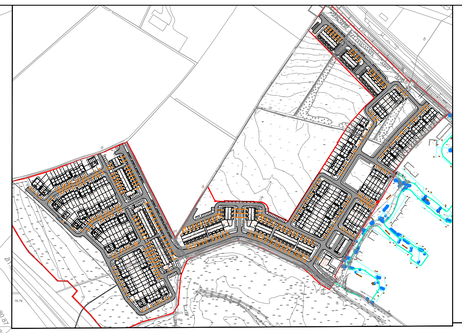
WATERMAIN AND LEVELS LAYOUT
SHEET 1 OF 2
-

PINNACLE CONSULTING ENGINEERS
GROSVENOR COURT,
67A PATRICK STREET,
DUN LAOGHAIRE,
COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041
NORWICH | WELWYN GARDEN CITY LONDON | BRISTOL

DRAWING STATUS			
PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
1:500	14.09.18	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
202		4	A1

REF: P180307

COPYRIGHT PINNACLE



KEY PLAN
SCALE 1:5000

LEGEND

- EXISTING WATERMAIN
- PROPOSED 150mm Ø HDPE, PE100, SDR17 WATERMAIN
- PROPOSED 100mm Ø HDPE, PE100, SDR17 WATERMAIN
- BOUNDARY BOX AND 25mm OD PE80 SERVICE CONNECTION AS PER IRISH WATER STANDARD STD-W-03
- FFL 100.200 — PROPOSED FFL
- +79.88 — PROPOSED LEVEL
- +67.72 — EXISTING LEVEL
- 1:66 — PROPOSED GRADIENT
- SLV — SLUICE VALVES AS PER IRISH WATER STANDARD DETAIL STD-W-14/15
- AV — AIR VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-20/22
- SCV — SCOUR VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-30/30A
- SVC — SCOUR VALVE CHAMBER AS PER IRISH WATER STANDARD DETAIL STD-W-30
- H — HYDRANTS AS PER IRISH WATER STANDARD DETAIL STD-W-16/18
- WH — WASH OUT HYDRANT CHAMBER AS PER IRISH WATER STANDARD STD-W-30A
- M — METER CHAMBER AS PER IRISH WATER STANDARD STD-W-26
- SITE BOUNDARY

WATERMAIN NOTES:

1. ALL WATERMAINS VALVES AND FITTINGS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE IRISH WATER STANDARD DETAILS AND IRISH WATER CODE OF PRACTICE FOR WATER INFRASTRUCTURE.
2. ALL WATERMAINS SHALL BE HDPE, PE100, SDR17 TO IS EN 12201 PART 2:2011 AND IS EN 12201-3:2011.
3. CONNECTION BETWEEN EXISTING AND PROPOSED WATERMAINS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER STANDARD DETAILS STD-W-03 TO STD-W-10.
4. ANCHOR BLOCKS TO BE POSITIONED AT DEAD ENDS, TEES, BENDS AND AT EACH SIDE OF HYDRANTS AND VALVES IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER STANDARD DETAIL STD-W-28 (WATER MAIN THRUST AND SUPPORT BLOCKS.DISMANTLING JOINTS TO BE INSTALLED AT EACH SLUICE VALVE AS PER IRISH WATER STANDARD DETAIL STD-W-15.
5. CONNECTION TO INDIVIDUAL HOUSES IN ACCORDANCE WITH IRISH WATER STD-W-03.
6. INSTALLATION OF SLUICE VALVES, AIR VALVES AND HYDRANTS SHALL BE IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS STD-W-14 TO STD-W-23.
7. MARKER POSTS AND PLATES ARE TO BE PROVIDED IN ACCORDANCE WITH IRISH WATER STANDARD DETAIL STD-W-27.
12. CONNECTION TO INDIVIDUAL HOUSES IN ACCORDANCE WITH IRISH WATER STD-W-03.
13. CONNECTION TO EXISTING WATERMAINS TO BE COORDINATED BY THE CONTRACTOR WITH IRISH WATER AND/OR THE LOCAL AUTHORITY.
14. CONTRACTOR TO LIASE WITH IRISH WATER AND / OR THE LOCAL AUTHORITY AS REQUIRED REGARDING TESTING, CLEANSING AND STERILISATION OF WATERMAINS
15. WATERMAINS TO BE PRESSURE TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER AND IGN 4-01-03, GUIDE TO TESTING OF PRESSURE PIPES AND FITTINGS FOR USE BY PUBLIC WATER SUPPLIERS, OCTOBER 2015. A FORMAL TEST REPORT SHALL BE SUBMITTED TO THE ENGINEER DETAILING THE TEST CARRIED OUT.

PROPOSED FOUL CHAMBER

BLOCK A
BLOCK B
CRECHE FACILITY

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
4	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19
3	LEVELS/SERVICES UPDATED	PC	SO'R	15.06.19
2	LEVELS/SERVICES UPDATED	PC	SO'R	15.03.19
1	FINISHED FLOOR LEVELS REVISED	KR	SO'R	11.09.18

CLIENT

RYCROFT HOMES LTD.

PROJECT

LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE

WATERMAIN AND LEVELS LAYOUT
SHEET 2 OF 2
-

PINNACLE CONSULTING ENGINEERS

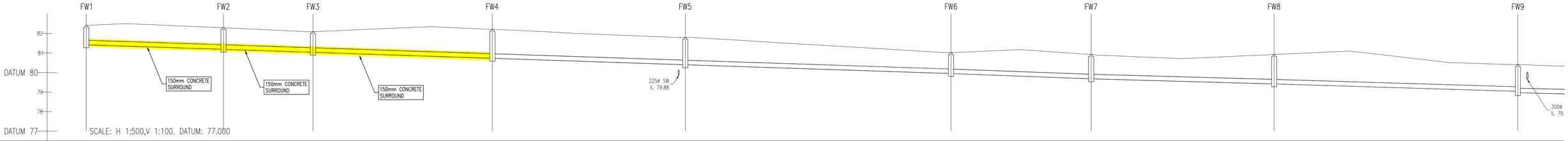
GROSVENOR COURT,
67A PATRICK STREET,
DUN LAOGHAIRE,
COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041

NORWICH | WELWYN GARDEN CITY | LONDON | BRISTOL

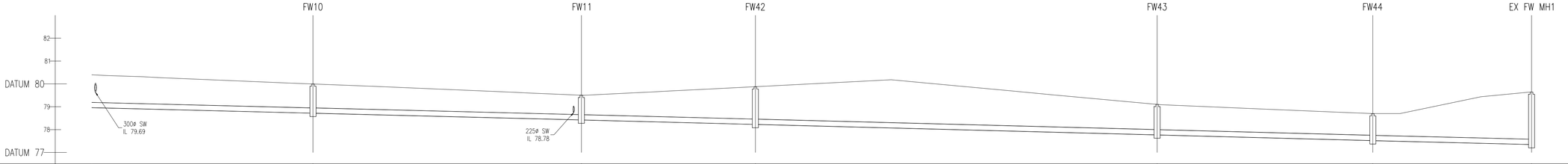
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PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
1:500	14.09.18	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
203		4	A1

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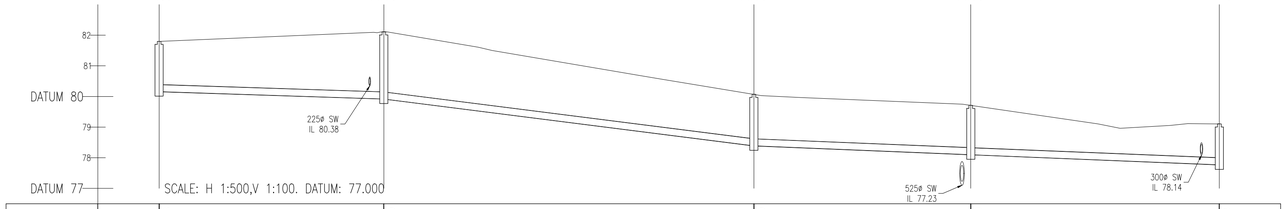
REF: P180307



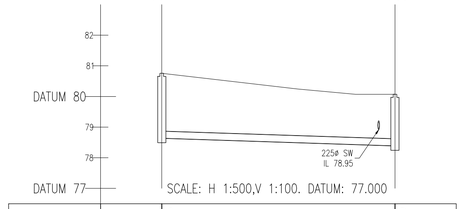
COVER LEVEL	82.410	82.290	82.091	82.206	81.792	81.014	80.920	80.921	80.404
INVERT LEVEL	81.420 / 81.190	81.190 / 81.190	81.037 / 81.037	80.730 / 80.730	80.400 / 80.400	79.950 / 79.950	79.680 / 79.680	79.420 / 79.420	79.040 / 78.970
DEPTH (m)	0.990	1.100	1.054	1.476	1.392	1.064	1.240	1.501	1.434
DISTANCE (m)	35.10	22.87	45.86	49.33	67.94	35.83	46.79	62.31	
PIPE SLOPE	1:153	1:149	1:149	1:149	1:151	1:133	1:180	1:164	
PIPE SIZE	225mm	225mm	225mm	225mm	225mm	225mm	225mm	225mm	



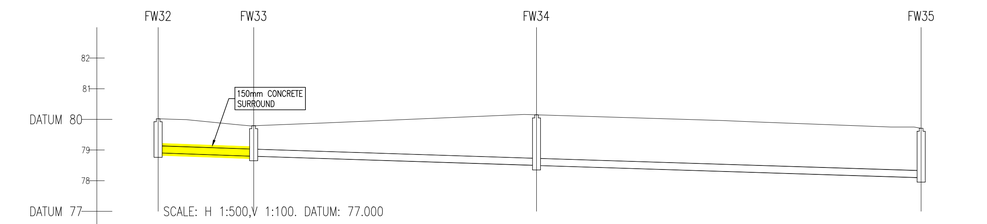
COVER LEVEL	79.997	79.503	79.876	79.104	78.699	79.646	
INVERT LEVEL	78.720 / 78.720	78.425 / 78.425	78.230 / 78.230	77.770 / 77.770	77.520 / 77.520	77.350	
DEPTH (m)	1.277	1.078	1.646	1.334	1.179	2.296	
DISTANCE (m)	49.99	58.68	38.04	87.84	47.14	34.71	
PIPE SLOPE	1:200	1:199	1:195	1:191	1:189	1:204	
PIPE SIZE	225mm	225mm	225mm	225mm	225mm	225mm	



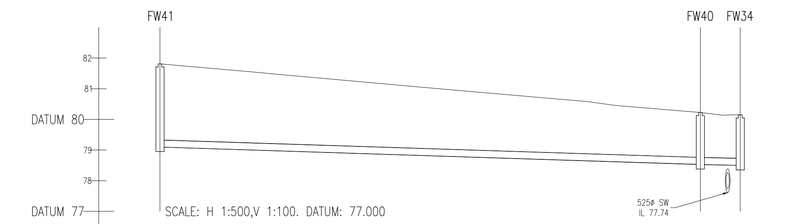
COVER LEVEL	81.798	82.109	80.069	79.710	79.104
INVERT LEVEL	80.160 / 79.920	79.920 / 78.390	78.390 / 78.100	78.100 / 77.770	
DEPTH (m)	1.638	2.189	1.679	1.610	1.334
DISTANCE (m)	36.68	60.41	35.40	40.58	
PIPE SLOPE	1:153	1:39	1:122	1:123	
PIPE SIZE	225mm	225mm	225mm	225mm	



COVER LEVEL	80.755	80.069	
INVERT LEVEL	78.640	78.390	
DEPTH (m)	2.115	1.679	
DISTANCE (m)	38.07		
PIPE SLOPE	1:152		
PIPE SIZE	225mm		



COVER LEVEL	80.022	79.794	80.148	79.710
INVERT LEVEL	78.910	78.800 / 78.800	78.500 / 78.500	78.100
DEPTH (m)	1.112	0.994	1.648	1.610
DISTANCE (m)	15.60	46.17	62.79	
PIPE SLOPE	1:142	1:154	1:157	
PIPE SIZE	225mm	225mm	225mm	



COVER LEVEL	81.810	80.224	80.148	
INVERT LEVEL	79.100	78.530 / 78.500		
DEPTH (m)	2.710	1.694	1.648	
DISTANCE (m)	88.21	6.51		
PIPE SLOPE	1:155	1:217		
PIPE SIZE	225mm	225mm		

0 50mm ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
I	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19

CLIENT

RYCROFT HOMES LTD.

PROJECT

LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE

PROPOSED FOUL SEWER
LONGITUDINAL SECTIONS
SHEET I

PINNACLE CONSULTING ENGINEERS

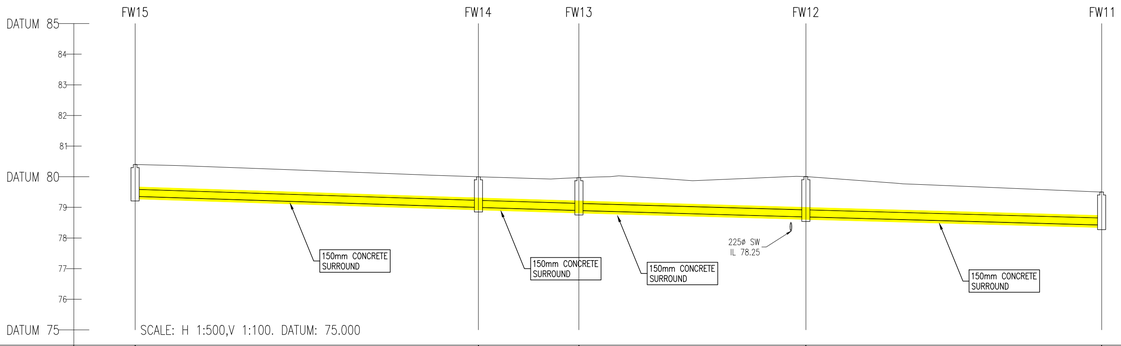
GROSVENOR COURT,
67A PATRICK STREET,
DUN LAOGHAIRE,
COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041

NORWICH | WELWYN GARDEN CITY | LONDON | BRISTOL

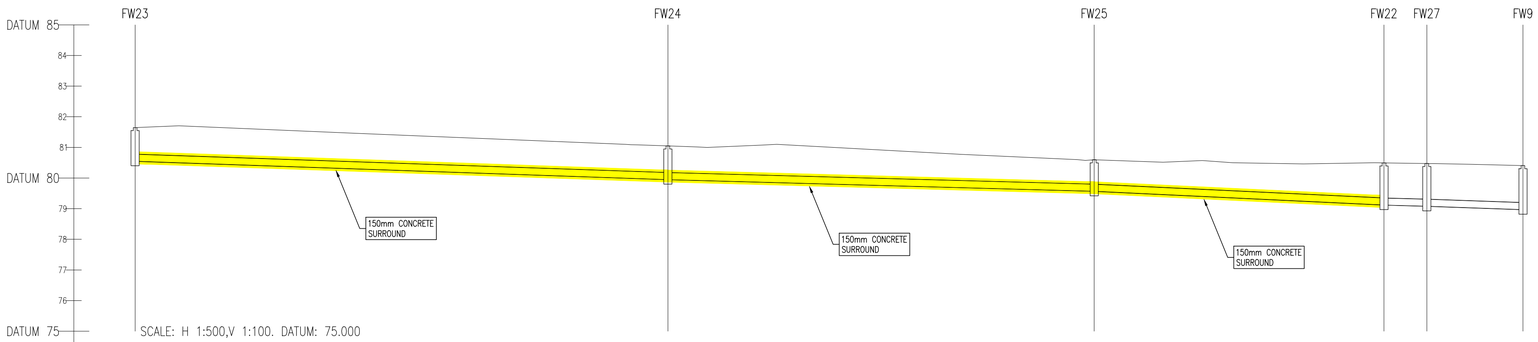
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PLANNING			
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100/500	Feb'19	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
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REF: P180307

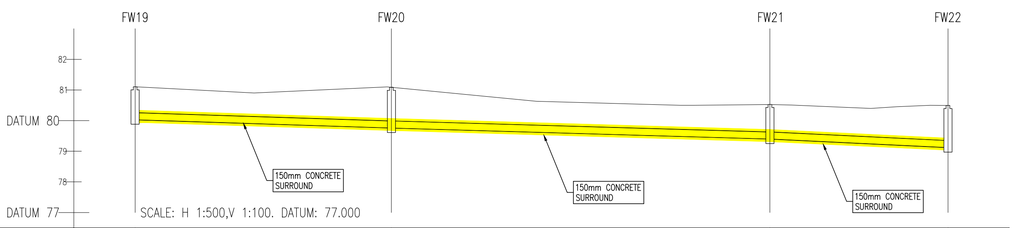
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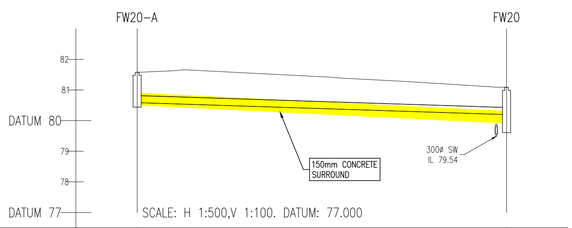
COVER LEVEL		80.398		79.998		79.972		80.004	79.503
INVERT LEVEL		79.360	79.000	79.000	78.900	78.900	78.690	78.690	78.425
DEPTH (m)		1.038		0.998		1.072		1.314	1.078
DISTANCE (m)		56.04		16.40		37.05		48.29	
PIPE SLOPE		1:156		1:164		1:176		1:182	
PIPE SIZE		225mm		225mm		225mm		225mm	



COVER LEVEL		81.647		81.648		80.595		80.495		80.474		80.404
INVERT LEVEL	80.550		79.950	79.950		79.570	79.570		79.120	79.120	79.080	79.080	78.970
DEPTH (m)	1.097			1.098			1.025			1.375		1.394	1.434
DISTANCE (m)		86.97			69.59			47.31		6.99	15.70	
PIPE SLOPE		1:145			1:183			1:105		1:175	1:143	
PIPE SIZE		225mm			225mm			225mm		225mm	225mm	



COVER LEVEL		81.103	81.087		80.527	80.495
INVERT LEVEL	80.030		79.760	79.760	79.400	79.120
DEPTH (m)	1.073		1.327		1.127	1.375
DISTANCE (m)		41.83	61.79		29.06	
PIPE SLOPE		1:155	1:172		1:104	
PIPE SIZE		225mm	225mm		225mm	



COVER LEVEL		81.576	81.087
INVERT LEVEL	80.580		80.200
DEPTH (m)	0.986		1.327
DISTANCE (m)		60.31	
PIPE SLOPE		1:155	
PIPE SIZE		225mm	

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
I	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19

CLIENT

RYCROFT HOMES LTD.

PROJECT

LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE

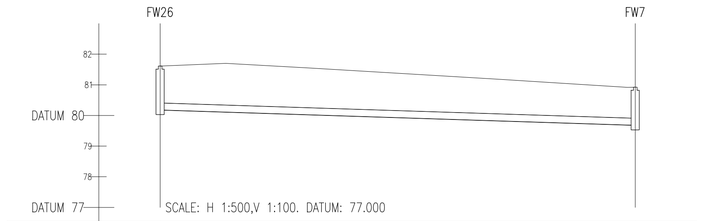
PROPOSED FOUL SEWER
LONGITUDINAL SECTIONS
SHEET 2

PINNACLE CONSULTING ENGINEERS
GROSVENOR COURT,
67A PATRICK STREET,
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COUNTY DUBLIN,
IRELAND. TELEPHONE: +353 1231 1041
NORWICH | WELWYN GARDEN CITY | LONDON | BRISTOL

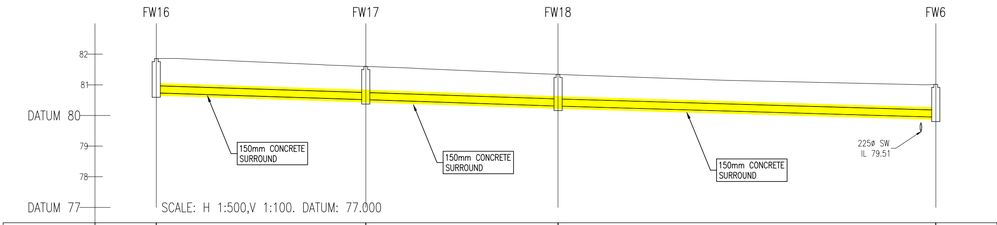
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PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
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DRG NO.		REVISION	SHEET SIZE
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REF: P1803O7

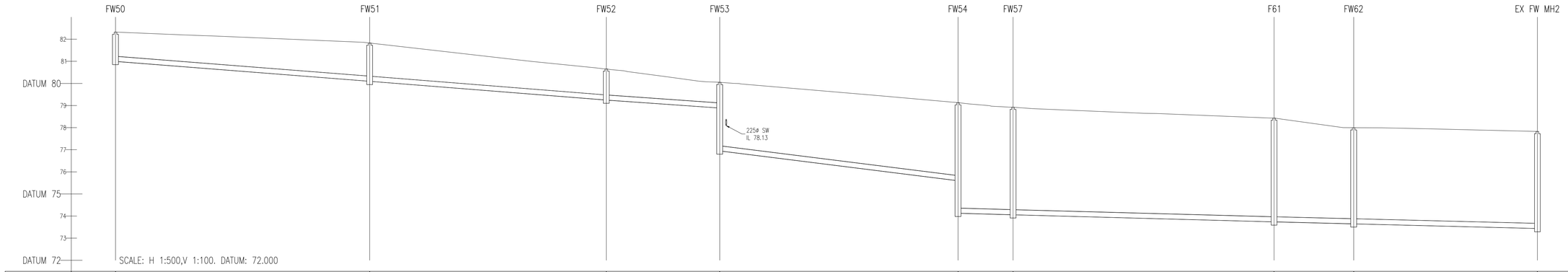
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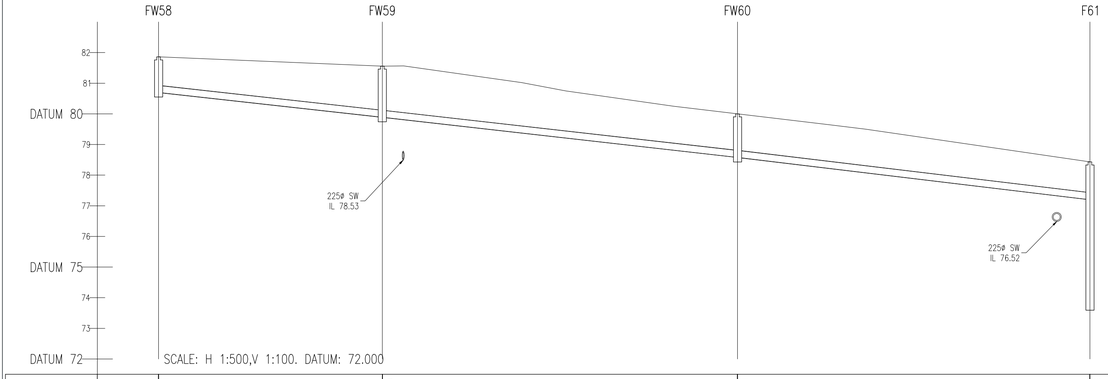
COVER LEVEL		81.611	80.920
INVERT LEVEL		80.180	79.680
DEPTH (m)		1.431	1.240
DISTANCE (m)		77.55	
PIPE SLOPE		1:155	
PIPE SIZE		225mm	



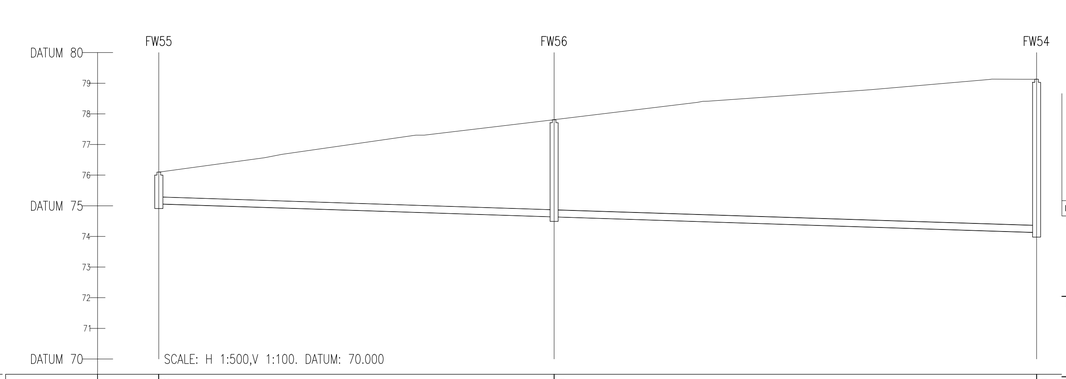
COVER LEVEL	81.857	81.599	81.340	81.014
INVERT LEVEL	80.740	80.520	80.310	79.950
DEPTH (m)	1.117	1.079	1.030	1.064
DISTANCE (m)	34.20	31.38	61.67	
PIPE SLOPE	1:155	1:149	1:171	
PIPE SIZE	225mm	225mm	225mm	



COVER LEVEL	82.322	81.827	80.653	80.050	79.129	78.922	78.433	77.995	77.828
INVERT LEVEL	81.000	80.100 / 80.100	79.250 / 79.250	78.890 / 76.950	75.600 / 74.130	74.060 / 74.060	73.740 / 73.740	73.650 / 73.650	73.440
DEPTH (m)	1.322	1.727	1.403	3.100	4.999	4.862	4.693	4.345	4.388
DISTANCE (m)	57.53	53.55	25.67	53.93	12.45	59.07	18.03	41.58	
PIPE SLOPE	1:64	1:63	1:71	1:40	1:178	1:185	1:200	1:198	
PIPE SIZE	225mm	225mm	225mm	225mm	225mm	225mm	225mm	225mm	



COVER LEVEL	81.861	81.559	80.001	78.433
INVERT LEVEL	80.700	79.880 / 79.880	78.580 / 78.580	77.200
DEPTH (m)	1.161	1.679	1.421	4.693
DISTANCE (m)	36.52	57.98	57.53	
PIPE SLOPE	1:45	1:44	1:42	
PIPE SIZE	225mm	225mm	225mm	



COVER LEVEL	76.100	77.809	79.129	
INVERT LEVEL	75.060	74.640 / 74.640	74.130	
DEPTH (m)	1.040	3.169	4.999	
DISTANCE (m)	64.52	78.75		
PIPE SLOPE	1:154	1:154		
PIPE SIZE	225mm	225mm		

0 50MM ON AI DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
I	LEVELS/SERVICES UPDATED	PC	SO'R	06.07.19

CLIENT

RYCROFT HOMES LTD.

PROJECT

LANDS ADJOINING BRAYTON PARK
KILCOCK
CO. KILDARE

DRAWING TITLE

PROPOSED FOUL SEWER
LONGITUDINAL SECTIONS
SHEET 3

PINNACLE
CONSULTING ENGINEERS

GROSVENOR COURT,
67A PATRICK STREET,
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COUNTY DUBLIN,
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NORWICH I WELWYN GARDEN CITY LONDON I BRISTOL

DRAWING STATUS			
PLANNING			
SCALE	DATE	DRAWN BY	CHECKED
100/500	Feb'19	KR	SO'R
DRG NO.		REVISION	SHEET SIZE
212		1	AI

REF: P1803307

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Appendix F

Rain Water Harvesting Details

Tri-Cel Package Rainwater Harvesting System.
A simple package solution, complete with a tri-cel rain control centre & tank.
- Overground & underground systems available –
- Pump direct to the services or to a header tank –



The tri-cel rain harvesting system is a simple solution for taking "free" rainwater off the roof on commercial or domestic buildings and reusing this water to flush toilets or as process water in factories etc. As water metering becomes more prevalent in Europe, using free Rainwater is an easy cost saving solution available to all.

Our simple system uses a tank (underground or overground) and a control centre. Almost any capacity in a single tank, either as an underground or overground system is available. A pressure controlled pump feeds the rainwater through a special pipework system to the building. If there is insufficient rainwater, only the required amount of water is drawn from the mains water supply, however the system always favours the rain harvesting tank. Once more rainwater becomes available, the system comes back online and the mains water is automatically shut off.

"Clean Water"
The rainwater is filtered from the roof using a volume filter (roof sizes up to 350m2 (larger filters available up to 3,000m2). Multiple filters may be required for different down pipes.

Overground systems are suitable for ground level or in a basement, reducing the costs of underground excavations & installation and are suitable for existing buildings. Our experienced site crews will assemble the tank and commission the system on site, all you have to do is plumb to the building. Underground systems, only a manhole and small control cabinet are visible after installation. Again we commission the system on site.

Introduction.
Today, we are using more water than ever before according to a Cambridge water study. Luxurious showers, large jacuzi baths, and manicaured gardens have all added to this rise in water usage. Although we sometimes feel, that its always raining, the water still has to be pumped, cleaned, treated and piped to meet our demands. All water goes through the same process, even the water for toilets.

The toilet.
A third of all domestic water used goes down the toilet. The average person uses about 150 litres of water per day. A bath uses 90 litres, 45 litres for a 5 minute shower, 110 litres for a washing machine and 45 litres for a dishwasher

Commercial applications.
Commercial water varies depending on the application, but large hotels, airporst and football grounds can waste a lot of water, literally flushing money down the toilet.

Commercial water charges

Ireland. Water charges are payable if water is being supplied for use by business, trade or manufacture. This includes hospitals, sanatoriums, homes for people with mental or physical disabilities, maternity homes, convalescent homes, laboratories, clinics, health centres, schools or clubs. Water rates vary and information can be found at local County Council level.

Drinking Rainwater.

We DO NOT recommend drinking harvested rainwater. Rainwater should only be used for flushing toilets and urinals. If to be used as process water, testing may be required to ensure compliance with local legislation. Harvested rainwater comes from roofs, and filtering typically only remove leaves moss etc. Filters will not remove, Legionella, Cryptosporidiosis, bacteria or excrement from birds, bats etc. Even with UV treatment, water would require regular testing etc, and we DO NOT recommend even for use in hand washing.

Potable Water Tanks
Underground tanks are not acceptable as "Potable Water Tanks" by the Irish Local Authorities, due to the possibilities of leeching from damage caused by underground growths, earth movements etc.

Scope.

1. Rainfall

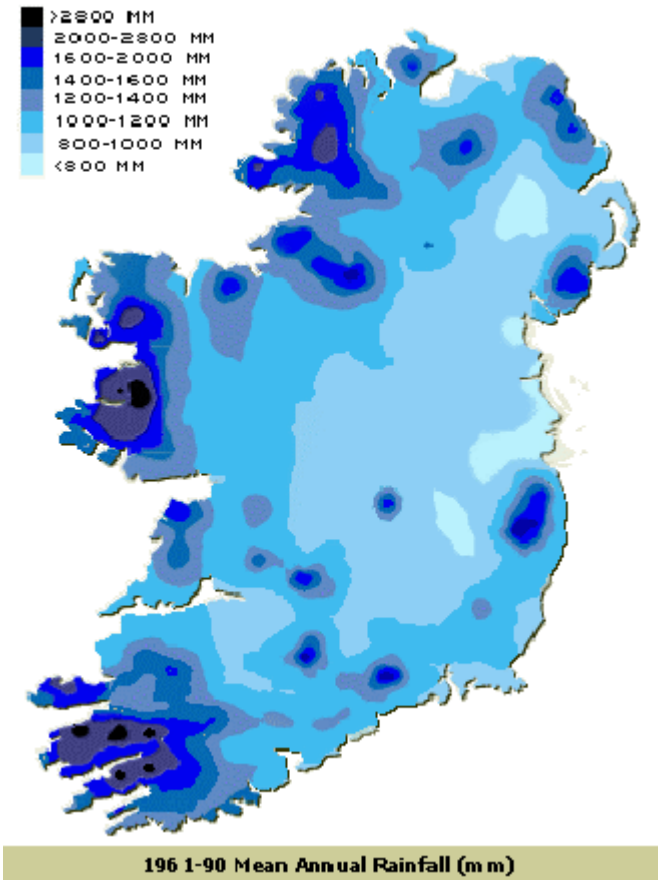
Rainfall in Ireland.

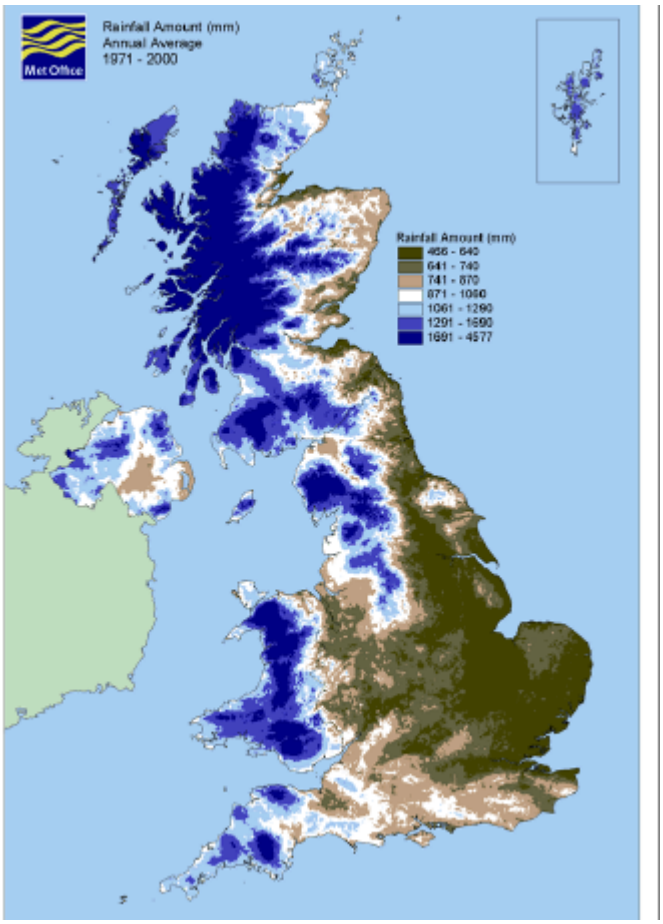
Most of the eastern half of the country has between 750 and 1000 millimetres (mm) of rainfall in the year. Rainfall in the west generally averages between 1000 and 1250 mm. In many mountainous districts rainfall exceeds 2000mm per year. The wettest months, almost everywhere are December and January. April is the driest month generally but in many southern parts, June is the driest. Hail and snow contribute relatively little to the precipitation measured.

.

Rainfall in England, Scotland & Wales.

Rainfall in England varies widely. The Lake District is the wettest part, with average annual totals exceeding 2,000 mm, comparable with the western Highlands of Scotland). The Pennines and the moors of south-west England are almost as wet. However, all of East Anglia, much of the Midlands, eastern and north-eastern England, and parts of the south-east receive less than 700 mm a year. Typically, it rains on about one day in three in England, more often in winter, though long, dry spells occur in most years. Near the south coast there is a maximum of rainfall, with totals in July barely half those in January; western, northern and eastern coasts are more likely to see the driest month in spring and the wettest in late autumn. Inland for example, at London and Birmingham, thunder occurs on an average of 15 days a year, but in the west and north-west the frequency declines to around eight days per year. Facts and figures. Maximum in a day (09-09 UTC): 279 mm at Martinstown (Dorset) on 18 July 1955.



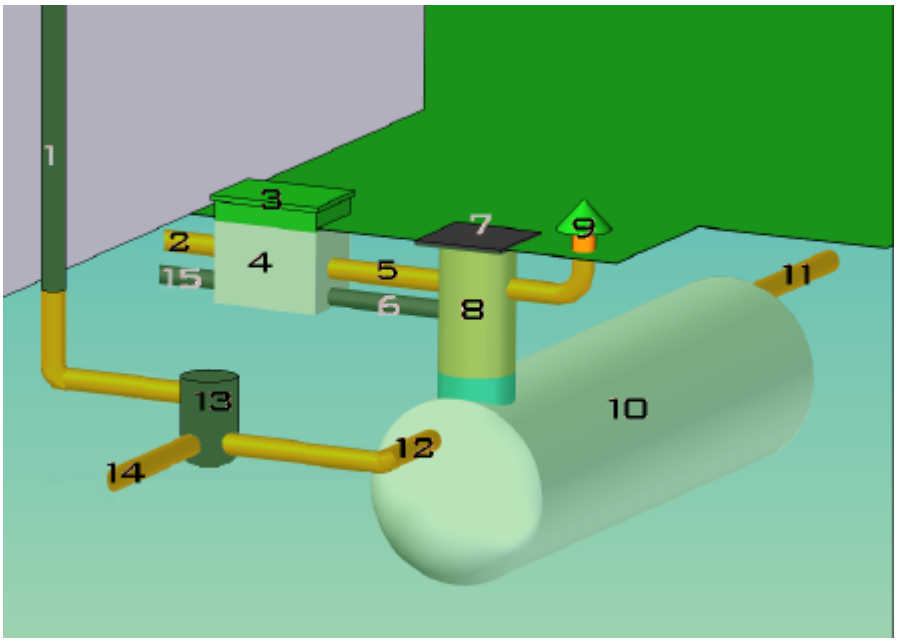


System sizing. (Source Environment Agency, UK)

Rainfall can be sporadic, but the tank size is usually less than imagined. As a guideline, size the tank of the system to hold 18 days worth of demand. Or 5% of annual yield, whichever is lower. To calculate the optimum tank size, first calculate the potential yield. Once you know the potential yield, simply find 5% of this.

Roof area in m2 x drainage factor x filter efficiency x annual rainfall in mm x 0.05.

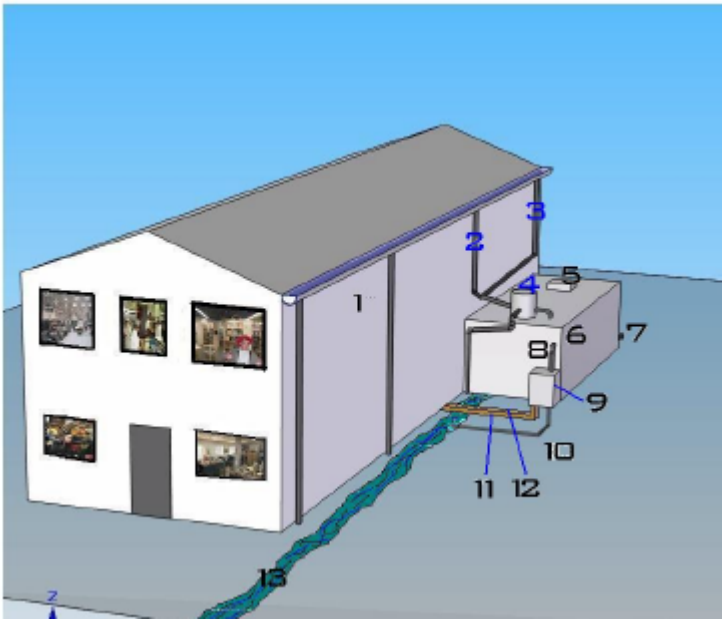
2. The Tri-Cel Package Rainwater Harvesting System.



1. Building down-pipe to filter
2. 4” duct, for Rainwater to services
3. TCRC Tank cover
4. TCRC Tank
5. 4” duct, for rainwater suction from the tank
6. 4” duct, for overflow to the rainwater tank
7. Manhole cover
8. Tank shaft
9. Vent
10. Tank
11. Overflow to storm drain
12. Harvested water inlet from filter
13. Filter
14. Overflow to storm drain
15. 4” duct for back-up mains water connection

Underground and over ground solutions. Typically overground tanks are placed into basements or existing buildings whereby an underground installation is undesirable. Overground systems can offer a more cost effective solution, not requiring excavations, groundworks etc. Package system consisting of an underground or overground tank, a TCRC Tank with tri-cel rain centre, filter with extension, calmed inlet with dip pipe, floating suction filter with hose and overflow siphon. Header tank system is also available.

1. Building
2. Down pipe
3. Down pipe
4. Filter with overflow to storm drain and pipe to fill the rainwater harvesting tank
5. Tank cover
6. Rainwater harvesting tank
7. Rainwater tank overflow to storm drain
8. Pump suction pipe for removing rainwater from tank
9. Kiosk for Tri-Cel rain centre
10. Overflow to storm drain
11. Duct for mains back up water pipe
12. Duct for rainwater delivery to WC’s
13. Storm drain



Drawing not to scale. Drawing is for indicative purposes only.

3. Components:

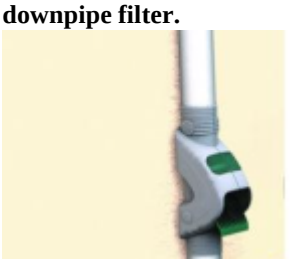
Tri-cel rain centre. The tri-cel rain centre is a ready to connect compact central unit for rainwater harvesting and can be used with any tank, over or underground. The modular design ensures ease of installation and consists of a-mains back-up tank with an integrated mechanical float valve for reliable water supply. The rainwater centre microprocessor controls the entire sequence of functions and ensures reliable performance. The display provides information on the actual state of operation. If the censors detect that there is no rainwater available in the tank, the 3-way valve switches over to mains water. Once rainwater is again available, the centre automatically switches back, ensuring that recycled water is primarily used.

Filtering the rainwater
Tri-Cel VF filter (WISY filters available to 3,000m2)
The Tri-Cel VF filter, filters leaves, moss and other debris from the water, ensuring cleanliness of water supplied. For roof areas of up to 350m2, the filter requires very little maintenance. Dirt is directly flushed away from the rainwater harvesting system. 80% to 95% of the rainwater is cleaned and fed into the tank for reusing. The filter inside of VF1 is s/s and can easily be cleaned, as opposed to being replaced. Telescopic extensions are available (right hand photo). As an extra precaution in areas with lots of leaves, a Down pipe filters "Rainus" also aid filtration.





Optional "Rainus" – downpipe filter.



WISY Filters: WISY WFF 100, 150, 300 suitable for roofs up to 200m2, 500m2 & 3,000 m2 respectively.







Calmed inlet.
The dip pipe & calmed inlet ensures a non-turbulent supply of rainwater into the tank. This slow flow of water helps in preventing sediments from being stirred up.







Floating suction filter.
The Floating suction filter is used for taking rainwater from the tank. The floating ball ensures that the water is always taken from the cleanest layer (the top of the tank). Included are a non-return valve, dirt collector and hose connection



Siphon.
Siphon for tank overflow with stench trap, rodent stop and connection for backwash.



4. Tri-Cel rain centre Technical information.



Tri-Cel rain centre

The "tri-cel rain centre".

- Pump.
- Armoured cable.
- Tank contents gauge.
- Pressure switch
- Dry run protection.
- Rainwater outlet.
- System control panel.
- Pressure gauge.
- Capillary tube for pressure indication.
- Float valve inlet for mains back up.
- 3-way valve. Mains back up water tank.
- Connection for maximelder.
- The rain centre is housed in the TRRC Tank, which is partially buried.

The Tri-Cel rain centre can be used as a rain water system control unit for all standard rainwater tanks. It can be retrofitted above or below ground. The pump, the processor units and all other elements are modularly arranged around the mains water reserve tank, a highly compact, plug and play solution. This compact system design incorporates the reserve tank with a mechanical float valve, which ensures reliable and safe water supply. The microprocessor-controlled Tri-Cel rain centre controls the entire system and ensures superior reliability.
Tri-Cel rain centre uses rainwater from the collection tank. If the tank is empty, the Tri-Cel rain centre uses a sensor to switch to mains water supply from the reserve tank via a 3-way valve. A short rain shower is sufficient for the Tri-Cel rain centre to switch back to rain water supply. An integrated level indicator shows the level in the rainwater tank. The system will work with either above or belowground.

TCRC Tank dimensions	**1060 x 760 x 680mm**
Dimensions tri-cel rain centre H x W x D	**600 x 650 x 300mm**
Weight tri-cel rain centre empty	**27.5 kg**
Weight tri-cel rain centre with water	**45 kg**
Capacity of reserve tank	**18 litres**
Operating temperature	
Water	**+ 4°C to + 35°C**
Ambient	**+ 4°C to + 40°C**
Supply voltage	**230V ac, 50Hz**
Maximum consumption	**1500 VA**
Maximum motor power	**550 W**
Maximum pumping height	**40 m**
Maximum pressure	**4.0 bar**
Maximum capacity	**4,500 litres / hour**
Maximum suction height	**8 m**
Maximum distance – tank to control unit	**15 m**
Emergency overflow	**DN50**
Protection class	**1 (EN 60335-1)**
Protection rating	**IP42 (EN 60529)**
Electrical safety	**According to EN 60335-1**
Mains in pipe	**¾ " BSP**
Pipework carrying rainwater to services	**1" BSP**
Suction pipework from RWHS	**1" BSP**

5. Pumping to a Header tank

Our header tank system differs from the standard system, whereby the harvested rainwater is pumped to a "Header" tank in an attic and the services are then drawn from there, for use in WC's. The Tri-Cel Rainwater Harvesting Tank will collect rainwater as with the standard system. This water will then be pumped via the Tri-Cel Rain Centre or a submersible pump up into an attic header tank, (available in standard sizes with a cover up to 9000 litres (2,000 gallons) in a one-piece tank or as a sectional tank of any capacity). The pump, pumps the rainwater via a LOWARA GENYO 16A R15-25. This is an electronic pressure / flow switch for control and protection of electric pumps. It has an Adjustable start Pressure of 1.5 ÷ 2.5 bar. The header tank will have 2 ball valves, one standard mains ball valve, which will be set at a lower position than the rainwater ball valve. In the first instance, rainwater will always fill the header tank. If rainwater is unavailable, the level in the header tank will drops to a pre set level, and then the mains water will automatically maintain the header tank levels. When more rainwater enters the RHH Tank, it will automatically enter the header tank.

6. Tanks used with the rainwater harvesting system "RHS"

Underground tanks: 3,000 litres to 150, 000 litres in one single tank. Recent tri-cel rain harvesting systems include from left, domestic system 3.5m3 system, 16m3, 30m3 & 75m3 systems.

Typical arrangement, underground tanks.
Tank with access manway, TCRC Tank containing the tri-cel rain centre, inlet from down pipe and overflow to storm drain.







Overground tank: One-Piece to 9,000 litres and any other capacity (any length x any width x 3m high)

Overground installations.
Overground installations offer a suitable cost effective solution especially in existing builds, whereby costly excavations can be avoided. The systems are suitable for either indoor (typically in a basement) or outdoor. Our package system can offer a relatively maintenance free system, whereby the tanks and the tri-cel rainwater centre require minimal maintenance. Overground tanks are built on site by KMG Killarney Plastics Ltd dedicated site crews and commissioned at that time. We can offer a bespoke package to suit all of your rainwater harvesting requirements.

Filter placed on the tank roof for ease of installation.



7. The operations manual

The operations manual details the following: Commissioning, Operation, Inspection and Maintenance, Troubleshooting

Systems component		Inspection		Maintenance	
		Interval		Interval	
		Annually	Monthly	Annually	Monthly
1	Tank	YES			
2	Float valve		YES	YES	
3	Reinforced/pressure Suction hose		YES		
4	Controller		YES		
5	Pump with switch		YES	Every 1000 h or 5 years	
6	Sensor and suction Sieve/filter	YSE		When the collector is checked	

Inspection and Maintenance

The tri-Cel rain centre system comprises components, which require inspection and maintenance. Inspections may be performed by the owner/operator of the system, however KMG Killarney Plastics Ltd are pleased to offer a "Servicing Contract to maintain your system"

Potable "Drinking" water.
Rainwater is NOT always suitable to be considered Potable water. Rainwater also contains pollutants, soil, plant parts, insect parts, bacteria, algae, and sometimes, radioactive materials that the rain/snow has washed out of the air. If filtered and or boiled, you could probably drink the water safely. However, it is safer yet to get your water from municipal water supplies or from wells that are frequently tested. The classification of a water as potable (i.e. fit for drinking) or otherwise is not just based on the opinion of an individual analyst, but on the requirements of the 1988 "Drinking Water Regulations" made by the then Minister for the Environment. The drinking water regulations cover a total of 53 bacteriological, chemical and physical parameters for each of which an upper concentration limit or MAC is specified, source "EPA the quality of drinking water in Ireland 2002".

Underground "POTABLE" tanks are unacceptable to the Irish Local Authorities due to the possibility of leeching and the lack of inspection possibilities and are therefore unavailable.

Above ground tanks are available as Rainwater Harvesting Systems and we recommend that not consume or wash, shower etc in rainwater.
Format 30 Potable Water Tanks are available from KMG Killarney Plastics Ltd, to suit all of your POTABLE water requirements and these are fully compliant with Irish, UK and EU legislation.

8. Glossary of terms

Access Shaft Extensions
Loose shafts should be sealed using s/s bolts, silicon sealant, sikaflex or similar prior to installation to prevent ingress of groundwater under high water table conditions. It is the contractor's responsibility to ensure a watertight seal.

Connections.
Only RH Kit connections are supplied with the system. Standard connections are supplied, however plumbing to the building is the responsibility of others.
Installation guidelines for GRP cylindrical underground tanks and overground tanks available on request (separate document).

Construction.
Underground tanks are to be manufactured from GRP and supplied by KMG Killarney Plastics Ltd. The GRP construction will contain glassfibre and polyester resins. The walls are rigid, self-supporting and cylindrical in shape, suitable for "man weight". Overground systems are constructed from Hot press moulded Sheet Moulding Compound panels. KMG Killarney Plastics Ltd are Europe's largest manufacturer of Hot Press SMC panels.

Control of Groundwater
Tanks must not be subjected to buoyant forces during installation, taking account of ground water levels and surface water run-off, and their accumulation in the tank pit, even if tanks are anchored. The excavation area should be adequately drained, in order to permanently remove ground water from the proximity of the tank (or tanks). This is critical in order to avoid flotation of the tanks. Incorrectly installed tanks that move, rotate or float may be damaged, and KMG Killarney Plastics Ltd, will not be liable for this damage. The excavation should be maintained dry by pumping or whatever suitable means until the cover depth reaches 300mm minimum above the tank. Refer to the technical manual.

Dimensions and tank capacities.
Underground tanks: Standard Diameter sizes: 1.5m, 1.7m, 1.8, 2.5m and 3m. Standard Lengths are 2.2m to 15m. Standard capacities from 3.5m3 to 150m3 in a single tank and multiple tanks can be connected. Dia 1.7m: 3m3 to 3.5m3, Dia 1.8m: 5m3 to 40m3, Dia 2.5m: 16m3 to 80m3, Dia 3.0m: 60m3 to 150m3, Dia 4.0m: on request
Sectional tanks: sectional tanks are in general 0.5m to 3m in height, any length and any width. Capacity 1m3 to 1,200 m3 and larger

Electrical Installation of the unit.
All electrical work to be carried out by competent person using suitable materials for the application. Electrical work must be carried out strictly to the manufacturer's instructions and to 'The National Rules For Electrical Installations' (ETCI) published by the 'Electro-Technical Council Of Ireland' or equivalent UK / EU regulations. Supply voltage: 230V 50hz. We recommend armoured cable be brought to the TCRC Tank and that a waterproof plug and socket are used.

Loadings
The tanks are designed to take a man-weight loading. Tanks are not suitable for vehicular or animal loadings.

Manways & turrets.
Standard underground tank, include manways of dia. 750mm. GRP shaft standard height is 0.7m. Covers are not supplied but must be fitted. Sectional tanks have a lockable manway fitted to the system.

Manway covers and Fencing.
Once the system has been completely installed, we recommend that a suitable lockable manhole, be put in place in order to prevent access by unauthorised people that could fall into the tank and be harmed. We also recommend that a fenced area may be required to ensure that access is restricted to the system and control cabinet. Access must be restricted to suitable trained maintenance personnel only. It is imperative that entry is not possible whereby (especially) children can be caused harm, by falling into the system. Local authority / government regulations, must be adhered to in relation to fence specifications and design.

Plumbing the system.
Competent ground-works site personnel should connect the plumbing from the building to the system. The system is only for rainwater from roof areas, not car parks etc. Do not plumb water or storm-water from drains, footpaths, car parks etc, into the rainwater harvesting system. The TRRC Tank will have a 4" (100mm ID) pipe, which must be plumbed to the rainwater storage tank. The mains back-up must be plumbed to the mains. The 1" BSP to the services (WC's) must be plumbed.

- **A mains-shut off must be fitted to the system by the mechanical contractors. This is required for maintenance and/or replacement of parts.**
- **A bypass valve must be fitted, in order to be able to manually bypass the system during power outages.**
- **The onsite mechanical contractors are to ensure that all plumbing connections are leak free.**

System orientation.
Your system may be constructed from 1 or more tanks depending on your requirements. The orientation of the tanks in general will be in series. We recommend that when the system arrives on site that it is inspected for damage, from miss-handling etc. If any damage is seen or suspected, please notify us immediately. Refer to installation instructions, available on request.

TCRC Tank for Tri-Cel Rain Centre:
The tri-cel rain centre will be placed into a separate underground tank, the TCRC Tank. This lockable tank is to be partially buried, leaving the grass green part overground. The tank will house all of the components belonging to the tri-cel rain centre and must be connected to the system via a 4" (100mm ID) pipe(s). The tank must remain waterproof, and any other drilled holes must be sealed against ingress of water. This pipe will need a rope laid placed in it, in order to pull through the hoses, plumbing works etc. Run the pipework from the 110mm connection on the cabinet to the manway shaft. The tank is normally laid in wet cement. Ensuring that you are a maximum of 2 meters from the system, prepare a suitable location. Ensure that the tank is placed dead level in the cement.

- An optional overground Kiosk is available, in place of the TCRC Tank. The Kiosk is green and 980mm width x 700mm depth x 1200mm height. There is an additional cost. Please consult sales.

Ventilation
Ventilation is crucial to the system.

9. Safety Precautions.
Safety is paramount, and "best practices" should be followed at all times in relation to the system. Health & Safety legislation must be followed at all times.

10. Terms & Conditions:
Subject to Killarney Plastics Ltd standard terms and conditions, available on request. Killarney Plastics Ltd. believe that the information contained is accurate, and is printed for information only. No warrants, express or implied, are contained therein, nor does any legal liability attach to Killarney Plastics Ltd. for any reason whatsoever. Property rights of the subject belong to Killarney Plastics Ltd., and transfer of these rights is not granted by possession of this document. KMG Killarney Plastics Limited shall not be liable for any damage or loss, including consequential loss, caused by the failure of any equipment.

In accordance with Killarney Plastics Ltd normal policy of product development, this specification is subject to change without notice. Aug 2008.

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