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CONSULTING STRUCTURAL and CIVIL ENGINEERS

ENGINEERING INFRASTRUCTURE REPORT & STORMWATER IMPACT ASSESSMENT for a Residential/Commercial project at Kilternan Village LRD, Kilternan, Dublin 18.

PROJECT:	**KILTERNAN VILLAGE DEVELOPMENT LRD - 2104C**
CLIENT:	**LISCOVE LTD**
DATE:	**JUNE 2024**
ISSUE NO:	**LRD STAGE 3**
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1.0 Introduction

1.1 This document relates to the Drainage & Water Infrastructure design, including the Storm Water Impact Assessment, for a proposed LRD residential/commercial development located on lands at Wayside, Enniskerry Road, Kilternan, Dublin 18.

1.2 We, Roger Mullarkey & Associates, were appointed by Liscove Ltd. to carry out the drainage and water supply infrastructure report to accompany the suite of other drawings and documentation relating to a proposed residential and commercial development at the above noted address.

1.3 The site application area is c.14.2Ha and the total drained S/W area is 12.6Ha. The existing lands are currently predominately greenfield and with a derelict dwelling known as "Rockville" and associated derelict outbuildings and the former Kilternan Country Market.

1.4 The development will principally consist of a mixed-use development consisting of 487No. residential units, a creche of 691m^2 floor space and a retail/commercial/community floor space of 5,434m^2. Please refer to Thornton O'Connor Planning Consultants for a full development description.

2.0 Key Objectives

2.1 This document relates to the Drainage and Water Infrastructure engineering that incorporates the design, background, and detail of the following aspects;

- Road & Block Levels
- Sustainable Drainage Systems (SuDS)
- Storm Water Impact Assessment
- Attenuation
- Foul Water
- Potable Drinking Water Infrastructure

2.2 Aspects relating to the Flood Risk Assessment are detailed in a separate document entitled the Site-Specific Flood Risk Assessment and the reader is referred to that report for further information in that regards.

2.3 Roads access and traffic/transportation assessments are contained in the separate submission documentation by Atkins Consulting Engineers included in the overall planning submission.

2.4 Reference should be made to all drainage drawings and designs included in the appendix of this report and all other consultant's reports and drawings as part of the overall application documentation.

2.5 The DLRCC Municipal Services Departments LRD Stage 2 DLRCC Opinion conditions have been addressed throughout this report and specifically responded to in the Appendix 12.22 of this report.

3.0 Site Location & Topography

3.1 The lands are located just east of the Enniskerry Road and south of the Glenamuck Road in Kilternan, Dublin18.

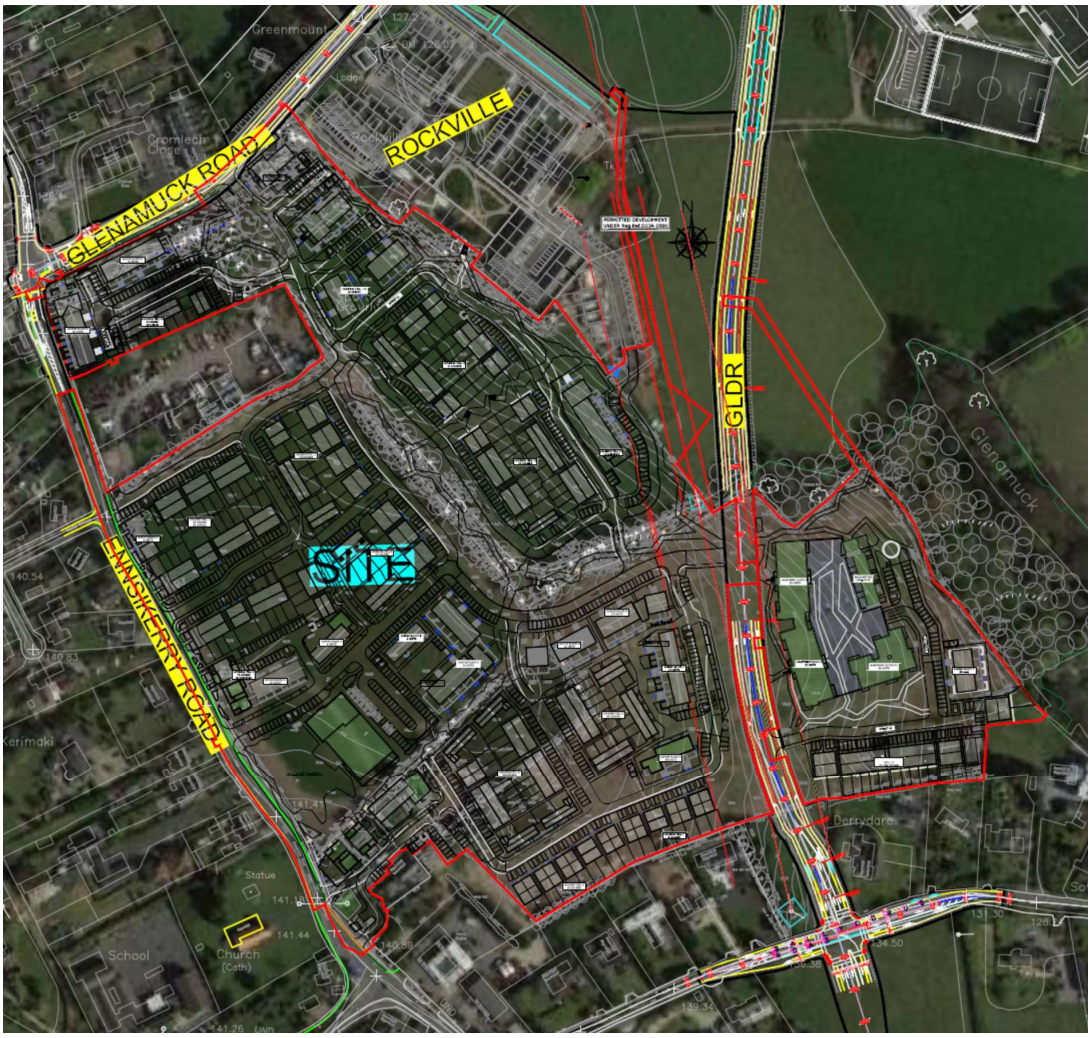

Fig. 1 – Site Location

3.2 The site application area is c.14.2Ha and the total drained S/W area is 12.6Ha. The existing lands are currently predominately greenfield and

with a derelict dwelling known as "Rockville" and associated derelict outbuildings and the former Kilternan Country Market. It is noted that the surface water drained area is 12.6Ha and is used for the Qbar and drainage calculations.

3.3 The topography is generally a gradually increasing slope downwards from the Enniskerry Road (western boundary) in a North-easterly direction and then falls off sharply (c 1/10 gradient) towards the eastern boundary. A site survey drawing is included in the application and can be viewed as background on RMA drawing Dwg.No's.2104C/300-302.

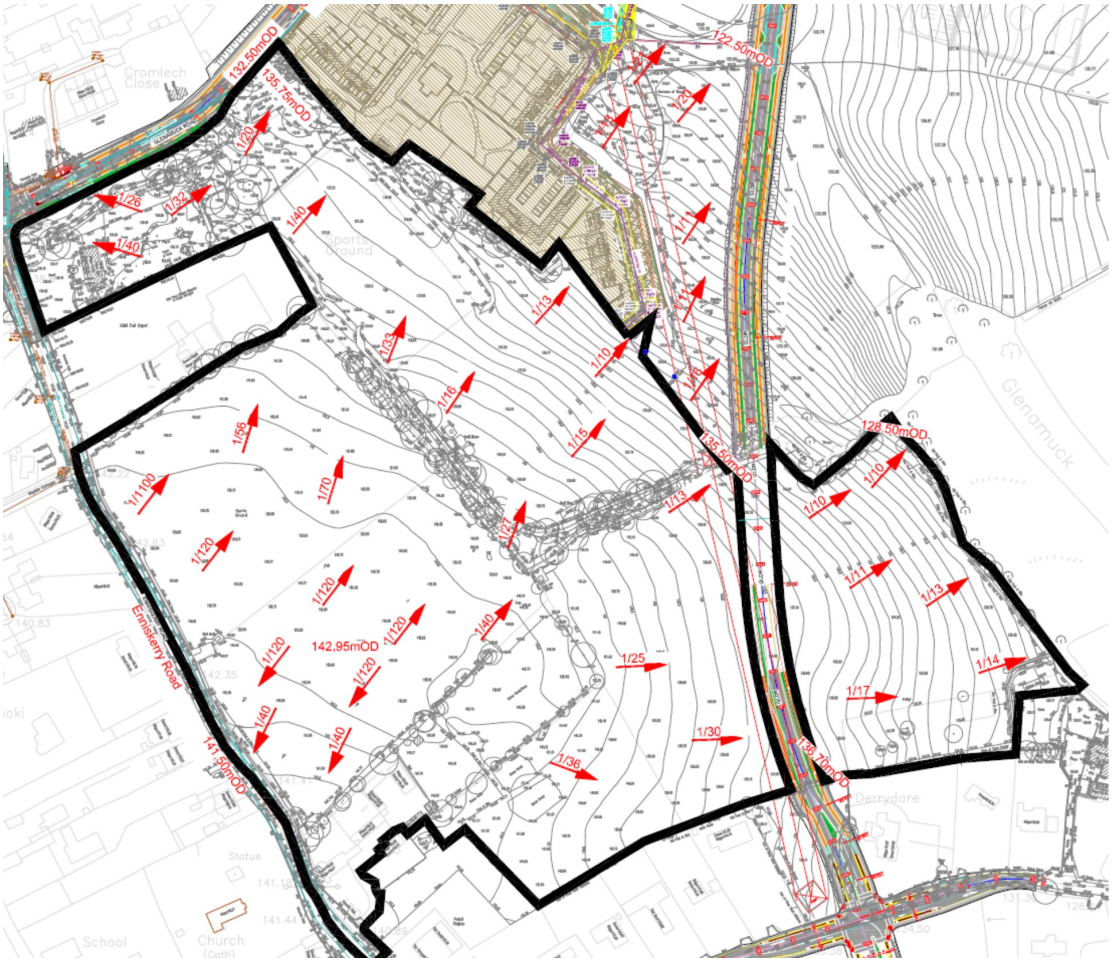

Fig.2 - Topography

3.4 The site is bounded by a c.1.2m high existing stone wall to the west (Enniskerry Rd), by hedgerows/trees to the northeast, by trees to the east and by hedgerow and green field along the southern boundary.

3.5 The Glenamuck Link Distributor Road (GLDR) as part of the Glenamuck District Roads Scheme (GDRS) will cross the eastern part of the subject

lands and as part of that roads scheme the existing Glenamuck Road will be upgraded the northern boundary of the site.

3.6 Consultations between the applicants and their agents with the Dun Laoghaire Rathdown County Councils (DLRCC) GDRS project team have taken place over several years. The interface between the GDRS and the proposed Kilternan Village development has been identified on the application drawings and land transfers between the applicant and DLRCC have been agreed to facilitate the GDRS project.

3.7 Road access from the Kilternan Village LRD development land and the GLDR has been facilitated in the contract documents of the GDRS, the detail of which is the included in this planning application and is subject to a successful grant of planning. Refer to the MCORM Architects and Atkins Ireland Traffic & Transportation consultants' drawings and documentation included in this application for more detail. Confirmation from the Capital Projects Team regarding consistency of this Stage 3 application with the GDRS project has been obtained and is included in the Appendix 12.17 of this report.

3.8 Drainage and water supply infrastructure included in the GDRS project have been designed by DLRCC to facilitate future connections to the subject Kilternan Village LRD development lands subject to a successful grant of planning for this subject sites proposed development.

3.9 Road & Block levels drawings has been prepared as part of this application and reference should be made to Dwg.No's.2014C/300-302 in this regards. Generally, the proposed road levels and house levels follow the existing contours of the site topography as closely as reasonably possible.

3.10 Proposed road gradients vary between 1/120 (0.83%) and 1/15 (6.7%) which are in accordance with the DOELG Recommendations for Site Development Works for Housing Areas and the Dept. Of Transport's Design Manual for Urban Roads and Streets (DMURS) documentation.

3.11 In relation to road gradients, the Design Manual for Urban Roads and Streets (DMURS) section 4.4.6 on page 112 states"...*vertical alignment should be considered at the network level as a response to the topography of a site*". As the existing topography of the subject site is steep up to a maximum gradient of 1/10(10.0%), the proposed development will provide road gradients, in limited locations, of 1/15 (6.7%) is a *response to the topography of the site* and in accordance with the DMURS standards.

3.12 The DMURS document further allows that the normal recommended maximum gradient of 1/20 (5%) can be exceeded on "*hilly terrain*" up to

a maximum of 1/12 (8.3%), section 4.4.6 on page 113. The subject application includes gradients in limited areas up to a maximum of 1/15 (6.7%) and is therefore in accordance with the DMURS standards document.

3.13 The DOELG Recommendations for Site Development Works for Housing Areas document allows road gradients to 1/10 (1%) vertical alignment and as noted above, the limited use of 1/14 (7.1%) gradients on the site is therefore in accordance with DOELG document.

3.14 Given that the existing topography in parts of the site are approximately 1/10 and 1/11 the proposed developments road gradients are an improvement on the existing topography and are in accordance with both the DOELG and DMURS documents.

3.15 Private house surface water drainage is limited to 8No.units per pipe run and is to be in accordance with the DOELG Recommendations for Site Development Works for Housing Areas.

3.16 Private foul water drainage is to be in accordance with the Uisce Éireann Code of Practice for wastewater Infrastructure 2020 which requires individual house connections to each dwelling.

3.17 The site zoning is classified as Zoning Objective NC (Mixed Use/Neighbourhood Centre) along the Enniskerry frontage and as Zoning Objective A (Residential Protect/Improve) on the remainder of the lands.

4.0 Existing Drainage & Water Services

4.1 Records drawings were obtained from Uisce Éireann(UÉ)/DLRCC in preparation for this planning application and are included in the appendix of this document.

4.2 There are no known public drainage services on the subject lands.

4.3 The proposed development will have 4No.surface water and 4No.foul water connection outfall points.

4.4 The total drained area of the site will be 12.6Ha and the surface water drainage is to be divided into 4No.main catchment areas as shown in Table 1 below;

SURFACE WATER CATCHMENT SUMMARY		
Catchment No.	**Catchment Drained Area**	**Outfall Location**
1	9.99Ha	Outfalls into existing 300mm pipe NE of Rockville development
2	0.21Ha	Outfalls into 225mm pipe to be constructed as part of the Glenamuck Road upgrade
3	0.56Ha	Outfalls into the existing 300mm pipe in the Enniskerry Road at the Glenamuck Road junction
4	1.80Ha	Outfalls into the 300mm pipe to be constructed as part of the GLDR project

Table 1 – S/W Catchment Summary

4.5 It is acknowledged that the attenuated S/W outfalls from Catchment No.'s 2 & 4 are dependant on the construction of the S/W infrastructure as part of the GLDR/Glenamuck Road project. It has been stated by DLRCC that the roads project will be completed within c.24 months (Q1 of 2026) which has now commenced as of May 2024. Therefore, the above noted catchments 2 & 4 will be phased to coincide with the GLDR completion.

4.6 The vast majority of the site area, Catchments 1 & 3 (totalling c.10.6Ha drained area) can outfall attenuated surface water flows into the existing drainage infrastructure without interface with the GLDR roads scheme.

4.7 The main Catchment No.1 (9.99Ha of drained area) of the proposed development will outfall the attenuated flow into the existing piped infrastructure constructed as part of the existing Rockville development (D17A/0793) to the NE of the subject site. This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm S/W pipe. This existing pipe currently outfalls into the Glenamuck Road roadside watercourse. Refer to Dwg.2104C/306 for further detail.

4.8 The proposed foul drainage system will also have 4No.outfall connection locations summarised in table 2 below;

FOUL DRAINAGE CATCHMENT SUMMARY		
Catchment No.	**Quantity Drained**	**Outfall Location**
1	308Residential Units + 5,434m^2 Commercial/Retail + 691m^2 Creche	Outfalls into existing 225mm pipe in Rockville development
2	18 Residential Units	Outfalls into 225mm pipe to be extended as part of the Glenamuck Road upgrade
3	36 Residential Units	Outfalls into the existing 300mm pipe in the Enniskerry Road at the Glenamuck Road junction
4	125 Residential Units	Outfalls into the 225mm pipe to be constructed as part of the GLDR project

Table 2 – Foul Drainage Catchment Summary

4.9 It is acknowledged that the foul outfalls from Catchment No.'s 2 & 4 are dependant on the construction of the foul drainage infrastructure as part of the GLDR/Glenamuck Road project. It has been stated by DLRCC that the roads project will be completed within 24 months (Q1 2026) of commencement, which has started as of May'24. Therefore, the above noted catchments 2 & 4 will be phased to coincide with the GLDR completion.

4.10 The vast majority of the site, Catchments 1 & 3 (c.344No.residential units and 5,434m^2 commercial/retail and 691m^2 creche) can outfall the foul water into the existing drainage infrastructure without interface with the GLDR roads scheme.

4.11 Catchment 1 outfall from the site will be via the existing piped foul drainage system constructed as part of the Rockville schemes (D17A/0793 and D18A/0566). This existing infrastructure in turn outfalls downstream into the existing Uisce Éireann owned 300mm foul drainage piped infrastructure on Glenamuck Road. Refer to Dwg.2104C/306 & 308 for further detail. Catchment 2 (18No.residential units) will outfall into the Glenamuck Road extended 225mm foul sewer as part of the commenced GDRS project. Catchment 3 (36No.residential units) is proposed to outfall into the existing 300mm UÉ/UÉ foul sewer in the Enniskerry Road new the Golden Ball pub. Catchment 4 will outfall into the foul drainage infrastructure to be provided in the GLDR project. Refer to Dwg.'s 2104C/306-309 for further detail.

4.12 The drinking water to all of the proposed development land to the west of the GLDR (c.362No.residential units and 5,434m^2 commercial/retail

and 691m^2 creche) can be supplied and connected to the existing UÉ/UÉ watermain infrastructure. West of the GLDR, the proposed developments potable drinking water supply connection will be into the existing 300mm Uisce Éireann watermain in Enniskerry Road fronting the west part of the site with a secondary/looping link into the existing 250mm watermain in the Glenamuck Road. Refer to Dwg.2104C/310-312 for further detail.

4.13 The already commenced GLDR roads project will construct a new 280mm OD watermain along the road fronting the east part of the proposed development (c.125No. residential units). As part of the land acquisition agreements for the GLDR between the Applicant and DLRCC, it has already been agreed that a spur watermain connection from this new main into the east site will be constructed as part of the GLDR project. Connection into this spur will be subject to a connection agreement with UÉ prior to construction of the proposed development.

5.0 Key Design Reference Documents

5.1 As part of the design of the storm water network and SuDS components, the following documentation were the principal references;

- Dun Laoghaire Rathdown County Development Plan 2022 – 2028
- Kilternan/Glenamuck Local Area Plan 2013
- CIRIA Report c753 "The SuDS Manual" 2015
- Greater Dublin Strategic Drainage Study (GDSDS) 2005
- DLRCC Stormwater management Policy
- The Greater Dublin Regional Code of Practice for Drainage Works
- DOELG Recommendations for Site Development Works for Housing Areas.
- DLRCC Drainage Records maps
- Available OPW flood maps and reports (from *floodmaps.ie*)
- DLRCC Carrickmines/Shanganagh River Catchment Study
- OPW Eastern CFRAM study
- OPW PFRM mapping
- Geological Survey of Ireland (GSI) website
- Teagasc soils data sets
- Ordnance Survey mapping
- Topographical survey
- Site Investigation reports
- Site walkover visits
- Discussions with DLRCC Drainage Department

6.0 STORMWATER IMPACT ASSESSMENT

6.1 The design of the storm water network has been carried out in accordance with and in conjunction with the requirements of Dun Laoghaire Rathdown County Councils Drainage Department as were ascertained in meetings, phone calls and email communications as part of the Pre-Planning process.

6.2 The existing site topography generally slopes from the Southwest towards the Northeast. That is, the ground falls away from the Enniskerry Road towards the Glenamuck Road South.

6.3 The majority of the western, southern and central parts of the site are predominately flat with gradients ranging between 1/40 to 1/120. The lands to the east and north of the site are steeper in gradient ranging between c.1/40 to 1/10. There is a drop in level across the application land by c.14.5m from the highest point on the site (143.07mOD) to the lowest point on the eastern part of the site (c.128.50mOD).

6.4 The general topography outside the application site and the surrounding lands is downwards towards the Glenamuck Road and the adjacent roadside ditch.

6.5 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in detail in Chapter 7 of this report, summarised as follows;

- Filter drains to the rear of the housing
- Permeable paving to all parking spaces
- Rainwater butts (200l) to the rear downpipes
- Swales adjacent to roads where practically feasible
- Tree pits where practically feasible
- Extensive Green Roofs and Blue Roof
- Bio-Retention areas and Rain Garden areas
- Silt-trap/catchpit manholes
- Hydrobrake limiting flow to the drained area Qbar greenfield rate
- Petrol interceptors
- Stone lined voided arch retention storage devices

6.6 As was noted above, the main Catchment No.1 (c.9.99Ha of drained area) of the proposed development will outfall the attenuated flow into the existing piped infrastructure constructed as part of the existing Rockville development (D17A/0793) to the NE of the subject site. This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm S/W pipe. This existing pipe currently outfalls into the Glenamuck Road roadside watercourse. Refer to Dwg.2104C/306 for further detail.

6.7 This "*Rockville*" outfall passes through the adjacent Applicant owned lands to the northeast of the subject site. The final 13m of the outfall pipe lies in lands outside the applicants ownership and the Applicant has a wayleave agreement relating to same. Similarly, the drainage outfall pipes from the "East" site pass through lands outside the Applicants ownership and agreement has been made with effected landowners to allow these pipes to cross their lands. For clarity the Applicant has full rights of access over/under these strips of land and can confirm that should a planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the

designed scheme in full. Landowner letters of consent relating to this are included in the Appendix 12. 21 of this report.

6.8 This connection point of the attenuated flow will be downstream of the existing Rockville attenuation system into the existing 300mm S/W pipe. This existing pipe currently outfalls into the Glenamuck Road roadside watercourse and is to be diverted into the regional attenuation pond located beside the Glenamuck Road/GDRS junction as part of the DLRCC GLDR/GDRS roads project and will in effect be in the ownership of DLRCC. Refer to Dwg.2104C/306 for layout of the existing 300mm S/W.

6.9 It was confirmed by DLRCC consultants that GDRS infrastructure has been designed to cater for the attenuated run-off from the Kilternan Village development lands and that the regional pond in that project has capacity to intercept and store the S/W outfall from the subject site. All drainage connections to the upcoming GDRS project are subject to a successful grant of this subject planning application.

6.10 Correspondence relating to the above interface is included in Appendix 12.17 of this report.

6.11 The surface water drainage design has been carried out in accordance with the Greater Dublin Regional Code of Practice, the GDSDS and the CIRIA Report c753 "The SuDS Manual" 2015. A SuDS treatment train and attenuation are included in the design. A Stage 1 Stormwater Audit has been completed and submitted to DLRCC Drainage Department in accordance with the Stormwater Management Policy at planning application stage.

6.12 As was discussed in paragraph 4.4 above, the sites surface water has been divided into 4 separate catchments, each outfalling their respective attenuated flows to different outfall points. Refer to Table 1 above.

6.13 As is recommended in the DLRCC Stormwater Management Policy, the HR Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for each of the respective catchments. It is relevant to note that S/W outfall rate from each of the proposed developments catchments have been calculated using the drained site area of each catchment and not the application "*redline*".

6.14 The soil type chosen (Type = SPR 0.37) to be used in the UKSuDS Greenfield estimation tool was determined using several methods as discussed in detail in Chapter 8 of this report.

6.15 In Pre-Planning discussions with DLRCC Drainage Department, it was requested that the smaller (<1Ha) Catchment No.'s 2 & 3 have the

attenuated outfall rate be governed by the minimum acceptable vortex control diameter of 50mm. Therefore, an analysis was carried out using the Hydro International online design tool to determine the maximum flowrate through a 50mm Hydrobrake, which was determined to be 1.5l/s. Refer to Appendix 12.20 for calculations of same.

6.16 The calculated and applied Qbar rates for each of the 4No. catchments are summarised in Table 3 below and refer to the appendix 12.5 for calculations of same; Refer also to Dwg.2104C/314 for a summary of the catchment and drained paved areas.

SUMMARY OF CATCHMENT QBars			
Catchment No.	Drained Area (Ha)	Qbar (from UK SuDS) l/s	Qbar Applied (l/s)
1	9.99	43.4	42.0
2	0.21	0.6	1.5
3	0.56	2.6	1.5
4	1.8	8.0	4.0
TOTAL	**12.5**	**54.6**	***49.0**

***Noting that the applied Qbar is less than the allowable**

Table 3 – S/W Catchment Qbar Summary

6.17 The surface water drainage infrastructure for the development will collect the rainfall on the site and convey the storm water run-off via roadside swales, rear garden filter drains, tree pits, bio retention areas, rain gardens, green & blue roofs, gullies, underground pipes, manholes, silt -traps and direct the flows via void arched attenuation systems and a petrol interceptors towards vortex flow restricting devices, Hydrobrake or similar.

6.18 As was described in paragraph 4.4 above, the site has been divided into 4No.separate catchment areas No.'s 1-4. Catchment 1's infrastructure will pass through a series of SuDS elements and cascading attenuation storage areas upstream of the outfall connection point. Catchments 2, 3 & 4 will pass through a series of SuDS elements upstream of their individual outfall points. The main Catchment No.1 has an arrangement of upstream cascading attenuation sub-areas (tanks 2-7), each of which has a vortex control device fitted to suit the overall S/W flow management as has been modelled in the MicroDrainage software drainage model within the catchment. A summary diagram of the Catchments SuDS and attenuation storage is shown below;

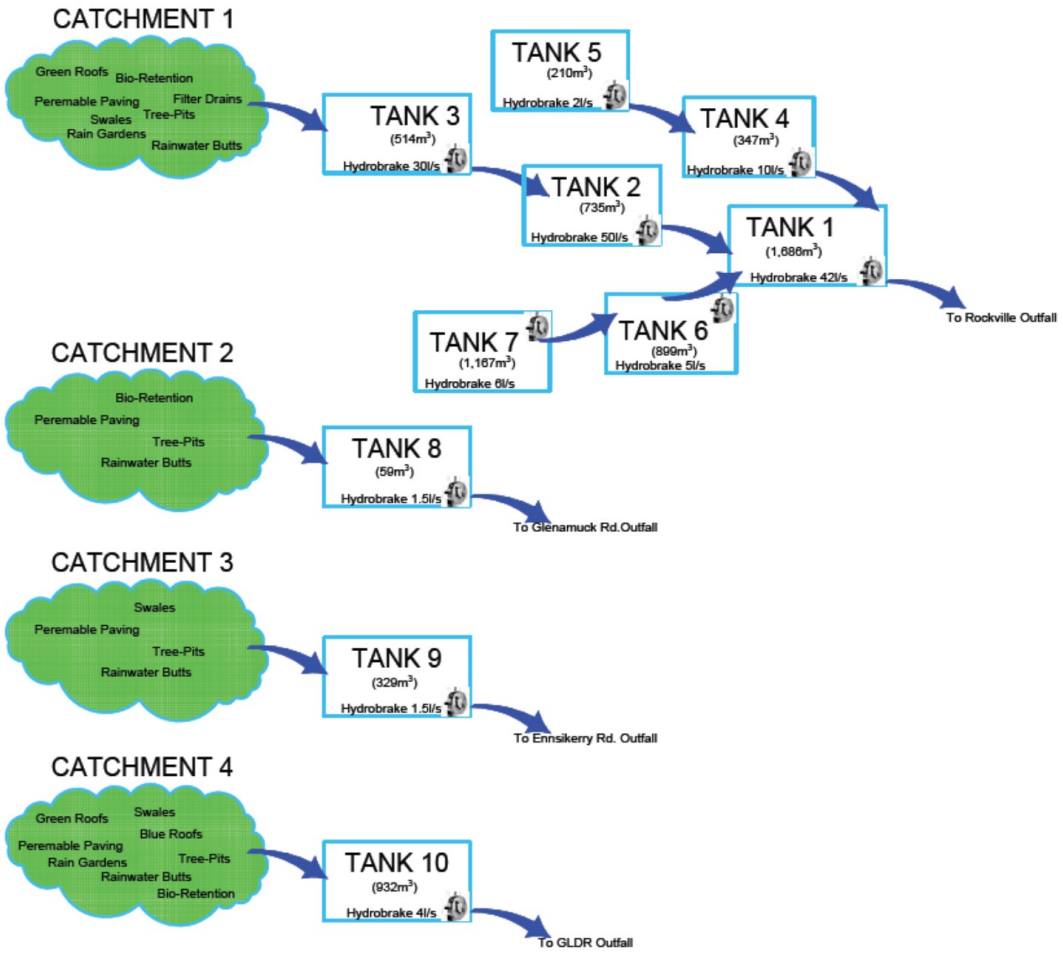

Fig.3 – Catchment cascade summary

6.19 The attenuated flow from Tank 1 drains through the Applicants lands and then outfalls into the existing Rockville Ph1 (Reg.Ref.D17A/0793) 300mm diameter outfall pipe across parkland. Noting that the existing S/W pipe is to be diverted into the regional attenuation pond as part of the GRDS project. This area is under the approved DLRCC Part 8 scheme known as *Glenamuck Park*.

6.20 This existing 300mm diameter S/W outfall pipe from Rockville Ph1 currently drains the already attenuated flows from the completed Rockville 1 & Rockville 2 (Reg.Ref. D18A/0566) projects at a total restricted flowrate of c.4.5 l/s. There is also a permitted Rockville apartment development (Reg.Ref.D20A/0015 in the ownership of the Applicant and currently permitted under D23A/0580) yet to be commenced that will have additional attenuated flowrate of c.2.5 l/s to be drained into the existing 300mm pipe. Therefore, there is an already allowed maximum c.7l/s flowrate into this existing 300mm outfall pipe.

6.21 The proposed Kilternan Village development Catchment 1 maximum outfall is proposed at 42 l/s. Upon completion of all development serviced by the existing Rockville 300mm pipe, the maximum possible flowrate from the Kilternan Village LRD development site plus the existing /permitted Rockville sites will be 42 + 7= 49 l/s.

6.22 The capacity of the existing Rockville outfall 300mm diameter pipe is primarily governed by the gradient at which it is laid and it can be seen from the as-constructed level survey (refer to Dwg.2104C/306) that the existing pipe gradients are generally 1/40 and 1/60 but with one portion near the end of the pipe into the public road (Glenamuck Rd.) at a gradient of 1/300. Standard hydraulic tables note the capacity of a 300mm diameter pipe to be c.150l/s at a gradient of 1/60 and 60l/s at a gradient of 1/300.

6.23 Therefore, the maximum flowrate from the Kilternan Village LRD Catchment 1 plus the existing/permitted Rockville sites will be 49 l/s which is less than the localised c.60l/s capacity and significantly less than the general 150l/s capacity.

6.24 It is relevant to note that this existing 300mm S/W pipe flows through open parkland that is to become part of the GLDR/GDRS open space (DLRCC *Glenamuck Park* Part 8), in the ownership of DLRCC, and is to be diverted into the regional attenuation pond as part of that project. This will remove both the 1/60 and the 1/300 gradient sections of the existing pipe therefore leaving the existing 1/40 gradient as the predominant capacity governor. Using standard hydraulic tables, a 300mm diameter S/W pipe at a gradient 1/40 has a capacity of c.180l/s which is far greater than the 49l/s maximum possible flow coming from all the upstream fully developed sites, including the subject applications main Catchment 1.

6.25 The SuDS management train approach to designing the storm water network has been applied for this development and is specifically discussed in Chapter 7.

6.26 Downstream of the SuDS elements, the retained storm water flows will be stored in a combination of an underground systems, such as the StormTech MC4500 system. As part of the Pre-Planning process, these proposals have been discussed and submitted to DLRCC Municipal Services Department and have been agreed with in principle. Refer to Dwg.No.'s 2104C/316 & 317 for SuDS details. A Stormwater Audit has also been carried out and submitted to DLRCC prior to lodgement of this Stage 3 application, refer to Appendix 12.6 for more detail.

6.27 The MicroDrainage software was used to generate drainage simulation models for storm events for 1 year, 30 year and 100 year return events

over multiple time periods. In accordance with the DLRCC Stormwater management Policy, an allowance for an increased rainfall due to climate change of 20% was applied in the drainage design model. Furthermore, the Cv values are set to 1.0 in Microdrainage software model and are visible in the calculations included in Appendix 12.1 of this report.

6.28 As part of the assessment for blockages in the system, the MicroDrainage design model was run on the basis that there was a near 100% blockage of the outfall vortex control devices for a 120 minute period. Therefore, the model was run with a reduction in the outfall rates from each Hydrobrake down to 0.1 l/s for a 120min duration in the Q100 + 20% event. These resulting volumes and top water level are contained beneath the ground level in 8 of the 10 storage areas and above ground flooding was noted in storage areas 2 & 3. An above ground flood path/exceedance flow route assessment was carried out to determine and manage the flooding routes across the site and these flow routes are represented on dwg.No.2104C/315. Dropped kerbs and profiling of the local landscape will be constructed to direct the overland flows to bunded landscaped areas. Refer to Dwg.No.2104C/315 and to Appendix 12.1 for these calculation results.

6.29 As noted in the DLRCC Stormwater Management Policy document, an allowance for 10% Urban Creep is required in the drainage calculations. This allowance has been applied in the model by increasing the drained paved area to the rear of the houses by more than 20% of the roof area draining to the rear of the houses. This additional area has been applied across all houses in the scheme to take account for possible house extensions in the future. Refer to Dwg.No.2104C/314 for details of same.

6.30 In accordance with the Greater Dublin Regional Code of Practice for Drainage Works (GDSDS) and in consultation with DLRCC drainage Department and in accordance with the DLRCC Stormwater Management Policy, the surface water drainage infrastructure was designed to the parameters as outlined in Table 4 below;

Time of entry	4mins generally and 6min when via SuDS features
Return periods for pipework	2 years- no surcharge
	Q30 15min no flooding
	Q100 15min – storage in designated areas only
Climate Change	20%
Allowance for Urban Creep	10%
Min.velocity	1 m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	0.6mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Standard Annual Average Rainfall (SAAR)	1003mm (Met Eireann data)
M5-60	16.5mm
Ratio r (M5-60/M5-2Day)	0.277
SPR Value	0.37
Total Site Outfall Rate	**Catchment 1=42 l/s; Catchment 2=1.5l/s;** **Catchment 3=1.5l/s ; Catchment 4=4l/s** (based on HR Wallingford Qbar & DLRCC requirements – refer paragraphs 6.15 & 6.16 & Chapter 8)
Attenuation storage	Q30 – no flooding on site Q100 – flooding on site, 500mm freeboard to FFLs of houses, flood routing plan.
Paved Area Runoff percentage	100% from roofs to drains 95% from roads and paths not drained to SuDS features 92% from Extensive Green Roofs 71% from roads and paths drained to SuDS filter swales 70% roof runoff and private path drained via rear garden filter drains 60% parking permeable paving areas and locally drained paths 37% & 15% grassland

Table 4 – S/W Design Parameters

6.31 In accordance with best practice, the internal drainage system has been designed as a completely separate foul and surface water system.

6.32 The freeboard between each separate storage tank top water level (TWL) and the lowest level house floor slab draining to that tank is greater than the GDSDS minimum of 0.5m. A summary of the freeboards is given in Table 5 below;

FREEBOARD SUMMARY				
Tank No.	**TWL (mOD)**	**FFL (mOD)**	**Freeboard (m)**	**Pass/Fail**
1	130.96	133.40	2.44	PASS
2	133.10	136.20	2.96	PASS
3	138.27	140.70	2.43	PASS
4	140.44	142.55	2.11	PASS
5	141.81	142.80	0.99	PASS
6	136.92	139.50	2.58	PASS
7	137.36	139.35	1.99	PASS
8	134.99	136.65	1.66	PASS
9	138.62	139.40	0.78	PASS
10	128.36	131.65	3.29	PASS

Table 5 - Freeboard Summary

6.33 In accordance with the GDSDS, the four principal design criteria as set out in section 6.3.4 of Volume 2 are summarized as follows;

- **Criterion 1** - River water quality protection
- **Criterion 2** – River regime protection
- **Criterion 3** – Level of service (flooding) for the site
- **Criterion 4** – River Flood protection

6.34 **Criterion 1** has been complied with by inclusion of **Interception** of at least 5mm of rainfall to prevent runoff to the receiving water. Interception has been calculated for each sub-catchment A-E of Catchment 1 as well as Catchments 2, 3 & 4. As per the GDSDS guidelines, the interception is to capture the first 5mm of rainfall from 80% of Paved Drained Area.

6.35 Interception will achieved be within the voids of the stone base of the permeable paving, in the stone below the filter drain pipework, in the tree pits, swales, bio-retention areas, in the green roof systems and in the stone base of the attenuation storage. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the following tables 6 & 7. Refer to Appendix 12.2 for detailed calculations.

INTERCEPTION SUMMARY - TOTAL SITE														
CATCHMENT REFERENCE	DRAINED PAVED AREA (Ha)	INTERCEPTION REQUIRED (m^3) *Area x 0.8 x 5mm	VOIDS IN STONE BELOW SuDS ELEMENT (m^3)			TREE PITS (m^3)	SWALES (m^3)	BIO-RETENTION (m^3)	GREEN ROOF (m^3)		Rainwater Butts (200l) (m3)	SUB-CATCHMENT INTERCEPTION PROVIDED (m^3)	SUB-CATCHMENT INTERCEPTION REQUIRED (m^3)	PASS/FAIL
			TANK	PERMEABLE PAVING	FILTER DRAINS				EXTENSIVE	BLUE				
1	9.99	399.72	531.54	289.67	105.41	72.25	13.61	113.60	60.17	0.00	36.60	1,222.8	399.72	PASS
2	0.20	8.40	9.00	9.72	0.00	1.75	0.00	3.00	0.00	0.00	0.60	24.1	8.40	PASS
3	0.58	22.40	32.40	27.77	3.38	6.00	6.00	0.00	0.00	0.00	2.00	77.5	22.40	PASS
4	1.80	72.00	108.90	39.38	6.48	10.50	1.62	13.60	69.58	139.34	3.00	392.4	72.00	PASS

*Refer to detailed calculation tables for each sub-catchment in main report appendix

Table 6 – Catchment Interception Summary

INTERCEPTION SUMMARY		
MAIN CATCHMENT REFERENCE	REQUIRED	PROVIDED
1	400	1,223
2	8	24
3	22	78
4	72	392
TOTAL	**503**	**1,717**

Table 7 – Total Interception Summary

6.36 **Criterion 2** is complied with in applying less than the total allowable Qbar outfall rate of 49.0 l/s (<54.6 l/s) and providing more than the required volume of attenuation storage in the MC4500 & MC3500 StormTech systems, refer to Appendix 12.3 and Dwg.No.2104C/320 for more detail.

6.37 **Criterion 3** is satisfied with as each of the 4No.sub-criterion design objectives have been met as per Table 8 the below;

Sub-criterion	*Design objective*	*Satisfied*
3.1	No flooding on site for the Q30 except where specifically planned	**OK**
3.2	No internal property flooding for site critical duration storm event.	**OK**
3.3	No internal property flooding satisfied as 500mm freeboard to house FFL's is achieved.	**OK**
3.4	No flooding of adjacent areas unless specific routing planned for the Q100 + 20% climate change	**OK**
Refer to the MicroDrainage surface water model results (Q1-Q100+20%) included in the appendix of this report for further detail		

Table 8 – Sub-criterion

6.38 **Criterion 4** River flood protection is satisfied under sub-criterion 4.3 in accordance with the application of less than the maximum Qbar (49 l/s) and therefore long-term storage is not required.

6.39 An exceedance flow routing plan can be viewed on Dwg.No.2104C/315 included with this Stage 2 submission.

6.40 Based on the drained area Qbar and the paved area factors identified in Table 3 above and using the MicroDrainage software, a drainage model was generated for multiple storm events and return periods of 2, 30 and 100 years were simulated. Full model simulation results for the network and storage units are included in Appendix 12.1 of this report but are summarised in Table 9 below;

ATTENUATION STORAGE SUMMARY					
	Flow control limit (l/s)	**Volume Required (m^3)**		**Volume Provided (m^3) and Top Water Level**	
Total Drained Catchment = 3.1Ha					
		Q30 +20% CC	**Q100 +20% CC**	**Tank Storage Volume Provided (m^3)**	**TWL**
Tank 1 (Outfall)	42	1191	1557	**1559**	130.96
Tank 2	50	493	661	**666**	133.10
Tank 3	30	343	465	**472**	138.27
Tank 4	10	232	313	**333**	140.44
Tank 5	2.0	144	190	**203**	141.81
Tank 6	4.0	780	897	**899**	136.92
Tank 7	5.0	783	1040	**1052**	137.36
Tank 8	1.5	39	52	**56**	134.99
Tank 9	1.5	241	311	**319**	138.62
Tank 10	4.0	664	855	**861**	128.36
TotalMax.Storage Required		4,910m^3	6,341m^3		
Total Storage PROVIDED				**6,420m^3**	
The total storage provided > required					

Table 9 – Storage Volume Summary

6.41 It is noted that there is additional **interception storage** volume of c.1,717-503= **1,214m^3** (refer to Table 7 above) that has not been subtracted from the required attenuation volume nor has it been added to the available storage volume and is therefore considered to be a safer design approach.

6.42 Refer to Dwg.No.'s 2104C/302-305 for layout of the attenuation systems.

6.43 In accordance with the requirements of the DLRCC Stormwater Management Policy, a Stage 1 SuDS audit has been completed and submitted to DLRCC Drainage Department with the LRD Stage 3 application.

6.44 A Hydrological and Hydrogeological Risk Assessment report has been prepared and submitted by Enviroguide Consulting at the LRD Stage 3 application.

7.0 Sustainable Drainage Systems – SuDS

7.0.1 SuDS addresses the water quality, water quantity, amenity, and biodiversity by the management of surface water run off in a sequence of treatment processes along the drainage infrastructure network.

7.0.2 The SuDS philosophy is illustrated in the GDSDS Volume 3 Section 6.3 as the "SuDS triangle", shown below. The principle is to reduce the storm water run-off through managed processes, improve the quality of the run-off and to replicate the natural characteristics of the rainfall run off.

Fig.4 – The SuDS Triangle

7.0.3 Replicating the natural characteristics and providing amenity/biodiversity has been achieved in the SuDS elements included in this application. A full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual, summarised as follows;

- Filter drains to the rear of the housing
- Permeable paving to all parking spaces
- Rainwater butts (200l) to the rear downpipes

- Swales adjacent to roads where practically feasible
- Tree pits where practically feasible
- Extensive Green Roofs and Blue Roof
- Bio-Retention areas and Rain Garden areas
- Silt-trap/catchpit manholes
- Hydrobrake limiting flow to the drained area Qbar greenfield rate
- Petrol interceptors
- Stone lined voided arch retention storage devices

With the inclusion of these measures, it is proposed that the SuDS treatment of the run-off has been adequately addressed.

7.0.4 The SuDS management train approach to designing the storm water network has been applied in this proposed developments design, similar in principle to Fig.5 below

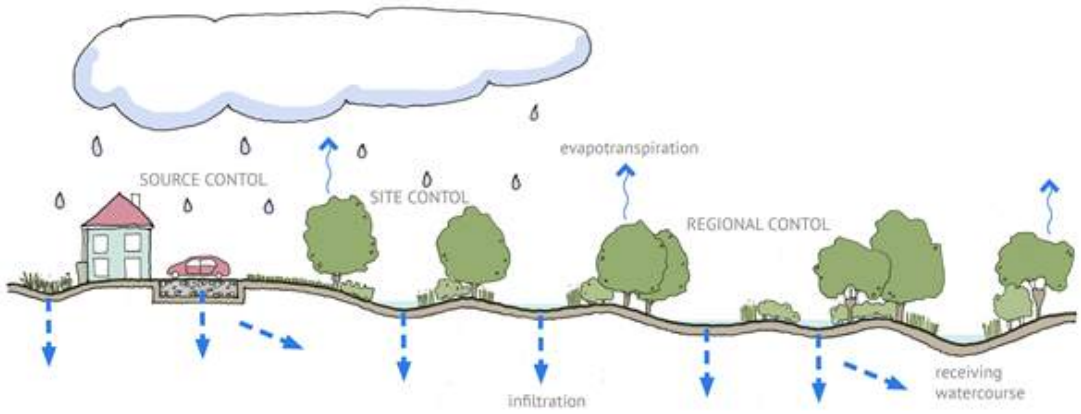

Fig.5 – Treatment Train

7.1 Source control

7.1.1 Source Control aims to detain or infiltrate runoff as close as possible to the point of origin.

7.1.2 The site investigation results (see appendix) suggest that there is some, but limited, (9.32×10^{-6} m/s) scope for infiltration of surface water flows. Even if the infiltration is limited there is still scope to provide some level of storage, time delay and treatment as the surface water flows through the stone medium.

7.1.3 It is proposed to use **filter drains** in the rear gardens of the house to cater for run off from the rear roofs and patios. The use of these filter drains will encourage run off to infiltrate directly to ground and will also provide interception storage in the c.40% voids ratio stone below the high-level drain. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system. The surface water runoff rate is also attenuated using these filter drains. A PAF of 0.70 (70%) will apply to these areas as was agreed in principle with the DLRCC Water Services Department as part of the Pre-Planning discussions. A silt-trap inspection chamber is included downstream of each filter drain. Refer to Dwg.2104C/316 for further detail.

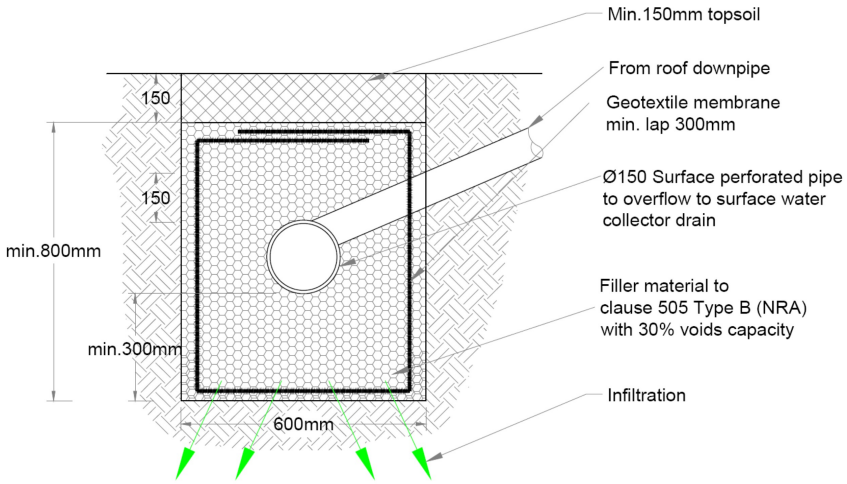

Fig.6 – Filter Drain

7.1.4 It is proposed to use **tree pits, rain gardens** and **bio-retention** areas where possible to collect run-off from the cambered road surface. The use of these tree pits will provide treatment of the run-off, will encourage run off to infiltrate directly to ground and will also provide interception storage below the high-level connection to the main S/W drainage. Any run-off that cannot infiltrate to ground will overflow to the high-level drain and connect to the main drainage system. The surface water runoff rate is also attenuated using these tree pits.

7.1.5 The road cambers roads are to be constructed to drain flow into these tree pits and bio retention areas to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No.'s 2104C/300-302 and further illustrated on Dwg.No.2104C/318.

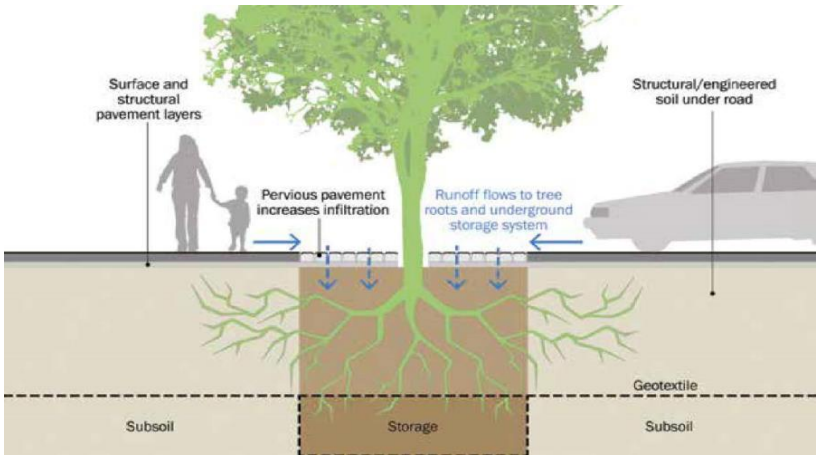

Fig.7 – Tree Pit (ex. SuDS Manual fig.19.3)

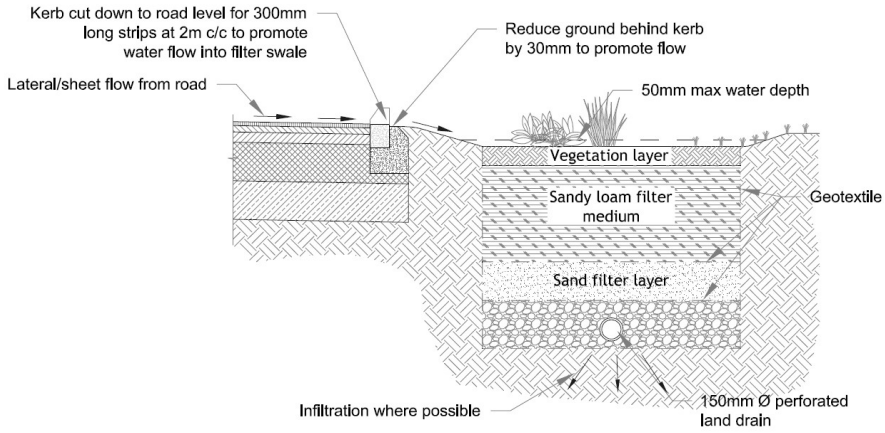

Fig.8 – Bio-Retention (ex.Dwg.2104C/316)

7.1.6 A PAF of 0.71 (71%) will apply to areas or paths/roads draining to these tree pits and bio-retention areas as was agreed in principle with the DLRCC Municipal Services Department as part of the Pre-Planning discussions. Refer Dwg.No.'s 2104C/302 & 305 for location and to Dwg.No.2104C/316 for details.

7.1.7 It is proposed to use **permeable paving** surfacing to the private driveways of the houses and in the car parking spaces of the duplex units and the road/paths remaining in control of a management company. This allows for the rainfall to percolate through open joints in the pavement and be strained through the unwoven geo-textile membrane beneath the paved surface. This method of surface water collection will improve water quality and prevent excessive sedimentation. There is a natural interception, attenuation and storage of surface waters flowing through the permeable paving system and an outfall pipe is provided

150mm above the bottom of the system to drain the overflow filtered/attenuated run off into the main drainage system.

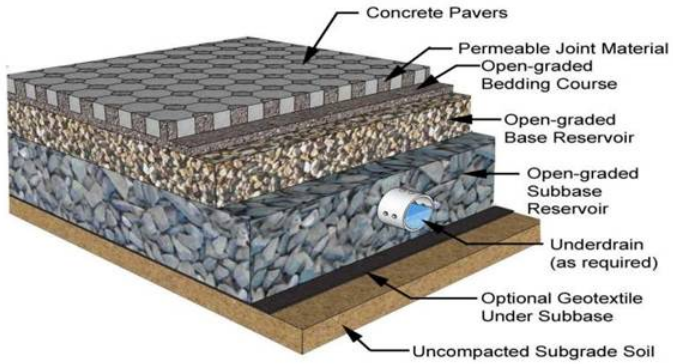

Fig.9 – Permeable Paving

7.1.8 In providing permeable paving systems on the site, a run-off rate of 60% (0.60 paved area factor applied) has been applied in the surface water calculations. Refer to Dwg.No.2104C/316 for details.

7.1.9 In accordance with the CIRIA SuDS Manual 2015, **green & blue roofs** can be used to treat and attenuate runoff in their substrate and support root uptake of water with appropriate planting and are an integral part of source control on a site. Green roofs can increase the indigenous biodiversity and is an encouraging environmentally design strategy, which is in accordance with the objectives as specified in the Greater Dublin Strategic Drainage Strategy (GDSDS) and in Appendix 7.2 of the DLRCC County Development Plan 2022-2028.

7.1.10 Requirements of the green roof policy are identified in the standards GR1-GR5 which are summarised below;

GR1- Make provision for green roofs if area > 300m2

- Green Roofs are provided to all blocks with flat roof areas greater than 300m^2 and is also included on other flat roofs where the flat roof area is less than 300m^2. Provision of same is deemed compliant with GR1

GR2- Maximize provision to achieve a minimum 70% area of building footprint

- Greater than the minimum percentage area of 70% extensive green roof has been achieved in each of the 3No.proposed blocks.

. PV panels are to be used for the apartment blocks only and the area of same has been subtracted from the green roof area measured for those blocks.

- Refer to Table 10 below for summary of the percentages achieved which complies with GR2

• GREEN ROOF COVERAGE SUMMARY					
CELL REFERENCE	**Extensive**	**Total Flat Roof Area (m^2)**	**% Coverage of Green Roof**	**Min.% Reqd.**	**Pass/Fail DLRCC Min. %**
Cell 3	253	292	87%	70%	**PASS**
CELL NC	1259	1384	91%	70%	**PASS**
CELL 09	599	689	86%	70%	**PASS**
CELL 06	421	452	93%	70%	**PASS**
CELL 13	61	70	87%	70%	**PASS**
CELL 16	47	54	87%	70%	**PASS**
APART'S (East site)	2485+2654	5566	92%	70%	**PASS**

Table 10 – Green/Blue Roof Coverage Summary

GR3- Hydraulic requirements & overflow

- The proposed green roofs have a minimum 80 substrate depth. Interception of rainfall is achieved in the green roof system and therefore a runoff factor of 92% has been applied in the drainage design accordance with the DLRCC table on page 260 of Appendix 7.2 of the CDP 2022-2028. 20% Climate change increases have been included in the stormwater hydraulic model. Exceedance flow from the green roofs are provided as part of the overall green roof system proposed and is typically detailed in Appendix 12.13 of this report. It is proposed that inclusion of the above therefore complies with GR3.

GR4- Best practice

- The green roof system proposed is in accordance with industry best practice details of which are shown on Dwg.No.2104C/316 and in Appendix 12.13. Connections to the main drainage network are provided in overflow events and therefore form a robust, cautious design approach in principle. This is deemed to be in compliance with GR4.

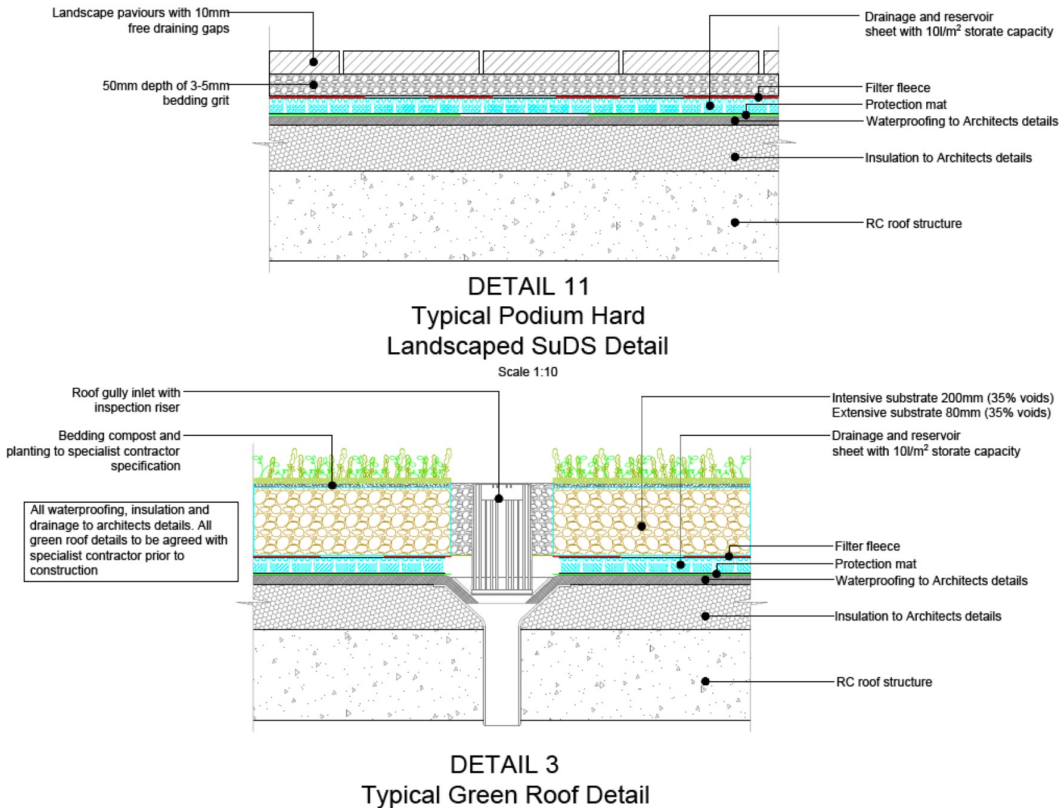

Fig.10 –Green & Blue Roof (ex.Dwg.2104C/316)

GR5- Provision for Maintenance

- Access for maintenance of the green roofs will be via the internal building stairwells and a roof hatch over or using a cherry picker where stairs access is not feasible. A roof fall arrest system is to be included in the project which will be specified at the detailed design/construction stage. Detailed cross sections of the proposed roof build-up are shown on Dwg.No.2104C/316 included in the submission. PV panels to these roofs do not form part of this application. A maintenance scheduling regime is to be established with an appropriate specialist contractor at construction/commissioning stage. This is deemed to be in compliance with GR5.

7.1.11 In providing the extensive green roof system, a run-off rate of 92% (0.92 paved area factor applied) has been applied in the surface water calculations for the Extensive Green Roof area in accordance with appendix 7.2 Green Roof Policy of the DLRCC County Development Plan 2022-2028.

7.1.12 The use of **rainwater butts** is another source control method in the SuDS treatment train process. It is proposed to provide 200l rainwater butts to collect rainwater from the house roofs for use as garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site.

Fig 11 – Rainwater Butt

7.1.13 Bypass oil separators are important SuDS devices that significantly reduce any potential hydrocarbons and suspended solids from surface water run-off. and are included upstream of inlets to the last storage area outfalling from the site. Sizing of the interceptors are based on the Microdrainage calculated flowrates and manufacturers details tables.

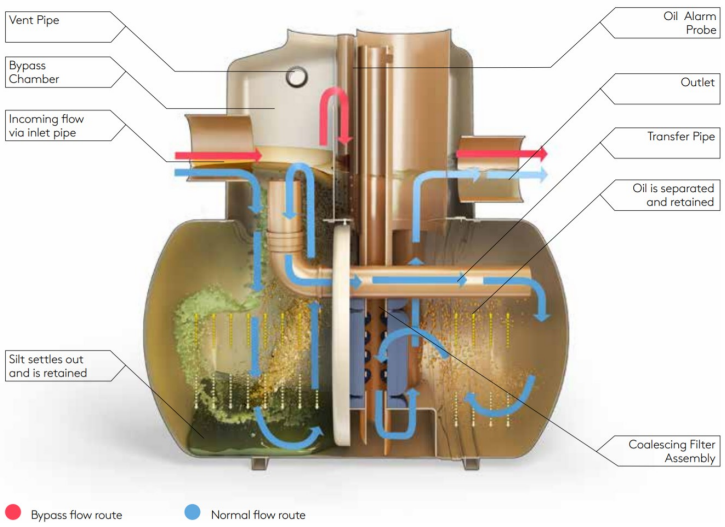

Fig 12 – Bypass Separator

7.1.14 An important aspect of Source Control is reducing pollution by prevention of chemicals and other pollutants from coming into contact with rainfall runoff. In this respect, it is proposed that the homeowner will be provided with information regarding the appropriate usage of the proposed drainage system.

7.1.15 Regular maintenance of all SuDS features by the development management team is required to protect runoff and prevention of blockages until such a stage that the Local Authority take in charge the project. The following inexhaustive monitoring measures are to be implemented;

- Green roof maintenance by specialist contractor
- Checking for any blockages in roof drainage inlets
- Maintaining grass levels and removing debris from the tree-pit areas
- Maintaining grass levels and removing any debris from the filter swales
- Cleaning of the joints of the permeable paving to prevent moss/silt build-up
- Clearing road gullies if required
- Checking of silt traps on the filter drains if required
- Checking and clearing the silt trap upstream of the attenuation storage
- Checking of the flow control device to ensure blockages do not occur
- Periodic inspection of the storage chambers and de-silting if required
- Periodic inspection of the petrol interceptor clearing if required

7.2 Site Control

7.2.1 Site control in the treatment train process involves the reduction in volume and rate of surface runoff run off and provide some treatment of the runoff.

7.2.2 Roadside **filter swales** are a method of site control that reduces harmful chemical pollutants and sediment reaching the piped network. These pollutants are trapped in the grassed areas leading to the filter strip. Filter swales reduce the surface water runoff rate and attenuate flows locally, therefore reducing stress on downstream facilities. Filter swales also facilitate interception of the “first flush” of rainfall. Fig.13 below from the CIRIA SuDS Manual illustrates the principle.

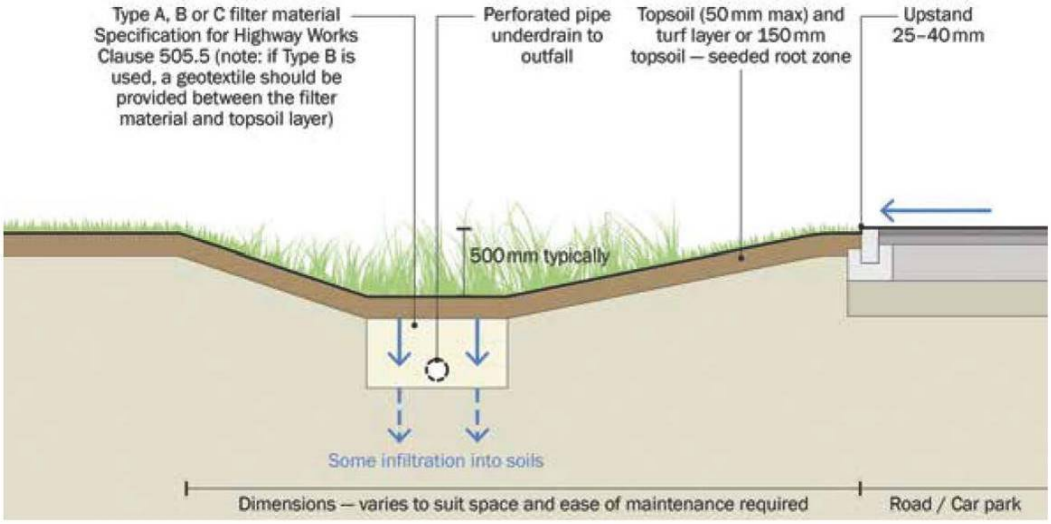

Fig.13 – Filter Swale

7.2.3 As part of the site control it is proposed to construct **filter swales** along the site roads at specified locations which will allow surface water runoff from roads to be intercepted and infiltrate to ground. In the event the ground is saturated, there are also positive drainage connections from the filter swales into the piped network. Refer to Dwg.No.'s 2104C/302-305 for proposed locations of the filter swales and to Dwg.2104C/316 for details of this proposal.

7.2.4 In providing the filter swales, a run-off rate of 71% (0.71 paved area factor applied) has been applied in the surface water calculations as was agreed in principle with the DLRCC Municipal Services Department as part of the Pre-Planning discussions. Typical calculations for these SuDS features are included in Appendix 12.2 of this report.

7.2.5 The road cambers roads are to be constructed to drain flow into these filter swales where appropriate to maximize the drained area into SuDS treatment & interception. The road cambers are shown on Dwg.No.'s 2104C/300-302.

7.2.6 A key landscape/bio-diversity feature of the proposed development is the embankment of existing trees forming the open space to the centre of the site. These trees provide an important role of intercepting rainfall run-off and managing same through evapotranspiration as well as infiltration to roots. The addition of landscaping and planting throughout the development is also an important aspect of site control in providing biodiversity, run-off reduction, interception, infiltration, and amenity. The project Arborist specialist has advised of the critical root zone constraints relating to this tree belt and as a result excavation within

the root zone is limited. Refer to the landscape architects and arborist drawings/reports for more information.

7.2.7 Silt-trap/catchpit manholes are provided upstream of the underground attenuation storage systems which will remove sediments and silts and forms part of the site control methodology used in the proposed development. Furthermore, silt-trap inspection chambers are included downstream of each filter drain and swale as recommended in the SuDS audit. Refer to Dwg.2104C/316 for further detail.

7.3 Regional Control

7.3.1 Regional control comprises of treatment facilities to reduce pollutants from runoff and control the surface water runoff rate to pre-development rates.

7.3.2 As part of the overall regional control for the site it is proposed to use a 4No.void arched **attenuation systems**, such as the StormTech MC4500/MC3500 systems (Fig.14).

Fig.14 – StormTech Attenuation System

7.3.3 The flow rate of the run-off outfalling from the attenuation systems is to be controlled using vortex control devices such as Hydrobrake vortex control devices.

7.3.4 Interception of the "*first flush*" of rainfall is captured upstream of the outfalls and can infiltrate to ground where possible. The interception storage will be within the stone base of the permeable paving, in the

stone below the filter drain pipework and swales, in the sub-strata of the green roof systems and in the stone base of the attenuation storage areas. As per the parameters laid out in the GDSDS the interception volume was calculated for the total site as per Tables 6 & 7.

7.3.5 A class 1 petrol interceptor (PI) is to be provided upstream of inlets to attenuation Tanks 1, 8,9 & 10. These PI's will further remove any pollutants not already captured in the above noted interception and treatment train elements. Sizing of the interceptors are based on the Microdrainage calculated flowrates and manufacturers details tables.

7.3.6 Prevention of pollutants and sediments entering the receiving watercourse has been achieved in providing Interception Storage throughout the proposed development. The interception will take place from the head of the catchment right down to the Hydrobrake manholes on the application lands. Refer to paragraphs 6.34 & 6.35 above and to Dwg.2104C/314 for further detail.

7.4 SuDS Summary

7.4.1 Interception will achieved be within the voids of the stone base of the permeable paving, in the stone below the filter drain pipework, in the tree pits, swales, bio-retention & rain garden areas, in the green & blue roof systems and in the stone base of the attenuation storage tanks. As per the parameters laid out in the GDSDS the interception volume was calculated and is summarised in the Tables 6 & 7. Refer to Appendix 12.2 for detailed calculations.

7.4.2 Replicating the natural characteristics and providing amenity/biodiversity will be encouraged by creating the roadside grassed swales, tree pits, bio-retention areas, green roofs, and filter drains.

7.4.3 The overall site surface water runoff rate has been restricted to less than the greenfield runoff rate, Qbar (49<54.6 l/s) and the DLRCC recommended HR Wallingford UK SuDS calculations for same can be viewed in Appendix 12.5 of this report. Refer also to Chapter 8 for background on the determination of the soil type used in the Qbar calculation.

7.4.4 Refer to the appendix and to Dwg. No's 2104C/303-306 and 316-317 for the drainage layout and SuDS features details.

7.4.5 In providing the above noted rear garden filter drains, roadside filter swales, house rainwater butts, permeable paving systems, catchpits,

tree pits, bio-retention & rain garden areas, green & blue roofs, attenuation storage, less than the greenfield run off Qbar, vortex controls and petrol interceptors it is proposed that the SuDS treatment of the run-off has been adequately addressed. The above noted proposals have been discussed and agreed in principle with DLRCC Municipal Services Department during the Pre-Planning application meetings.

7.4.6 In advance of submission of the main planning application and in accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, a Stormwater Audit has been carried out for the proposed development submitted to DLRCC Drainage Department with the Stage 3 application.

8.0 Determination of Qbar

8.1 The overall allowable surface water outfall rate Qbar is based on the greenfield run off rate of the drained site area, as specified in the GDSDS section 6.6.1.2. As recommended in the DLRCC Stormwater Management Policy document, the Wallingford UKSuDS Greenfield runoff rate estimation tool was used to calculate the Qbar for the site, refer to Appendix 12.5.

8.2 While the development area of the site is c.14.2 Ha in this application, the actual positive drained area is c.12.5Ha. This is the area used in the calculation of Qbar. In Pre-Planning discussions with DLRCC Drainage Department, it was requested that the smaller (<1Ha) Catchment No.'s 2 & 3 have the attenuated outfall rate be governed by the minimum acceptable vortex control diameter of 50mm. Therefore, an analysis was carried out using the Hydro International online design tool to determine the maximum flowrate through a 50mm Hydrobrake, which was determined to be 1.5l/s. Refer to Appendix 12.20 for calculations of same.

8.3 The Standard Annual Average Rainfall for the Kilternan Site is 1003mm as determined from Met Eireann 1km^2 grid dataset. Refer to Appendix 12.14 for the Met Eireann data.

8.4 The value for SOIL used in the IH 124 Qbar formula noted above is derived from the pervious surface runoff factor (SPR) using the formula

$$SOIL = \frac{(0.1S1 + 0.3S2 + 0.4S3 + 0.45S4 + 0.5S5)}{S1 + S2 + S3 + S4 + S5}$$

Where the soil type S1-S5 is determined in accordance with the following paragraphs.

8.5 In determination of the SOIL value for this Kilternan site, a number of different sources of data were reviewed such as the site specific site investigation trial holes, the soakaway tests, the Winter Rainfall Acceptance Potential (WRAP) – the Wallingford Procedure Volume 3 Maps, the Flood Studies Report (FSR - NERC, 1975), Transport Infrastructure Ireland (TII, formerly NRA) – Drainage of Runoff from Natural Catchments 2015, HR Wallingford website, the site specific topographical survey as well as site visits by the design engineer. The following paragraphs provide context and detail behind the choosing of the **SOIL Type 3** for the Qbar calculation.

8.6 As part of the preparation for the planning application, research into the existing site ground conditions were undertaken. Furthermore, a Hydrological and Hydrogeological Risk Assessment report has been prepared by Enviroguide Consulting and has been included with the LRD Stage 3 planning application.

8.7 Site investigations were undertaken including trial hole opening and soakaway testing. Refer to Appendix 12.8 of this report for the SI results.

8.8 In total 9No. soakaway tests were carried out in accordance with BRE Digest 365 and the results indicated infiltration rates varied between unobtainable f values up to $9.3x10^{-6}$ m/s. These results indicate limited but some availability for infiltration across the site. Refer to the soakaway test results in Appendix 12.8 of this report for further information.

8.9 The sub-soil conditions as determined by trial hole opening noted topsoil over cohesive clay overlying silt above broken granite.

8.10 A review of the Geological Survey of Ireland website http://www.gsi.ie and that of the Teagasc sub specific http://gis.teagasc.ie/soils/map.php websites both of which provide publicly available soils and bedrock datasets.

8.11 The soil association composition as determined from the Teagasc data is noted as Carrigvahanagh peat over lithoskeletal acid igneous rock on most of the site. Refer Fig.15 below and to Appendix 12.7 of this report for the summary extracts from the GSI/Teagasc datasets.

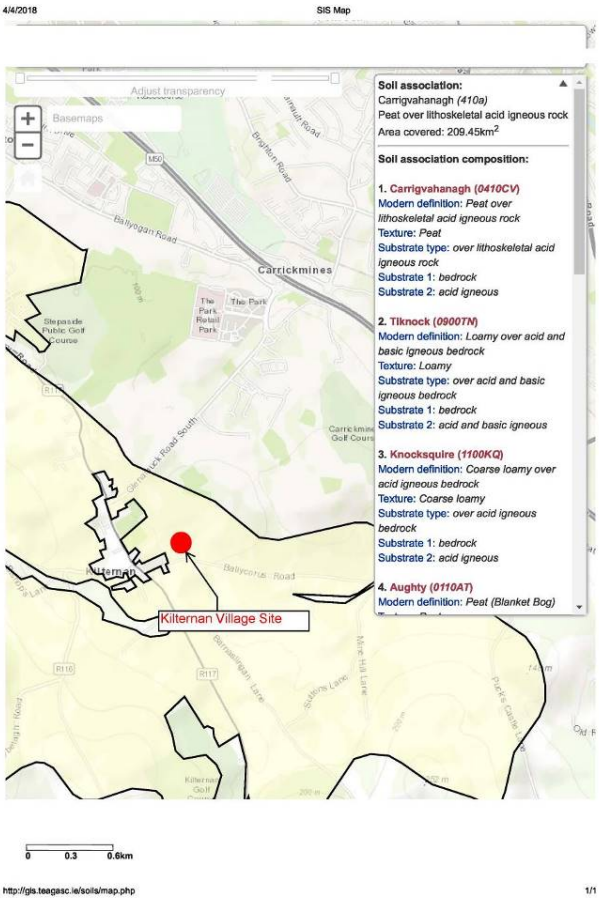

Fig.15 – GSI/Teagasc Soil Data

8.12 SOIL indices (1 to 5) are defined in the Flood Studies Report (NERC, 1975). The index broadly describes the maximum runoff potential and was derived by a consideration of soil permeability and topographic slope, see Table 11 below;

FSR Soil Indices	
Soil Type 1	Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone, and related drifts. Earth peat soils drained by dykes and pumps Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys
Soil Type 2	Very permeable soils with shallow ground water Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. Moderately permeable soils, some with slowly permeable sub-soils
Soil Type 3	Relatively impermeable soils in boulder and sedimentary clays, and in alluvium. Permeable soils with shallow ground water in low lying areas. Mixed areas of impermeable and permeable soils in approximately equal proportions.
Soil Type 4	Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
Soil Type 5	Soils of wet uplands with peaty or humose surface horizons and impermeable layers at shallow depth Deep raw peat associated with gentle upland slopes or basin sites Bare rock cliffs and screes (iv) shallow, permeable rocky soils on steep slopes.
Based on the above definitions a SOIL Type 3 or 4 could be chosen for the Kilternan Village* development *site	

Table 11 – FSR Soil Indices

8.13 The WRAP map gives a broad-spectrum overview of the soil type location across the entire country as per Fig.16 below;

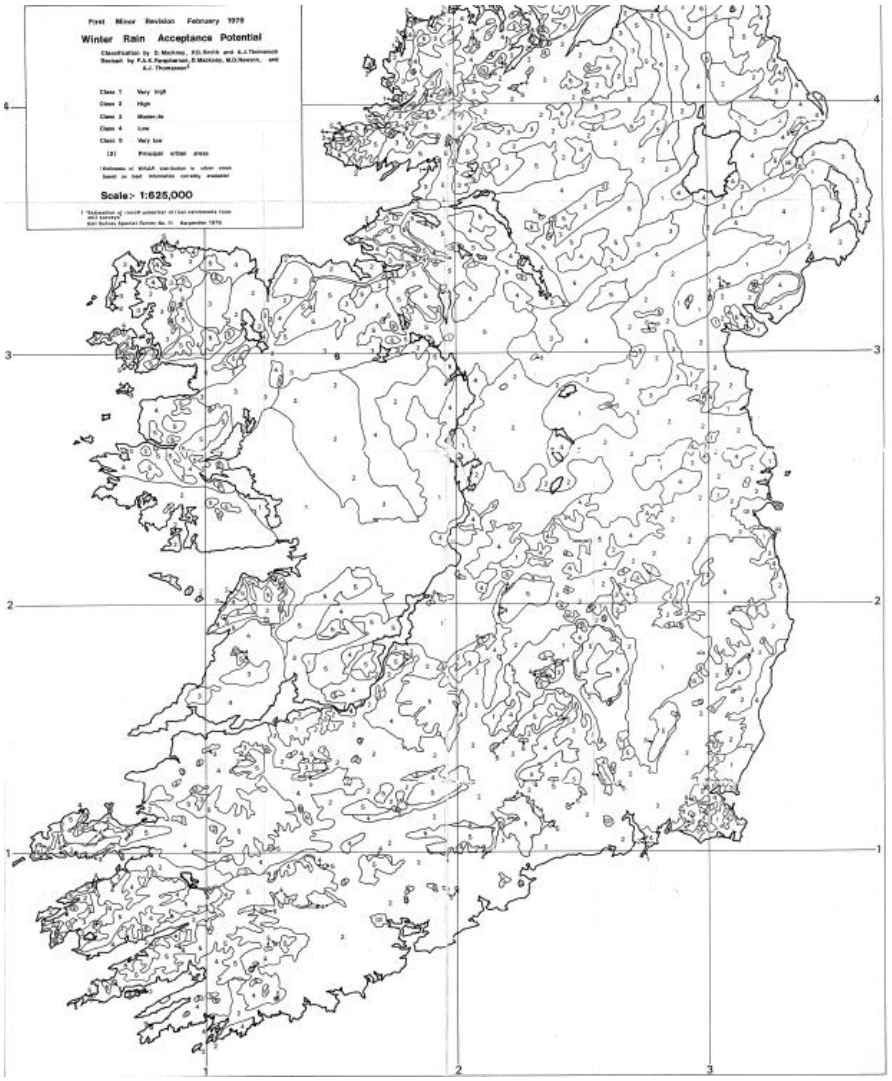

Fig.16 – WRAP Map - Full

8.14 At an expanded scale and overlaid with the Kilternan site specific location the WRAP map and Soil index is as Fig.17 below;

Fig.17 – WRAP Map - Local

8.15 Based on the WRAP map a **SOIL value of 5** could be interpreted but is not applied for this site. It is noted that SOIL type 5 is rarely applied and is more associated with exposed rock or peat wetlands.

8.16 From the FSR table, reproduced in in Fig.18 below, showing the noted drainage and slope classes, the **Soil type could be interpolated between a type 4 and a type 3**.

Drainage Class	Depth to impermeable layer (cm)	Slope Classes								
		0-2°			2-8°			>8°		
		Peremability rates above impermeable layers								
		Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)
1	>80	1			1			1	2	3
	40-80					2		3		4
	<40	--------	--------	--------	--------	--------	--------	--------	--------	--------
2	>80	2		3				--------		
	40-80						4			
	<40	3								
3	>80							--------		
	40-80						5	--------		
	<40									

Winter rain acceptance indices:1, very high; 2, high: 3, moderate; 4, low; 5, very low Upland peat and peaty soils are in Class 5. Urban areas are unclassified.

Fig.18 – Soil Type Table

8.17 Reference to the Transport Infrastructure Ireland -TII (formerly the National Roads Authority – NRA) publication Drainage of Runoff from Natural Catchments 2015, Volume 4 Sections 2 of the Design Manual for Roads and Bridges (DMRB) the following table was noted (Fig.19);

General soil description	Runoff potential	Soil class
Well drained sandy, loamy or earthy peat soils Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys	Very low	S_1
Very permeable soils (e.g. gravel, sand) with shallow groundwater Permeable soils over rocks Moderately permeable soils some with slowly permeable subsoils	Low	S_2
Very fine sands, silts and sedimentary clays Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas Mixed areas of permeable and impermeable soils in similar proportions	Moderate	S_3
Clayey or loamy soils	High	S4
Soils of the wet uplands: Bare rocks or cliffs Shallow, permeable rocky soils on steep slopes Peats with impermeable layers at shallow depth	Very high	S_5

Fig.19 – TII Soil Class

8.18 Using the results of the site investigation trial holes as well as the Teagasc data sets noted previously, a **Soil class of S4** could be interpolated from the TII Fig.16 above but is not applied for this Kilternan Village development site.

8.19 In reference to the HR Wallingford online design tool, it is noted that a **SOIL type 5** was the default value given for the input site coordinates. but is not applied for this site. It is noted that SOIL type 5 is rarely applied and is more associated with exposed rock or peat wetlands.

8.20 The site is generally flat in the western side and is more steeply sloped on the eastern side but the underlying soil type evidenced from the trial hole logs is consistent in that the strata are topsoil over clays over silts over broken granite. Refer to Appendix 12.8 for the trial hole and soakaway test results.

8.21 Based on interpretation of each of the above data sets a Soil Type 3 or 4 could be reasonably be interpreted. As part of the Pre-Planning consultations, agreement in principle was reached with the DLRCC Drainage Department and a **Type 3 soil** was chosen as appropriate for

this site. The decision to choose a type 3 is deemed as conservative and yields a lower outfall rate than of a soil type 4.

8.22 From the GDSDS Table 6.7, shown in Fig.20 below, using a Soil value of 3 equates to an SPR value of 0.37. The SPR value of 0.37 was used in the HR Wallingford Qbar calculator to override the default higher SPR value of 0.53.

SOIL	SPR value (% runoff)
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

Fig.20 – GDSDS SPR Values

8.23 Using the DLRCC recommended HR Wallingford UK SuDS calculation tool the resultant Qbar = 54.6 l/s for the entire drained site. As was noted previously (paragraph 6.15), in Pre-Planning discussions with DLRCC Municipal Services Department, it was requested that the smaller (<1Ha) Catchment No.'s 2 & 3 have the attenuated outfall rate be governed by the minimum acceptable vortex control diameter of 50mm. Therefore, an analysis was carried out using the Hydro International online design tool to determine the maximum flowrate through a 50mm Hydrobrake, which was determined to be 1.5l/s. Therefore, the outfall rate from Catchments 2 & 3 is restricted to 1.5l/s, while Catchments 1 & 4 are based on the UKSuDS calculation tool. Furthermore, the calculated Qbar for the entire site of 54.6 l/s has been reduced to a **proposed total outfall rate of 49 l/s** to which is deemed as a more conservative approach to the drainage design and is an improvement on what is actually allowable. Refer to paragraphs 6.15-6.18 for more detailed discussion on the sub-division of the allowable outfall rates.

9.0 S/W Design Conclusion

9.1 The S/W outfalls are described in detail in Section 6 of this report.

9.2 Full SuDS treatment train approach has been implemented in accordance with the CIRIA SuDS Manual as described in Section 7 above.

9.3 A thorough examination of the site characteristics were undertaken in determination of the soil type and greenfield run off rate as described in Section 8 above.

9.4 The drainage design and attenuation storage volumes have been determined using an industry standard computer modelling software program MicroDrainage, for designing drainage networks as described in Section 6 above and are included in Appendix 12.1 of this report. Climate change of 20% and Urban Creep of 10% has been applied in the design and is detailed in Section 6 above.

9.5 A Site-Specific Flood Risk Assessment was completed and is included in the application as a separate report.

9.6 A Hydrological and Hydrogeological Risk Assessment report prepared by Enviroguide Consulting has been completed and included with this LRD Stage 3 planning application.

9.7 Pre-Planning consultations were held with the DLRCC Municipal Services Department and their requirements were ascertained and complied with in this document and the accompanying drawings.

9.8 In accordance with the requirements of the Stormwater Management Policy of the DLRCC County Development Plan 2022-2028, in advance of submission of the main planning application, a Storm Water Audit has been carried out for the proposed development, submitted to the Drainage Department of DLRCC and is included in Appendix 12.6 of this report.

9.9 Should planning permission be granted the Applicant has the ability to deliver the services and ancillary works required to implement the designed scheme in full and confirmation of same is shown in Appendix 12.21.

9.10 A full summary response to the DLRCC Stage 2 Opinion conditions is included in Appendix 12.22

10.0 Wastewater Infrastructure

10.1 Foul drainage records drawings were obtained from Uisce Éireann/DLRCC in preparation for this planning application and are included in Appendix 12.11 of this document.

10.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Uisce Éireann (UÉ) and a Confirmation of Feasibility (CoF) was received from UÉ (ref.CDS21006509) noting that a foul connection is "*feasible without infrastructure upgrade*". Furthermore, the detailed foul drainage drawings were submitted to the CDS Design section of UÉ and were subsequently approved as compliant with the UÉ standards. A copy of the Confirmation of Feasibility and the Statement of Design Acceptance letters can be viewed in Appendix 12.16 of this report.

10.3 The minimum public sewer diameter is to be 225mm and the foul drains/sewer are to be in accordance with the Uisce Éireann Code of Practice for Wastewater Infrastructure 2020.

Foul Sewer Design Criteria	
Min.velocity	0.75m/s
Max.velocity	3m/s
Min.sewer size for TIC	225mm diameter
Pipe friction (Ks)	1.5mm
Minimum pipe depth	1.2m below roads 0.9m in open/grassed spaces
Ave.Occupancy	2.7 persons/unit
Residential loading/person/day	150 l/day
Commercial loading/person/day	50 l/d

Table 12 – Foul Sewer Design Criteria

10.4 Each individual house is to be connected to the main public foul sewer using a 100mm diameter drain with a minimum gradient of 1/60 in any one drainage connection.

10.5 The proposed foul drainage system will also have 4No.outfall connection locations summarised in Fig.21 and Table 13 below;

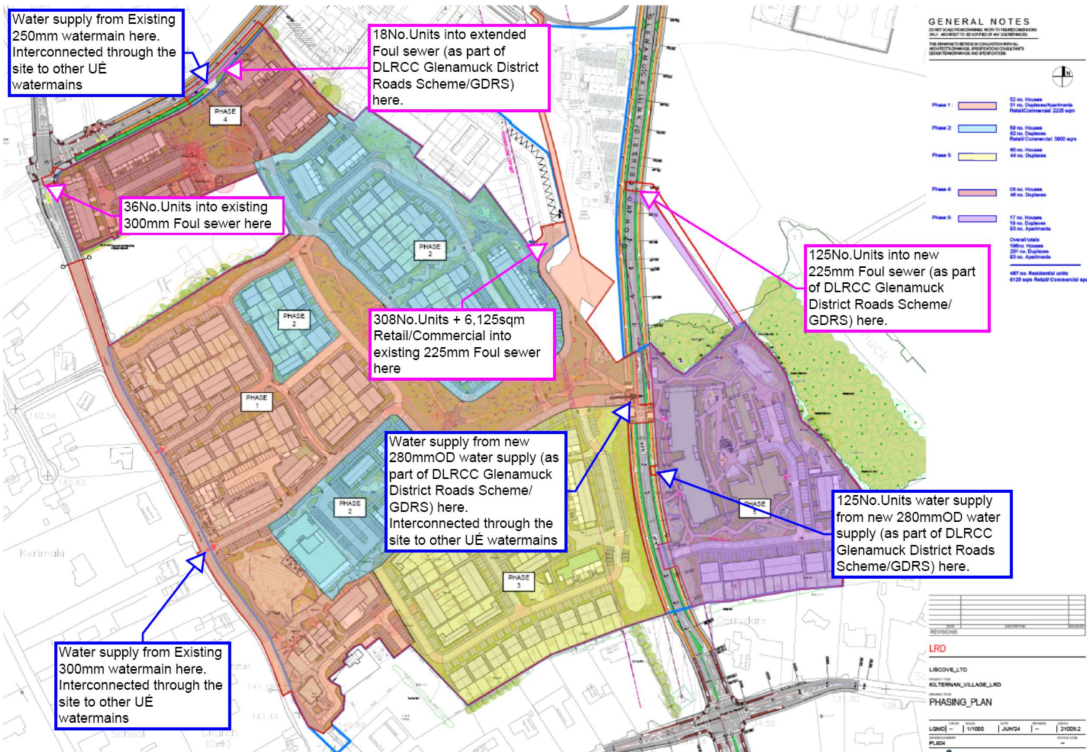

Fig.21 – Foul and Water Connections Summary

FOUL DRAINAGE CATCHMENT SUMMARY		
Catchment No.	**Quantity Drained**	**Outfall Location**
1	308Residential Units + 5,434m^2 Commercial/Retail + 691m^2 Creche	Outfalls into existing 225mm pipe in Rockville development
2	18 Residential Units	Outfalls into 225mm pipe to be extended as part of the Glenamuck Road upgrade
3	36 Residential Units	Outfalls into the existing 300mm pipe in the Enniskerry Road at the Glenamuck Road junction
4	125 Residential Units	Outfalls into the 225mm pipe to be constructed as part of the GLDR project

Table 13 – Foul Drainage Catchment Summary

10.6 It is acknowledged that the foul outfalls from Catchment No.'s 2 & 4 are dependant on the construction of the foul drainage infrastructure as part of the GLDR/Glenamuck Road project. This roads project has already commenced as of May 2024 and it has been stated by DLRCC that it will

be completed by Q1 2026. Therefore, the above noted catchments 2 & 4 will be phased to coincide with the GLDR completion.

10.7 The vast majority of the site, Catchments 1 & 3 (c.344No.residential units and 5,434m^2 commercial/retail and 691m^2 creche) can outfall the foul water into the existing drainage infrastructure without interface with the GLDR roads scheme.

10.8 Catchment 1 outfall from the site will be via the existing piped foul drainage system constructed as part of the Rockville schemes (D17A/0793 and D18A/0566). This existing infrastructure in turn outfalls downstream into the existing Uisce Éireann owned 300mm foul drainage piped infrastructure on Glenamuck Road. Refer to Dwg.2104C/308 for further detail. Catchment 2 (18No.residential units) will outfall into the Glenamuck Road extended 225mm foul sewer as part of the forthcoming GDRS project. Catchment 3 (36No.residential units) is proposed to outfall into the existing 300mm UÉ/UÉ foul sewer in the Enniskerry Road new the Golden Ball pub. Catchment 4 will outfall into the foul drainage infrastructure to be provided in the GLDR project. Refer to Dwg.'s 2104C/306-309 for further detail.

10.9 Access into the main Catchment 1 foul outfall into the Rockville's existing piped foul drainage system (D17A/0793 and D18A/0566) has been agreed with the developer of the Rockville scheme. The existing Rockville foul sewer has been submitted by the Rockville developer for taking-in-charge by Uisce Éireann/Uisce Éireann and the Applicant has a wayleave agreement for the connection into this foul pipe. That existing infrastructure in turn outfalls downstream into the existing Uisce Éireann/Uisce Éireann owned 300mm foul drainage piped infrastructure on Glenamuck Road. Refer to Dwg.2104C/306 for further detail.

10.10 Refer to Dwg.No.2104C/307-309 for the alignment and levels of the proposed foul network.

10.11 Design estimates for the foul water loading for the entire site are summarised as per Table's 14 and 15 below and refer to Appendix 12.18 for calculations of the sub-catchments;

Foul Wastewater Calculations

New Network - DOMESTIC Wastewater Flows – TOTAL SITE						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Residential	487Units	2.7No./Unit	1,315	150	197,235	
				Total =	**197,235 l/day**	
				Flowrate per day (l/s)		**2.28l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.2
				Dry Weather Flow	**PG + I**	**2.48 l/s**
				Peaking Factor (Pf_{Dom})	3	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**7.45 l/s**
				Misconnection Allowance (SW)	1.5%	0.04l/s
				Design Flow (l/s)		**7.49 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Table 14 – Residential Wastewater Calculations

New Network - COMMERCIAL Wastewater Flows -TOTAL SITE						
Usage	**Quantity**	**Occupancy (h)**	**Population (P)**	**Consumption (G) (l/h/day)**	**Loading (PxG)(l/day)**	
Retail/Comm	5,434m^2	1per 5m^2	1087	50	54,340	
Crèche	691m^2	1child/5m^2 + Staff (20%) + support accommodation	166	50	8,282	
				Total =	**62,622 l/day**	
				Flowrate per 12hr day (l/s)		**1.45l/s**
				Growth Rate	1	1
				Infiltration (I)	10%	0.14
				Dry Weather Flow	**PG + I**	**1.6 l/s**
				Peaking Factor (Pf_{Dom})	4	
				Design Foul Flow (l/s)	**Pf_{Dom} x PG**	**6.4 l/s**
				Misconnection Allowance (SW)	1.5%	0.09l/s
				Design Flow (l/s)		**6.4 l/s**

Based on Irish Water Code of Practice Wastewater Infrastructure (Rev 2 July 2020)

Table 15 – Commercial Wastewater Calculations

10.12 Details of manholes are to be as per Dwg.No.2104C/21 and in accordance with the Uisce Éireann Code of Practice for Wastewater Infrastructure 2020.

11.0 Site Potable Watermain

11.1 Water infrastructure records drawings were obtained from Uisce Éireann/DLRCC in preparation for this planning application and are included in Appendix 12.11 of this document.

11.2 A Pre-Connection Enquiry Form application (PCEA) was submitted to Uisce Éireann and a confirmation of available service was received from UÉ (ref.CDS21006509) noting that the water connection was "*feasible without infrastructure upgrade*". Furthermore, the detailed foul drainage drawings were submitted to the CDS Design section of UÉ and were subsequently approved as compliant with the UÉ standards. A copy of the Confirmation of Feasibility and the Statement of Design Acceptance letters can be viewed in Appendix 12.16 of this report.

11.3 There is an existing 300mmØ diameter water supply main located along the Enniskerry Road passing in front of the proposed development and likewise a 250mm diameter main along Glenamuck Road. It is proposed to make a new connection into the watermain on the Enniskerry Road to supply the development as confirmed by the UÉ/UÉ CoF letter.

11.4 The drinking water to all of the proposed development land to the west of the GLDR (c.362No.residential units and 5,434m^2 commercial/retail and 691m^2 creche) can be supplied and connected to the existing UÉ watermain infrastructure. West of the GLDR, the proposed developments potable drinking water supply connection will be into the existing 300mm Uisce Éireann watermain in Enniskerry Road fronting the west part of the site with a secondary/looping link into the existing 250mm watermain in the Glenamuck Road. Refer to Dwg.2104C/310-312 for further detail.

11.5 The already commenced GLDR roads project will construct a new 280mm OD watermain along the road fronting the east part of the proposed development (c.125No. residential units). As part of the land acquisition agreements for the GLDR between the Applicant and DLRCC, it has already been agreed that a spur watermain connection from this new main into the east site will be constructed as part of the GLDR project. Connection into this spur will be subject to a connection agreement with UÉ prior to construction of the proposed development.

11.6 Refer to Dwg.No.'s 2104C/310-312 for the watermain layout.

11.7 Each individual residential dwelling within the development is to be provided with a boundary box for a separate domestic water meter. The type and configuration of the water meter is to be agreed with Uisce Éireann in advance of construction commencing at the development.

11.8 Each dwelling will be fitted with a cold-water storage tank to provide 24 hours of supply.

11.9 In accordance with best practice, the use of water conservation appliances in the buildings are to be employed as part of this scheme to reduce the water demand. Although the consumption of treated water depends a lot on the behaviour of consumers, demand on the network is limited in the scheme by incorporating water saving tap valves, eco-flush toilet system and water saving appliances.

11.10 As a further measure of demand reduction, it is proposed to provide a total of c.185No. 200l **rainwater butts**, placed to the rear of each gabling property. This will collect rainwater from the house roofs for use in garden irrigation, therefore reducing drinking water demand and decreasing run-off from the site. Refer to Appendix 12.5 for more information.

11.11 All watermain layout and details are to be in accordance with the Uisce Éireann Code of Practice for Water Infrastructure 2020 and the Water Infrastructure Standard details 2020.

11.12 Estimates of the water demand for the entire site were carried out using the guidelines in accordance with the UÉ COP for Water Infrastructure 2020 publication and are shown in Table's 16 and 17 below and refer to Appendix 12.18 for calculations of the sub-catchments;

Water Demand Calculations

New Network – DOMESTIC Water Demand – Total Site								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l//h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Resi'	487 Units	2.7 No./Unit	1,315	150	197,250	2.28	2.85	**14.27 l/s**
Peak Hour Water Demand (Domestic)								**14.27 /s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Table 16 – Residential Water Demand Calculations

New Network – COMMERCIAL Water Demand- Total Site								
Usage	**Quantity**	**Occupancy**	**Population**	**Consumption (l//h/day)**	**Ave. Daily Domestic Demand (l/day)**	**Ave. Daily(12hr) Domestic Demand (l/s)**	**Ave. Day/Peak Week (l/s)**	**Peak Hour Water Demand (l/s)**
Retail/ Comm	5,434m^2	1per 5m^2	1087	50	54,340	1.26	1.57	7.86
Crèche	691m^2	1child/5m^2 + Staff (20%) + support accommodation	166	50	8,282	0.19	0.24	1.12
Peak Hour Water Demand (Commercial)								**9.1l/s**

Based on Irish Water Code of Practice for Water Infrastructure (Rev 2 July 2020)

Table 17 – Commercial Water Demand Calculations

12.0 APPENDIX

12.1 MicroDrainage Drainage Calculations
12.2 Interception and Sample Swale Calculations
12.3 StormTech System & Calculations & Details
12.4 OPW PFRA Map No.2019/MAP/221/A
12.5 HR Wallingford/UK SuDS Report
12.6 SuDS Audit Report
12.7 GSI Data
12.8 Site Investigations Reports
12.9 DLRCC Flood Zone Map No.9
12.10 DLRCC Local Area Plan Map.NoPL-13-402
12.11 UÉ/DLRCC Records Drawings
12.12 OPW Flood Hazard Mapping Report
12.13 Green Roof Information
12.14 Met Eireann Data Sheet
12.15 Surface Cover Type
12.16 Uisce Éireann CoF/Design Acceptance Letters
12.17 GDRS/GLDR Capital Projects correspondence
12.18 Water and Wastewater Calculations
12.19 Bypass Separator Data
12.20 Hydrobrake Calculations
12.21 Offsite Drainage Connection Legals
12.22 Response to DLRCC Stage 2 Opinion - Drainage