Waterman Moylan
Engineering Consultants

Engineering Assessment Report

Proposed Residential Development Site at Knockrabo Phase 2, Mount Anville Road, Goatstown

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This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

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Comments

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Appendices

1. Introduction

Waterman Moylan have been appointed by Knockrabo Investments DAC to provide Engineering services for the development of the lands to the north of Mount Anville Road, Goatstown. This report has been prepared as part of the formal applicaiton to An Bord Pleanála, for the proposed development of 227 No. residential apartment units, Phase 2 of the overall Knockrabo Lands development.

The subject and adjacent lands to the west currently has a grant of planning for the development of 93 No. residential units and childcare facility along with community/leisure facilities and all associated infrastructure. The existing grant of planning DLRCC Register reference is D17A/1124.

This report describes the criteria used to design the storm water discharge, SuDS proposals, disposal of foul water, water supply, DMURS compliance, vehicular access, road/pedestrian facilities and vehicular/cycle parking for this higher density development.

2. Site Description

2.1 Site Location

The site is in Goatstown, Dublin 14. In this regard, we refer you to the accompanying site location plan 20-086-P100 and *Figure 1* below. It is bounded to the south by Mount Anville Road, to the east by Phase 1 of the overall Knockrabo development, to the southwest by existing allotments including Cedar Mount (a protected structure) and to the north by the reservation corridor for the Dublin Eastern By-Pass (DEBP). It is noted that an agreed access reservation for the DEBP project is supplied along Knockrabo Way, the entrance road to the development, as indicated in the accompanying Road Hierarchy drawing 20-086-P105.

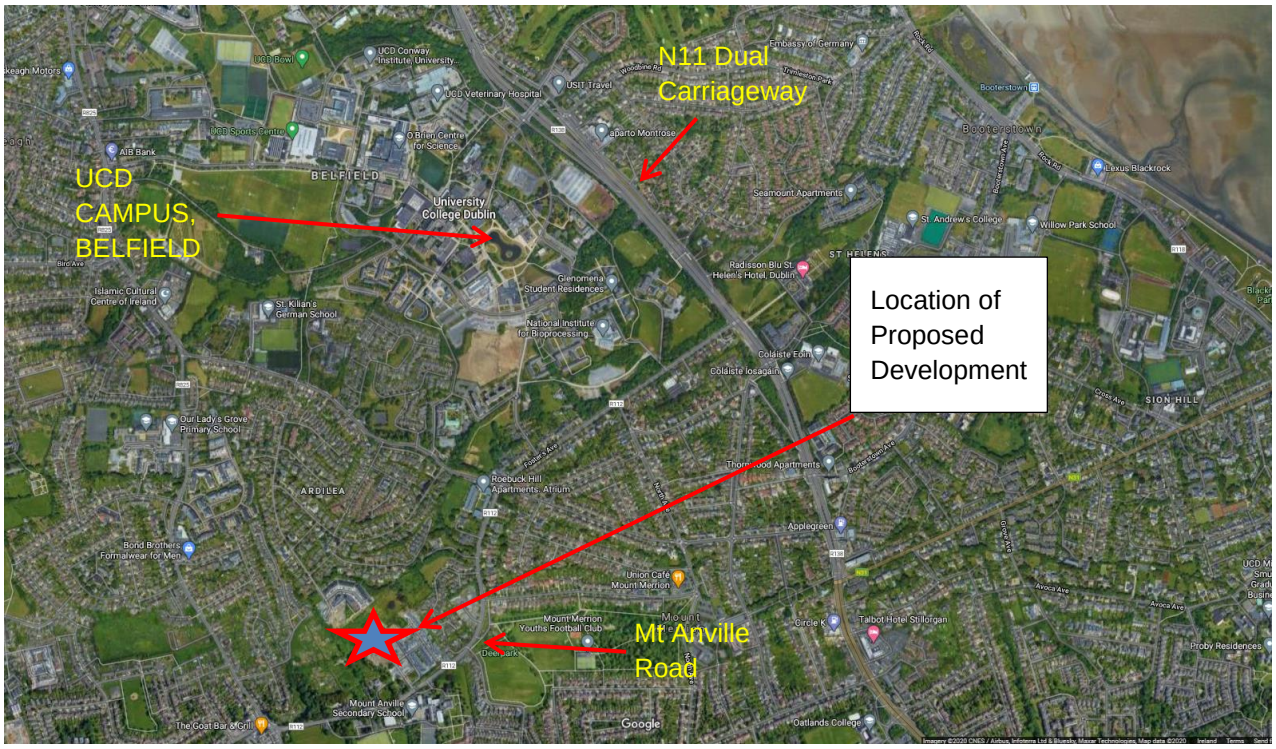

Figure 1: Site Location (image taken from Google Earth)

2.2 Existing Development

The total site area is approximately 1.78 hectares and is predominantly greenfield. The subject site is accessed from a circa 100m section of constructed entrance road, Knockrabo Way, that also facilitates access to the adjacent Phase 1 development to the east. The site falls sharply from south to north ranging in level from 76.5m in the south east to 59.6m in the north. The subject lands abut lands under control of the Applicant to the west of the proposed entrance road. These abutting lands include 'Cedar Mount' (a protected structure) and 'Knockrabo Gate Lodge (West) (a protected structure), including entrance gates and piers. There are also several well-established trees and foliage on site.

The site forms part of a broader site on which the construction of Phase 1 has already taken place. Phase 1 to the east of the subject lands comprises a mix of houses and apartments and was granted under Reg. Ref. D13A/0689. The subject lands occupy the western side of this broader Knockrabo site, which has an existing grant of planning (D17A/1124) for the development of 93 No. Residential Units and Childcare Facility along with community/leisure facilities and all associated infrastructure. The Knockrabo Way entrance road previously permitted under Reg Ref D17A/1124 is proposed to remain as previously granted. The proposed submission does not impact on the reservation corridor for the Dublin Eastern Bypass.

In terms of the Dublin Eastern Bypass (DEBP), we would note that following the publication of its Feasibility Study in 2007 the Corridor Protection Study was issued in January 2011. The Corridor Protection Study confirms the alignment of the final scheme and designates a route corridor based upon the alignment. The purpose of the Corridor Protection Study is to assist the Local Authorities in their deliberations on planning applications by establishing guidelines for developments near or adjacent to the proposed route corridors. These guidelines have been prepared with a view to permitting certain development of the adjacent lands without undermining the future deliverability of the motorway scheme. In this regard, the accompanying Construction Management Plan to this submission addresses the development control measures that are proposed to be put in place, per the recommendations supplied within the Corridor Protection Study Report.

2.3 Proposed Development

It is proposed to construct 227 No. residential apartment units within four separate blocks (Blocks E, F, G & H) with associated communal open space and residential on street and podium parking. The developer will construct all associated infrastructure to service the development including a network of foul water and surface water drains, watermain, access road and footpaths. The surface water, foul water, watermain and local access road strategies are to remain as previously granted. The design of the entrance road, Knockrabo Way shall remain as previously granted and does not form part of this revised planning application. The proposed submission does not have any impact upon or propose any change to the extent of lands that are subject to future licence agreement with DLRCC to facilitate the provision of a Construction Access Road to the DEBP.

The proposed apartment units will provide a higher density of residential units to that supplied under the adjacent Phase 1 and also to that previously granted for the subject lands, supplying an overall gross density on the Knockrabo Lands (Phase 1 and 2) of 65.3 Units/ha.

The ground floor of the proposed buildings are proposed to match the existing levels on site as much as reasonably practicable.

In summary, the development will consist of:

- The development, with a total gross internal area of c. 23,096.7 sqm, will consist of the construction of 227 no. residential units in 4 no. apartment blocks ranging in height from Part 2 – Part 8 storeys including semi-basement podium.
- The development will provide 76 no. 1 bed units, 145 no. 2 bed units and 6 no. 3 bed units as follows:
- **Block E** (c. 1015.3 sqm GIA) is a 5-storey including semi-basement podium apartment block comprising of 8 no. units (1 no. one bed unit and 7 no. 2 bed units).
- **Block F** (c. 8042.2 sqm GIA) is a Part 2 to Part 8 storeys including semi-basement podium apartment block comprising 84 no. units (53 no. 1 bed units and 31 no. 2 bed units).

- **Block G** (c. 8626.5 sqm GIA) is a Part 6 including semi-basement podium to Part 8 storey including semi-basement podium apartment block comprising of 82 no. units (37 no. 1 bed units, 40 no. 2 bed units and 5 no. 3 bed units).
- **Block H** (c. 5413.7 sqm GIA**)** is a Part 6 to Part 7 storey apartment block including semi-basement podium comprising 53 no. units (7 no. 1 bed units, 45 no. 2 bed units and 1 no. 3 bed unit).
- Residential Tenant Amenities comprising c. 537.2 sqm are provided at Level 00 of Block G and H to serve all residential units within this application.
- Balconies/Wintergardens are provided on all elevations at all levels for the 4 no. apartment blocks, with (Private) Terraces provided at top floor levels and a communal Roof Terrace of c. 198 sqm to be provided on Block F.
- The development will also provide 178 no. car parking spaces, which comprises 125 no. residential podium parking spaces, 35 no. on-street parking spaces, 16 no. visitor/drop off parking and 2 no. car sharing on-street parking spaces are provided; Provision of 389 no. private residential bicycle parking spaces and 130 no. visitor bicycle parking spaces; Provision of 12 no. motorcycle parking spaces;
- All other ancillary site development works to facilitate construction, site services, piped infrastructure, 2 no. sub-stations, plant, public lighting, bin stores, bike stores, boundary treatments, provision of public, communal and private open space areas comprising hard and soft landscaping, site services all other associated site excavation, infrastructural and site development works above and below ground.
- The development will be served by the permitted access road 'Knockrabo Way' (DLRCC Reg. Ref. D13A/0689; ABP Ref. PL.06D.243799, DLRCC Reg. Ref. D16A/0821 and DLRCC Reg. Ref. D16A/0960). The application does not impact on the future access to the Reservation for the Dublin Eastern Bypass.

2.4 Existing Ground Conditions

A soil infiltration report was commissioned as part of this planning application and is detailed in Appendix B. In total 4 trial holes were excavated, and infiltration tests were undertaken on 2 of these holes in accordance with BRE Special Digest 365. The soakaway tests failed the specification and thus demonstrated the unsuitability of the soils for soakaway design. The descriptions of the materials in the area of the site where soakaway tests were conducted further outlines the unsuitability of the soil for soakaways, i.e. "well compacted clay/silt soils".

Considering the above Site Investigations and previous site investigations undertaken on the site (included as Appendix C), the soil index used to determine the surface water design has been determined to be Soil Type 4. The site predominantly contains either made ground or cohesive deposits at a shallow level, with weathered bedrock beneath. Given the steep nature of the site, with approximate gradient of 1 in 12, the nature of the soil and underlying ground conditions, it is considered that Type 4 is appropriate for this site and for the necessary calculations associated with the greenfield runoff analysis, further developed in section 4 below.

3. Foul Water Drainage

3.1 Receiving Environment

There is an existing 225mm diameter foul sewer outfall in the northeast of the subject site which was constructed under Phase 1 of the Knockrabo development and was designed and built to drain the Phase 1 and 2 lands.

All foul drainage on the subject lands is proposed to drain via gravity to this existing on-site foul outfall.

3.2 Proposed Wastewater Network

The proposed layout of the foul drainage network facilitates a gravity connection from the proposed scheme. Pipe sizing and gradients have been designed in accordance with Irish Water design requirements. Refer to drawings 20-086-P121 & 20-086-P122 for the proposed foul water layout.

3.3 Irish Water Pre-Connection Enquiry and Statement of Design Acceptance

A Pre-Connection Enquiry form was submitted to Irish Water in October 2020 (CDS21002520), which outlined the above foul water discharge proposal. A response Confirmation of Feasibility (CoF) Letter was received from Irish Water dated 10 June 2021 confirming that subject to a valid connection agreement, the proposed connection to the foul water sewer is feasible without an upgrade. The CoF is appended as Annex G.

A detailed drawing submission was subsequently made to Irish Water for both foul and water supply design. In response, Irish Water have issued a Statement of Design Acceptance stating that there are no objections to the proposals. A copy of the letter has also been included in Appendix G.

3.4 Foul Water – Calculations

The foul water drainage for the proposed development has been designed so that minimum cleansing velocities outlined in the "Irish Water Code of Practice for Wastewater Infrastructure" are achieved for all foul sewers. The peak foul flow is based on Irish Water recommended peak demand/flow factors which are provided in the Irish Water 'Code of Practice for Wastewater Infrastructure'. Pipe capacities and velocities have been calculated using the Colebrook-White formula with a roughness coefficient (Ks) of 1.5mm.

The proposed development will consist of 227 residential units. Based on Irish Waters Code of Practice, the peak foul flow from the proposed development will be as follows:

Table 1: Calculation of proposed Foul Water Flow

Description	No. of Units	Flow l/h/day	Population per Unit	Infiltration Factor	Total Discharge (l/d)
Residential Units	227	150	2.7	1.1	101,128.5
				Totals	***101,128.5 l/d***

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge *(from Table 1.)*	101,128.5	l/d
Dry Weather Flow (DWF)	1.17	l/s
Peak Foul Flow (=6 x DWF)	***7.02***	***l/s***

Waterman Moylan Drawing No's 20-086-P120-122 illustrates the proposed layout for the foul water sewer outfall for the subject site.

The proposed foul water outfall from the development is a 225mm diameter pipe laid at a gradient of 1:100, giving a capacity of 45.6 l/s. Therefore, the proposed outfall pipe has more adequate capacity to cater for the flows from the development.

3.5 Network Design & Foul Water General

Drains to the apartment blocks will be laid to comply with the Building Regulations 2010, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Foul water sewers outside the basement will consist of uPVC or concrete socket and spigot pipes (to IS 6) and will be laid strictly in accordance with Irish Waters code of practice for Wastewater Infrastructure and Dun-Laoghaire Rathdown County Council requirements for taking in charge.

4. Surface Water Drainage

4.1 Introduction

The following section deals with surface water drainage design including details of the SUDS measures proposed as part of the development.

The existing site is greenfield. It is proposed that the development will attenuate the surface water on site before discharging it, at a restricted rate, to an outfall pipe in the north-eastern corner of the development, constructed as part of the adjacent Knockrabo Phase 1 development and installed to facilitate development of the subject lands.

The Surface Water design calculations, reports and drawings have been audited (Stage 1 Audit) by JBA consulting, as required by Dun Laoghaire Rathdown County Council as part of the planning submission process. The audit report, appended as part of Annex A of this report, considers that the surface water drainage design is acceptable and meets the requirements of a Stage 1 Stormwater Audit. We refer you to section 4.8.

4.2 Site Characteristics

The following parameters have been used in greenfield run-off rate calculations, which are also provided in the Causeway Flow design output report, supplied in Appendix A .

Table 2: Surface Water Catchment Details

	Catchment
Site Redline Area (Gross) – Ha	1.78
Site Hardstanding and positively drained Area (Net) - Ha	1.21
SAAR - mm*[1]	774
SOIL Index*[2]	0.47
Climate Change	20%

*1 – From MetEireann data

*2 – The soil type map of Ireland indicated Soil Type 2 however the SI would suggest this is not correct for this particular site with soil conditions being compacted clay/silt above weathered bedrock in the southern part of the site and shallow bedrock in the northern end of the site, expected for Soil Type 4. Therefore 0.47 is used as the Soil Index for this site. In addition, there is a natural steep slope of c. 1:12 across the site which will increase the rate of run-off from site, even in its greenfield state.

4.3 Greenfield run-off rates

The Local Authority requirements are that post-development run-off rates are limited to greenfield run-off rates for the site. The greenfield run-off rates for the site have been calculated in accordance with the Institute of Hydrology report No 124 “Flood Estimation for Small Catchments”, using the UK SUDS Website. As outlined above, a Soil Index of 0.47 was used in our drainage design calculations. The Greenfield run-

off for the site is 6.5 l/s (Qbar). We refer you to the below calculation in this regard. Site investigations have been undertaken to determine the soil infiltration values and to verify the above Soil Index value, and are included as Appendix B. It was determined that it is not viable to use soakaways to infiltrate the surface water at source for this site and that the ground conditions would be typical of Soil Type 4.

Table 3: Calculation of Greenfield Runoff Rate

Greenfield Runoff:

$Q_{BARrural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times Soil^{2.17}$

Area	=	0.01201km²	… *Total site area in km²*
SAAR	=	774mm	… *Standard Average Annual Rainfall in mm*
SOIL	=	0.47	… *The "SPR" index from FSR*

Note: Where a site is <0.5km², the $Q_{BARrural}$ formula should be applied for 0.5km² and the result factored based on the ratio of the actual site area and the applied area.

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$Q_{BARrural}$ = 0.007m³/s
$Q_{BARrural}$ = 6.523 l/s
$Q_{BARrural}$ = 5.430 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	5.54	13.70	16.96
Q_{BAR} (l/s/Ha)	4.62	11.40	14.12
Allowable Discharge	6.52	6.52	6.52

4.4 Proposed Surface Water Strategy

It is proposed to drain surface water from the development by gravity to the existing public surface water drainage outfall pipe in the north-eastern corner of the development site. Storm water will discharge to the outfall at a controlled rate, limited to the greenfield equivalent runoff. Excess surface water runoff during storm events will be attenuated in new below ground stormwater attenuation tanks within the open space at the northern end of the site, as shown on Waterman Moylan's Drainage Layout Drawing No 20-086-P120-P122. As noted in section 4.3 above, the suitability of the soil for infiltration soakaways has been explored through site investigation, however the ground conditions are not favourable to this means of surface water design. As such, alternative SuDS measures including attenuation tanks are proposed, as further explained below.

The proposed surface water outfall pipe from the development is a 225mm diameter pipe laid at a gradient of 1:100, giving a capacity of 51.9 l/s. Therefore, the proposed outfall has more than adequate capacity to cater for restricted greenfield rate flows from the development lands.

Furthermore, the adjacent Stage 1 development lands are similarly attenuated, as indicated in the site services layout drawing supplied in Appendix A. The Stage 1 lands are restricted to 13l/s, which, when combined with phase 2 equates to a combined flow rate of 19l/s, still within the capacity limits of permitted combined surface water outfall drainage through the Phase 1 Lands.

Strict separation of surface water and wastewater will be implemented throughout the development. Internal private surface water will consist of uPVC (to IS 123) or concrete socket and spigot pipes (to IS 6). These drains will be laid to comply with the Building Regulations 2010, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H. Surface water sewers will consist of uPVC or concrete socket and spigot pipes (to IS 6) and will laid strictly in accordance with Dun Laoghaire Rathdown Council requirements for taking in charge.

The proposed development has been designed to incorporate best drainage practice. Section 4.3, above, sets out the methodology used in determining the existing greenfield runoff rate and calculating attenuation storage requirements for the site. The relevant design calculations are included in Appendix A as part of the Causeway Flow design output report.

It is proposed to incorporate a Storm Water Management Plan through the use of various SuDS techniques to treat and minimise surface water runoff from the site. The methodology involved in developing a Storm Water Management Plan for the subject site is in accordance with the requirements of Dun-Laoghaire Rathdown County Council and is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual (Ciria C753). Based on three key elements – Water Quantity, Water Quality and Amenity – the targets of the SuDS train concept have been implemented in the design, providing SuDS devices for each of the following:

- Source Control
- Site Control
- Regional Control

The following drainage hierarchy was used to determine the most suitable and sustainable SUDS strategy. This is in accordance with the GDSDS initiative that all new developments will conform to Best Management Practices for urban storm water drainage:

1. The use of green roofs;
2. Store rainwater for later use;
3. Use infiltration techniques, such as porous surfaces in non-clay areas;
4. Attenuate rainwater in ponds or open water features for gradual release;
5. Attenuate rainwater by storing in tanks or sealed water features for gradual release;
6. Discharge rainwater direct to a watercourse;
7. Discharge rainwater to a surface water sewer/drain;
8. Discharge rainwater to the combined sewer.

A plan of the SuDS measures proposed has been supplied on drawing 20-086-P140 and plans of the SuDS details are supplied on drawings 20-086-P141 and P142, all of which accompany this report.

4.4.1 Source Control

Green Roof:

Green Roofs have been considered and incorporated into the development proposals in accordance with Appendix 16 of DLRCC County Development Plan. The locations of the green roofs are illustrated on the accompanying Waterman Moylan SUDS Drawing 20-086-P140, and a section of the proposed roof is supplied on details drawing 20-086-P142. The total roof area on site is 4550m^2 and the area of green roof provided is 3640m^2 providing 85% coverage in green roof. This is in excess of the minimum requirement of 60% outlined in section 3.1 of DLRCC Green Roof guidance document.

As well as providing ecological benefits, green roofs contribute the following positive effects to surface water drainage design:

- The retention of water, through storage in the growing medium and evapotranspiration from the roof's plants and substrate, reducing run-off volumes and the burden on the drainage network.
- Due to the time for water to infiltrate and permeate the substrate, there is also a reduction in peak rates of run-off, helping to reduce the risk of flooding.
- They improve water quality through the filtration of pollutants during the process of water infiltration. This provides treatment in line with CIRIA SUDS Manual management train.

Although green roof space can reduce peak flow rates in the small storm events and aid in reducing the volume of run-off from the site, they operate as conventional roofs in higher storm events. Therefore, green roofs cannot be considered in the surface water drainage run-off calculations for the development. As stated in CIRIA C697 *"although green roofs absorb most of the rainfall that they receive during ordinary events, there is still the need to discharge excess water to the building's drainage system. This is because their hydraulic performance during extreme events tends to be fairly similar to standard roofs."*

The green roofs proposed will not be accessed as amenity areas. With respect to maintenance access, we refer you to the accompanying architectural layouts and drawings. Maintenance access to those areas is via level access from internal corridors & stairwells where that is possible, and via external mobile access from hard standing areas where that is not possible. A review of M&E plant space requirements document confirms that PV panels are not proposed for use on the apartment roofs and as such there is no requirement for compatibility between the two.

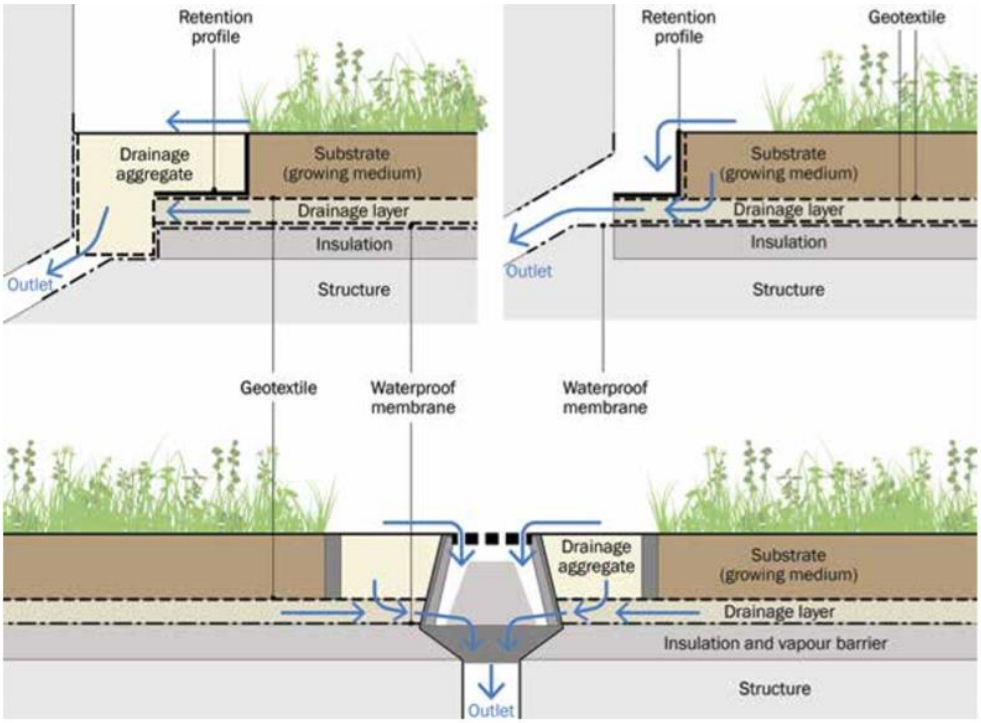


Figure 2: Example Details of outlets from a green roof (CIRIA C697)

The substrate and the plant layers in a sedum roof absorb large amounts of rainwater and release it back into the atmosphere by transpiration and evaporation. They also filter water as it passes through the layers, so the run-off, when it is produced, has fewer pollutants. Rainfall not retained by green roofs is detained, effectively increasing the time to peak and reducing peak flows.

A green roof can reduce annual percentage runoff by between 40% and 80% through this retention and evapotranspiration, with the impact dependent on a range of factors including the depth of substrate, the saturation of substrate at the onset of a rain event, the angle of the roof, the range of vegetation growing, intensity of rainfall and the time of year.

Rainwater storage for later use

Rainwater harvesting is often considered the most sustainable solution as it will reduce the total volume of water draining to the outfall as well as reducing the water demand for the proposed buildings. It must be assumed, however, that any water harvesting tanks are full prior to a storm event, and therefore cannot be considered as providing any rainwater attenuation. Rainwater harvesting shall be allowed for in the form of rainwater butts located at the position of rainwater downpipes

4.4.2 Site Control

As the site investigations have determined, infiltration techniques cannot be utilised on site. However, it is proposed the following site control measures before any discharge to the public surface water sewer

Permeable paving:

Permeable paving will be utilised at public roadside parking bays providing some treatment volume, with underlying perforated pipes connecting to the storm water sewer network within the roads. Adjacent road gullies will be connected to the underlying filter drains to treat and slow down the runoff rate by means of infiltration. Permeable Paved parking bays have been successfully incorporated in local developments in recent years.

Filter Drains:

Filter Drains are shallow trenches filled with gravel and wrapped in a geotextile membrane to treat and temporarily store surface water run-off. It is proposed to use filter drains on the footpaths and outside communal areas to treat surface water falling on ground level hardstanding areas at source before discharging into the attenuation tanks.

Tree Pits / Bio-retention Areas:

Where possible, surface water runoff from the roads will discharge to tree pits (via kerb inlets) located on the side of the road. Gullies will be positioned downstream of the tree pits to cater for overflow during high rainfall events. Tree pits are suitable for installation alongside carriage ways. The tree pit receives surface water runoff from the road via gully inlet. The surface water drains through the tree pit which is filled with engineered filter material to the underdrain system which discharges the treated surface water to the main surface water sewer in the roadway.

4.4.3 Regional Control

Flow Control:

A Hydrobrake or similar approved flow control device is proposed before the outfall to the public network, with an online attenuation system provided to store excess rainwater during storm events. Flows will be limited to the greenfield equivalent runoff rate. It is proposed to provide a penstock on the inlet to the hydrobrake manhole, which shall be connected to the proposed upstream attenuation tanks. This will facilitate ease of maintenance for the proposed hydrobrake manhole.

Underground Attenuation Storage System:

Private underground attenuation storage tanks are proposed to store excess surface water during storm events before discharging to the public network at the greenfield equivalent runoff rate. The attenuation tanks are to be located in the open space at the north of the proposed site. The attenuation shall incorporate an isolator row that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-rapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation. The underground storage tanks are supplied with minimum 900mm of stabilised over material, to facilitate future construction traffic should the need arise for the DEBP construction access way to be utilised above. In this regard, we refer you to attention cross sectional drawing 20-086-P127.

Downstream Defender (or similar approved)

Surface water shall then pass through one final level of treatment before outfall to the existing network, passing through a proposed downstream defender, which is an advanced hydrodynamic vortex separator used to remove fine particles, oils and other floatable debris effectively and reliably from the surface water

runoff. It is proposed that the petrol interceptor shall be fitted with an audible high level silt and oil alarm for maintenance and safety purposes. Regular maintenance and inspection are recommended on these units.

It is also noted that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.

4.5 Interception Storage

Interception storage is defined in the SUDS Manual as *"the capture and retention on site of the first 5mm of the majority of rainfall events"*. In accordance with the table 24.6 of the SUDS Manual CIRIA C753 the following guidelines have been used in calculating the area of the site benefiting from interception storage.

Table 4: Interception Mechanisms (Table 24.6 The SUDS Manual)

Systems	Interception methods assumed compliant for zero runoff from the first 5mm of rainfall for 80% of events during the summer and 50% in winter.
Green Roofs	All surfaces that have green roofs
Permeable Paving	All permeable pavements, whether lined or not, can be assumed to comply, provided there is no extra area drained to the permeable pavement. Where the pavement also drains an adjacent impermeable area, compliance can be assumed for all soil types where the pavement is unlined, as long as the extra paved area is no greater than the permeable pavement area
Swales / Filter Strips	Roads drained by filters strips/swales, where the longitudinal gradient of the vegetated area is less than 1:100, are suitable for Interception delivery for impermeable surface areas up to 5 times the base of the vegetated surface area receiving the runoff. Components steeper than 1 in 100 cannot be deemed to provide Interception unless additional effective Interception design can be demonstrated.

As described in section 4.3 and 4.4 the proposed development will provide, Green Roofs, Permeable Paving/Asphalt & Filter Drains. In order to calculate the percentage area of site benefiting from each form of interception storage the site areas are described in Table 5 below and demonstrated on Waterman Moylan drawing 20-086-P140.

Table 5: Interception Storage Provided

Area	Total Hard standing Area	Interception mechanism	% Area Draining to Interception feature	Interception Provision	Percentage Benefiting
Block E	319 m^2	Green Roof (319m2 @ 85% coverage) Non-Green Roof Area draining to gravel filter strip/water butts/planters (319m2 @15%)	100%	319m^2	100%
Block F	2,238m^2	Green Roof (1700m2 @ 85% coverage) Non-Green Roof Area draining to gravel filter strip/water butts/planters (1700m2 @15%)	100%	1700 m^2	100 %
		Podium Terrace area draining to softscape (538m2)		538 m^2	
Block G/H	3,632m^2	Green Roof (2532m2 @ 85% coverage) Non-Green Roof Area draining to gravel filter strip/water butts/planters (2532m2 @15%)	100%	2532 m^2	100 %
		Podium Terrace area draining to softscape (1100m2)	100%	1100 m^2	
Hard Standing – Road/Path/ Parking	4,750m^2	Tree Pts 205m2	100%	1025m2	77%
		Filter Drain – 120m x 0.6 = 72m2		360m2	
		Path draining to landscape open space		784m2	
		Permeable Paving 740m2		1,480m^2	
Total	**10,939m^2**		**10,939m^2**	**9,838m^2**	**90%**

4.6 Interception or Treatment Storage and Attenuation Storage

As noted above, the methodology involved in developing the Storm Water Management Plan for the subject site is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual. Appendix E of the Greater Dublin Strategic Drainage Study (GDSDS) sets out criteria

for determining the provision of interception or treatment storage, attenuation storage and long-term storage at a development site. These calculations are summarised below:

4.6.1 Criterion 1: River Water Quality Protection

Criterion 1.1: Interception

The Greater Dublin Strategic Drainage Study (GDSDS) states that approximately 30% to 40% of rainfall events are sufficiently small that there is no measurable runoff from greenfield areas into the receiving waters. These events are generally considered as the first 5mm of rainfall. Assuming 80% runoff from paved surfaces and 0% from pervious surfaces for the first 5mm of rainfall yields the following:

The required interception volume is circa 43.78m^3. It is proposed to provide interception mechanisms for the entire site, as described in section 4.5 above.

Table 6| *Interception Calculation*

Paved surfaces connected to drainage system	*17,795m² x 0.615 x 0.80 =* 8,755m²	*17,795m² site area* *62% of the site is paved* *80% of the paved area*
Volume of Interception Storage	*8,755m² x 5mm =* **43.78m³**	*Paved area directly drained* *5mm rainfall depth*

For this site, interception storage is achieved using green roofs, permeable paving, tree pits and filter drains in various locations throughout the site, however this is assumed to be quite small due to the nature of the sub-soils.

Referring to the soakaway tests conducted throughout the site, as contained in Appendix B, low permeability was observed. Criterion 1.2 will then be assessed to provide the required River Water Quality Protection in accordance with Criterion 1.

Criterion 1.2: Treatment Volume

For events larger than 5mm, and in situations where interception storage cannot be provided, surface water runoff treatment is provided.

Assuming 80% runoff from paved surfaces and 0% from pervious surfaces for the first 15mm of rainfall:

Table 7 | *Treatment Volume Calculation*

Paved surfaces draining to river	*17,795m² x 0.615 x 0.80 =* 8,755m²	*17,795m² site area* *61.5% of the site is paved*
Volume of Treatment Storage	*8,755m² x 15mm =* **131.33m³**	*Paved area directly drained* *15mm rainfall depth*

The proposed green roofing amounts to a cumulative area of approximately 3,640m^2. The sedum roofing shall consist of 75mm substrate with a sedum blanket. Assuming a 30% water volume retention, this amounts to approximately 82m^3 of treatment storage volume.

The proposed permeable paving provides approximately 0.1m^3 of treatment volume square metre area. This amounts to approximately 74m^3 of treatment volume when the external parking areas are considered.

The proposed tree pits 300mm layer of voided stone similarly affords approximately 0.1m^3 of treatment volume square metre area. This amounts to approximately 14m^3 of treatment volume.

The proposed filter drains (120m) provision of stone surround similarly affords approximately 0.1m^3 of treatment volume per linear metre. This amounts to approximately 12m^3 of treatment volume, however given that 40m of the filter drain is providing positive drainage from non impermeable green open space surface water runoff, only 80m of the filter drainage has been considered to provide treatment.

The treatment volume afforded by the above measures is therefore more than sufficient to meet the required treatment volume for the respective hardstanding areas.

Table 8: Interception Storage Provided

Area	Total Hard standing Area	Treatment mechanism	Treatment Storage
Block E/F/G/H Plan Area	4,551 m^2	Green Roof (4551m2 @ 85% coverage = 3868m2)	87 M^3
Road, Path and Podium Level	6,338m^2	Bio Retention Tree Pits 205 M^2	14.5 M^3
		Filter Drain – 80m	8m^3
		Permeable Paving 740m2	74 m^3
Total	**10,939^2**		**183.5**m^3

4.6.2 Criterion 2: River Regime Protection

Attenuation storage is provided to limit the discharge rate from the site into receiving waters. As per the GDSDS, the required attenuation volume is calculated assuming 100% runoff from paved areas, and has been calculated for the 1-year, 30-year and 100-year return periods, identifying the critical storm for each – refer to the Causeway Flow calculations included in Appendix A.

Based on these calculations, the required attenuation storage volume is 703m^3. This volume is sufficient for the 1-in-100-year storm, accounting for a 20% increase due to climate change. Attenuation tanks are

proposed in the northern open space, as indicated on drainage layout drawing 20-086-P120, and these afford 725m3 in storage volume, 20m3 more than the modelled storage requirements of the site. Cross section drawings and details of the proposed tanks are provided on drainage drawing 20-086-P127 and chamber specifications and details are supplied under Appendix D.

Surface water runoff shall be restricted via a hydro-brake or similar approved flow control device, limited to 6.5/s, before the outfall to the existing public surface water network, via a downstream defender as detailed in Section 4.4.3 above.

4.6.3 Criterion 3: Levels of Service

There are four criteria for levels of service. These are:

Criterion 4.1: No external flooding except where specifically planned (30-year high intensity rainfall event).

Criterion 4.2: No internal flooding (100-year high intensity rainfall event).

Criterion 4.3: No internal flooding (100-year river event and critical duration for site storage).

Criterion 4.4: No flood routing off site except where specifically planned (100-year high intensity rainfall event).

Both internal and external flooding are assessed in the Flood Risk Assessment report which accompanies this submission. The Flood Risk Assessment has been carried out in accordance with the *DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management* published in November 2009.

The assessment identifies the risk of both internal and external flooding at the site from various sources and sets out mitigation measures against the potential risks of flooding. The sources of possible flooding assessed in the report include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical errors, in order to meet the above referenced criteria.

4.6.4 Criterion 4: River Flood Protection

The long term storage volume is a comparison of pre- and post-development runoff volumes. The objective is to limit the runoff discharged after development to the same as that which occurred prior to development.

Of the three methods described in the GDSDS for establishing River Flood Protection by comparison of the pre- and post-development runoff volumes, (Criteria 4.1, 4.2 and 4.3 respectively), Criteria 4.3 is selected for use as the most practical criteria at this stage in the design.

The Criteria 4.3 approach is for all runoff to be limited to either Q_{BAR} or to 2 l/s/Ha, whichever is the greater. The proposed drainage system includes a flow control device to ensure that the discharge rate is limited to the greenfield equivalent and ample attenuation is provided for the 1-in-100-year storm, accounting for a 20% increase due to climate change.

4.7 Surface Water Drainage – General

Surface water sewers will generally consist of PVC (to IS 123) or concrete socket and spigot pipes (to IS 6) and laid strictly in accordance with Dun Laoghaire Rathdown County Council requirements for taking in charge. It is intended that all sewers within the public domain will be handed over to Dun Laoghaire Rathdown County Council for taking in charge.

All private outfall manholes will be built in accordance with the Greater Dublin Regional Code of Practice for Drainage Works. No private drainage will be located within public areas.

Drains will be laid in accordance with the requirements of the Building Regulations, Technical Guidance Document H.

4.8 Surface Water Audit

As outlined in Section 4.1, the surface water design was subject to a Stage 1 Audit by JBA consulting. As part of the design review process, JBA provided feedback to Waterman Moylan, *namely*:

- *"The interception and treatment receptors were not calculated or distributed correctly and required to be amended. Filter drain and bio-retention details require to be amended at detailed design stage to ensure the match the capacity provided for in the design, and that suitable outlets are provided."*
- *"Green areas not contributing to the storm network are to be shaped and constructed so as to not drain into the network"*
- *"Issues relating to cover and vertical/horizontal separation requirements."*

A summary of the JBA comments and record of the audit are appended to the report included in Annex A.

To address each of the above summarised bullet points, as part of the audit process, Waterman Moylan amended the interception and treatment receptors to satisfy JBAs audit findings. We also refer you to section 4.6.1 above which addresses JBAs audit finding relating to filter drain allowances within the treatment volume, and similarly drainage layout drawings have been amended to note the requirement for suitable low level outlets to bio-retention tree pits.

As regards above bullet point two, it is agreed that green areas shall be shaped and constructed as as to not drain into the network, save for the green open space south of Block F which is to be positively drained to the network, as agreed through the audit process.

All raised issues relating to cover and vertical/horizontal separation requirements have been addressed as part of the audit process.

5. SUDs Maintenance

For the SUDS strategy to work as designed it is important that the entire drainage system is well maintained. It will be the responsibility of the site management team to ensure the drainage system is maintained. Maintenance and cleaning of gullies, drain manholes (including catch pits) and attenuation tanks will ensure adequate performance. The recommended program is outlined in the tables below.

Table 9: Stormtech (or similar approved) Attenuation Tank Maintenance Schedule

SUDS Element	Maintenance		
Attenuation Tanks	Maintenance Issues	Failure of components, blockage from debris	
	Maintenance Period	Maintenance Task	Frequency
	Regular	Inspect and identify any elements that are not operating correctly. If required, take remedial action.	Monthly for three months, then annually
		Remove sediment/debris from catchment surface that may lead to blockage of structures.	Monthly or as required
		Remove sediment/debris from catch pits/ gullies and control structures.	Annually, after severe storms or as required
	Remedial Work	Repair inlets, outlets, vents, overflows and control structures.	As required
	Monitoring	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are in good condition and operating as designed.	Annually or after severe storms
		Survey inside of tank for sediment build-up and remove if necessary	Every five years or as required

Table 10: Permeable Paving/Pavements Maintenance Schedule

SUDS Element	Maintenance		
Permeable Paving	Maintenance period	Maintenance Task	Frequency
	Regular	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or as required, based on site specific observations of clogging or manufacturer's recommendations.
	Occasional	Removal of weeds or management using glyophosphate applied directly into the weeds by an applicator rather than spraying	As required
	Remedial work	Remediation work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required
	Monitoring	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually

		Monitor inspection chambers	Annually

Table 11: Green Roof Maintenance Schedule

SUDS Element	Maintenance		
Green Roof	Maintenance Issues	Vegetation becoming either overgrown or dying	
	Maintenance Period	Maintenance Task	Frequency
	Regular	Inspect all components including soil substrate, vegetation, drains, membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect soil substrate for evidence of erosion channels and identify any sediment source	Annually and after severe storms
		Inspect drain inlets to ensure unrestricted run-off from the drainage layer to conveyance or roof drain system.	Annually and after severe storms
		Inspect underside of roof for evidence of leakage.	Annually and after severe storms
		Remove debris and litter to prevent clogging of inlet drains and interference with plant growth.	Six monthly and annually or as required
		During establishment (i.e. year one), replace dead plants as required.	Monthly
		Post-establishment, replace dead plants as required (where >5% of coverage)	Annually (in autumn)
		Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
		Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
		Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate.	Six monthly or as required
	Remedial Work	If erosion channels are evident, these should be established with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
		If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

6. Water Supply

6.1 Water Supply – Proposed

There is an existing 150mm diameter watermain installed along the entrance road to the development site. This main was installed as part of Phase 1 of the Knockrabo development and a spur left out to facilitate connection to the Phase 2 subject lands.

Waterman Moylan Drawing No. 20-086-P130 illustrates the proposed layout for the water main on the subject site.

6.2 Irish Water Pre-Connection Enquiry and Statement of Design Acceptance

A Pre-Connection Enquiry form was submitted to Irish Water in October 2020 (CDS21002520), which outlined the above water supply proposal. A response Confirmation of Feasibility (CoF) Letter was received from Irish Water dated 10 June 2021 confirming that subject to a valid connection agreement, the proposed connection to the water network is feasible without an upgrade. The CoF is appended as Annex G.

A detailed drawing submission was subsequently made to Irish Water for both foul and water supply design. In response, Irish Water have issued a Statement of Design Acceptance stating that there are no objections to the proposals. A copy of the letter has also been included in Appendix G.

6.3 Water Supply Calculations

The calculated water demand at the subject development is set out in the below table. The average domestic demand has been established based on an average occupancy ratio of 2.7 persons per dwelling with a daily domestic per capita consumption of 150 litres per head per day and with a 10% allowance factor. The average day/peak week demand has been taken as 1.25 times the average daily domestic demand, while the peak demand has been taken as 5 times the average day/peak week demand, as per Section 3.7.2 of the Irish Water Code of Practice for Water Infrastructure.

Description	Total Population	Water Demand	Average Demand	Average Peak Demand	Peak Demand
	No. People	*l/day*	*l/s*	*l/s*	*l/s*
227 Units	612.9	101,128.50	1.17	1.46	7.3

Table 12 | *Calculation of Water Demand for the Development*

The average demand for the development is 1.46 l/s, with a peak demand of 7.3 l/s.

6.4 Water Supply – General

All watermains will be laid strictly in accordance with Irish Water requirements for taking in charge.

Valves, hydrants, scour and sluice valves and water meters will be provided in accordance with the requirements of Irish Water and DLRCC Water Services Department.

6.5 Water Conservation

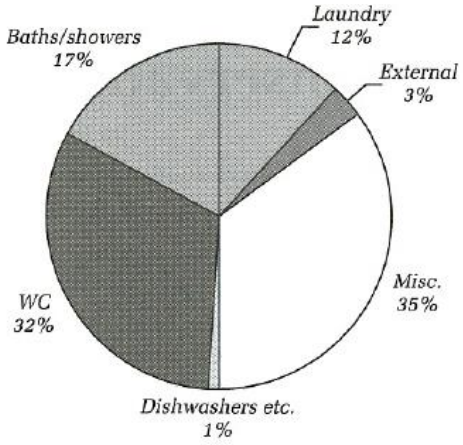
The water demand for the development can be subdivided as follows:

- Potable / Non-potable Breakdown

Detailed studies have quantified the breakdown between potable and non-potable uses for residential uses.

The following diagram illustrates the current percentage breakdown of water usage in domestic circumstances and is from Griggs and Shouler 1994 as published in Chapter 11 of 'Water, Sanitary & Waste Services for Buildings' by Wise and Sheffield.

Figure 2: *| Extract from Griggs and Shouler (1994)*



Water conservation measures will be used, to reduce overall water demand, including:

- Low volume flush / dual flush WC's
- Aerated shower heads
- Spray taps
- Draw off tap controls
- Rainwater reuse – water butts
- Leak detection measures – through the metering of supply

7. Roads

7.1 Introduction

A site-specific Transport and Traffic Assessment (TTA) has been carried out by Waterman Moylan. This is included under separate cover as part of this application.

In addition, a Travel Plan together with a Construction Management Plan, have been prepared and are provided under a separate cover. It is noted that the Construction Management Plan includes a section on the proposed development control measures recommended as part of the Dublin Eastern Bypass Corridor Protection Study.

The following section provides a summary on site access, the internal road layout, parking and the findings and proposed resolutions to the Stage 1 Quality Audit.

7.2 Site Access

The site will be accessed via extension of the existing Knockrabo Way (extension permitted under extant permission reference D17A/1124), off Mt Anville Road, which currently provides vehicular and pedestrian access via a 7m wide access road and adjacent 2m wide footpath. The site access from Mount Anville Road is located in a 50 km/h zone. A 2.4m x 49m sightline, which is in compliance with the requirements of the Department of Transport 'Design Manual for Urban Roads and Streets' recommendation for a road of design speed of 50 km/h, is currently provided at the access road junction onto Mount Anville Road. No development works will infringe upon this existing sightline provision.

7.3 Internal Road Layout, Hierarchy and Pedestrian Facilities

The proposed internal road layout connects to the Knockrabo Way entrance road, discussed in above section 7.2. The internal road layout provides access to podium level parking, where the majority of residential parking if afforded. Given that residents will predominantly be parking at podium level, the surface road network is only proposed to be lightly trafficked. An element of off-street parking spaces and drop off areas are supplied for residents, visitors, and delivery drivers. The road network is proposed and designed to be a low-speed environment, a "slow zone" environment with a maximum speed limit of 30kph.

Refuse and high reach fire tender vehicular movements have been tracked and a demonstration of the largest regular vehicle (refuse vehicle) movements at turning points is supplied in Appendix F. Safe vehicle movement is achievable in each instance. For fire tender access and movements, vehicle tracking has similarly been undertaken and movements are also accommodated. It is noted that the high reach fire tender tracking does allow for some minor encroachment above proposed kerblines, however these vehicle movements have been considered and co-ordinated with the landscape architect and architecture teams to ensure that any encroached corners are kept free of hard landscaping or infrastructure to permit all necessary movements.

The subject site will be serviced by an internal road network with dimensions ranging from 5.0m – 6.6m in width, with minimum 2.0m wide pedestrian areas afforded adjacent, as demonstrated on the cross-sectional drawings supplied on drawing 20-086-P116. A road width of 5.5m is afforded along the main thoroughfare at the northern end of the site, which connects to the 7.0m previously permitted Knockrabo Way entrance road. This 5.5m wide road connects to a predominantly narrower 5.0m wide shared surface zone.

Wheel Stops shall be provided to parking bays fronting pedestrian walkways, in the form of an integrated half batter kerb on edge, 600mm offset from the end of the parking bay, as demonstrated in details drawing 20-086-P116.

Dedicated Creche Staff parking is afforded off the shared surface road network, as identified on road hierarchy drawing 20-086-P105 and vehicle parking movements in this location have been demonstrated in Appendix F and as further discussed in Section 7.6 below.

The road hierarchy has been designed to ensure the entering traffic remains on the wider thoroughfare entrance road, to the point at which these vehicles can enter “at grade” to the podium level parking at the lower southern side of the site. In doing so, the traffic to the Phase 2 development remains on the primary route until the logical “at grade” point of exit to the respective apartment block podium parking levels. Beyond the “at grade” entrances, where the layout has ensured that traffic is light, the surfacing and design becomes shared surface.

To ensure drivers are aware that they are entering a shared surface area, the materials and finishes used will indicate that the carriageway is an extension of the pedestrian domain.

The natural topography of the site is very steep at circa 1 in 12 and as such, the road vertical alignments are dictated by this constraint. The maximum road grade (north to south) is 1 in 12.5. East-west routes are at much flatter grades, as indicated on road layout drawing 20-086-P110

7.4 Car Parking including Electrically Operated Vehicles

Parking, including loading bays, disabled spaces and set-down drop/off will be provided in podium level car parks along with on street spaces. A breakdown of the parking provision and the justification for the quantum has been supplied under Section 13.0 of the accompanying Traffic and Transport Report. Electric Vehicle Parking has been afforded to make adequate provision of a minimum of 10% of parking spaces equipped with EV charging points, as demonstrated in the accompanying M&E layout drawing supplied under separate cover, with additional infrastructure proposed for the future upgrade to electric charging in the form of electric cable tray running along the structure from the Landlord distribution board to allow wall-mounting or ceiling mounting for both cars and bikes. All proposed parking is detailed on the architectural layout drawing 1307F-OMP-00-00-DR-A-1000 supplied under separate cover.

7.5 Cycle & Motorcycle Parking

Secure bicycle parking will be provided within the development, and the provision for this development has been supplied under Section 14.0 of the accompanying Traffic and Transport Report.

The proposed development affords high quality cycle and motorcycle parking, with provision for a variety of bicycle types, as identified in the Architectural Schedule of Accommodation and as detailed on the architectural layout drawing 1307F-OMP-00-00-DR-A-1000 supplied under separate cover.

For specific location of spaces for disabled parking, motorcycle parking and electrically operated vehicles parking, please refer to architectural drawings accompanying the submission package, supplied under separate cover.

7.6 Road Safety Audit

A Stage 1 Quality Audit (QA) has been performed by Bruton Consulting Engineers on the proposed design layout. The Quality Audit includes a road safety audit (in accordance with TII Publication GE-DTY-01024), an access audit, a walking audit, a cycle audit, and a non-motorised use audit. The completed QA is supplied as Appendix E of this report.

The QA identified four problems and supplies recommended measures. These, together with the agreed designer responses have been accounted for in the design submission:

Problem 1 – Parking provision along steep central road will provide accessibility issues for the mobility impaired.

Recommended Measure 1 – Parking to be supplied away from steeper roads or landing bays to be provided.

Design Team Response 1 - It is proposed to retain parking along this central road. Disabled spaces are not proposed on this steep section of road. Disabled space parking and parking for mobility impaired shall be afforded at podium level and along flatter gradient east/west road to allow for safe access for all. The potential for landing bays shall be reviewed on steeper sections of road through detail design stage.

Problem 2 – Central Road steep gradient will provide difficulty for vehicles to get traction during periods of snow/ice.

Recommended Measure 2 – High PSV aggregate to be used in surface course and salt containers to be supplied in appropriate locations.

Design Team Response – Accepted, high friction surface to be installed.

Problem 3 – No clear path for cyclists or pedestrians from main access way to the visitor cycle spaces at the southwestern side of the site or the block access on the southern side of the development.

Recommended Measure 3 – Path to be supplied to avoid sudden changes in direction and conflict with vehicular parking.

Design Team Response - A path network exists for pedestrians/cyclists through the public open space indicated. This network has been identified on the road hierarchy layout drawing 20-086-P105 and the accompanying landscape and architectural drawings supplied under separate cover.

Problem 4 – There may be difficulty for drivers to use the most easterly parking bay for childcare on the internal road due to the approach angle of vehicles.

Recommended Measure 4 – Swept Path Analysis to be undertaken.

Design Team Response - Swept path undertaken to demonstrate function. Swept path movements are supplied in Appendix F

7.7 DMURS

7.7.1 Background

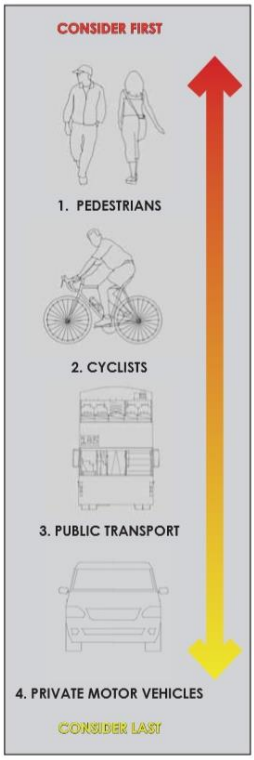
The stated objective of DMURS is to achieve better street design in urban areas. This will encourage more people to choose to walk, cycle or use public transport by making the experience safer and more pleasant. It will lower traffic speeds, reduce unnecessary car use, and create a built environment that promotes healthy lifestyles and responds more sympathetically to the distinctive nature of individual communities and places. The implementation of DMURS is intended to enhance how we go about our business, how we interact with each other, and have a positive impact on our enjoyment of the places to and through which we travel.

7.7.2 DMURS: Statement of Design Consistency

Waterman Moylan Consulting Engineers considers that the proposed road and street design is consistent with the principles and guidance outlined in the Design Manual for Urban Roads and Streets (DMURS). Outlined below are some of the specific design features that have been incorporated within the proposed scheme with the objective of delivering a design that is in compliance with DMURS.

7.7.3 Creating a Sense of Place

Four characteristics represent the basic measures that should be established in order to create people friendly streets that facilitate more sustainable neighbourhoods. These characteristics are connectivity, enclosure, active edges, and pedestrian activities/facilities.



Connectivity:

"The creation of vibrant and active places requires pedestrian activity. This in turn requires walkable street networks that can be easily navigated and are well connected."

In order of importance, DMURS prioritises pedestrians, cyclists, public transport and private cars. This is illustrated in the adjacent image extracted from DMURS.

The proposed development has been designed with pedestrians and cyclists taking precedence over other modes of transport. In this regard, footpaths are provided throughout the development with suitable connections through the open spaces and pedestrian crossings along anticipated desire lines. Footpaths within the development will generally by 2m wide, which is wide enough to allow 2 wheelchairs to pass each other without inconvenience.

Pedestrian crossings have been designed to allow pedestrians to cross the street at grade. Shared surface areas proposed, which provide a safe space for residents, pedestrians, and cyclists with the dominance of cars reduced. These can be viewed on the Road Hierarchy drawing, 20-086-P105 and the accompanying Landscape Architecture drawings submitted under separate cover. This drawing indicates the proposed shared surface areas and identifies the location of pedestrian crossings. The crossings will utilise tactile paving and drop kerbing to facilitate safe crossings at grade and have also been located on elevated road surfaces where possible, such as raised tables. These elevated

road surfaces can only be accessed by car via a ramp, which is one of many safety measures implemented throughout the development, and in line with the recommendations of DMURS, to reduce the speed of vehicles. The shared road surfaces will be of a different colour, and potentially texture, the exact composition of which is to be agreed with DLRCC, to further make motorists aware of the change of user priority, this being a change from a vehicle priority road to a pedestrian priority surface. A visual example of the above design strategy as implemented has been extracted from the Proposed Road Hierarchy drawing and is shown in *Figure 5* below. This extract shows the road surface, with a different surface composition to that of the entrance road which will be a clear transition into a low traffic environment.

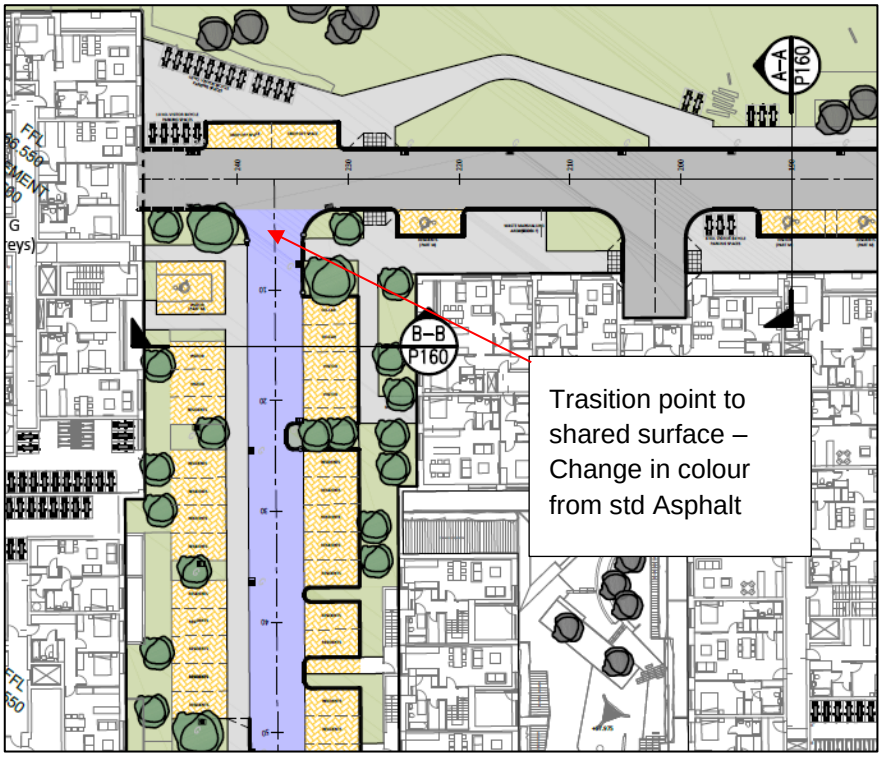


Figure 4 | *Extract from Drawing number: 21-011-P116 Road Construction Details – Shared Surfacing*

DMURS notes that cul-de-sacs should not dominate residential layouts, and their use should be limited. In particular, the number of walkable/cyclable routes between destinations should be maximised. Section 3.3.2 of DMURS notes that cul-de-sacs may be used to serve a small number of dwellings, to enable more compact/efficient forms of development. The proposed development does include a cul-de-sac road however, the proposed cul-de-sac layout has been designed to prioritise a pedestrian focused environment in an area of very light traffic, beyond the access points to the underground car parks and off of the main Knockrabo Way entrance road. The cul de sac road facilitates pedestrian and cyclist movement. In this regard, we also refer you to the Architecture layout drawings and design statements supplied under separate cover, that identify proposed pedestrian and cycle routes proposed through the open spaces. The proposed cul-de-sac is safe, with clear, open sightlines and passive surveillance.

Enclosure:

"A sense of enclosure spatially defines streets and creates a more intimate and supervised environment. A sense of enclosure is achieved by orientating buildings towards the street and placing them along its edge. The use of street trees can also enhance the feeling of enclosure."

The proposed development has been designed with residential units overlooking streets and pedestrian routes throughout. High quality landscaping and tree planting are proposed throughout the scheme which creates a definitive sense of place. Road widths are generally 5.0m-6.6m throughout the development and ensure that a strong sense of enclosure is achieved on residential roads.

Active Edge:

"An active frontage enlivens the edge of the street creating a more interesting and engaging environment. An active frontage is achieved with frequent entrances and openings that ensure the street is overlooked and generate pedestrian activity as people come and go from buildings."

As stated in Section 2.2.1 of DMURS, an active frontage enlivens the edge of the street, creating a more interesting and engaging environment. An active frontage is achieved with frequent entrances and openings. Section 3.4.1 of DMURS further notes that designers should avoid the creation of Dendritic networks, which place heavy restrictions on movement.

There are a number of advantages to more permeable networks in regard to the management of traffic and vehicle speeds. Drivers are more likely to maintain lower speeds over shorter distances than over longer ones. Since drivers are able to access the underground car parks more directly from the main Access Knockrabo Way (where speeds are more moderate), they are more likely to comply with lower speed limits on the shared Local streets, as stated in Section 3.4.1 of DMURS.

Section 4.4.7 of DMURS recommends the use of horizontal and vertical deflections on straights where there is more than 70m between junctions. The internal road network of the proposed development has been designed by the Civil Engineers in conjunction with the Architects so as to ensure that this distance of 70m has generally not been exceeded through the development, and that in cases where a reduction in straight length was not possible, that appropriate traffic calming measures such as raised tables (vertical deflections) or build-outs (horizontal deflections – Refer Figure 6 below) have been incorporated to the design.

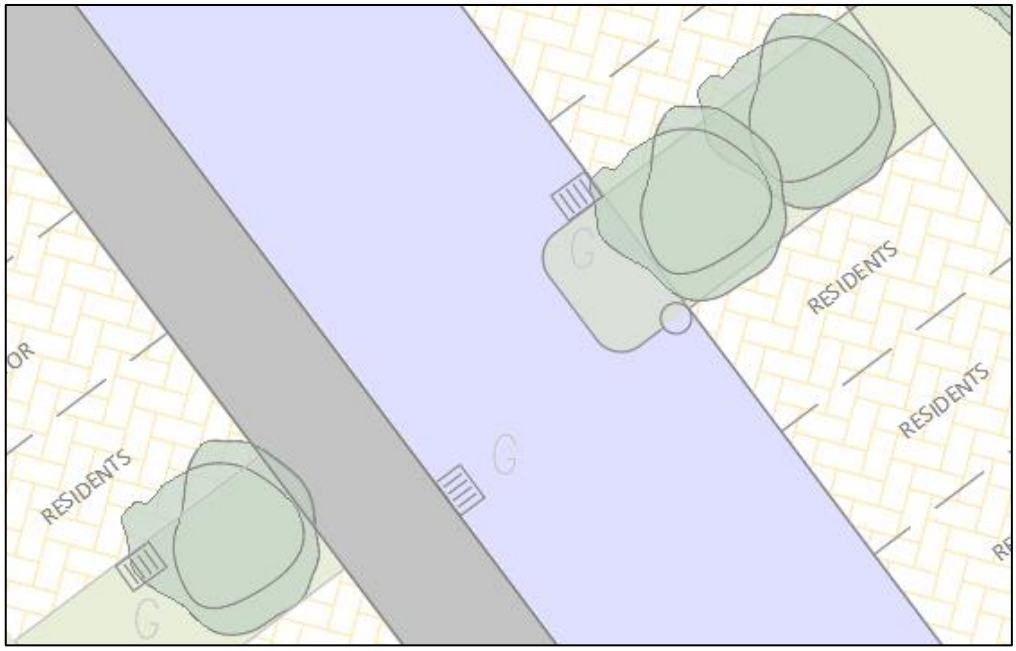


Figure 5 | *Extract from Drawing number: 21-011-P105 Road Hierarchy – Kerb Build Out*

On-street parking separates pedestrians from the vehicle carriageway and, as per DMURS Section 4.4.9, can calm traffic by increasing driver caution, contribute to pedestrian comfort by providing a buffer between the vehicular carriageway and footpath and provide good levels of passive security. On-street parking has been designed at selected locations throughout to implement the DMURS recommendation.

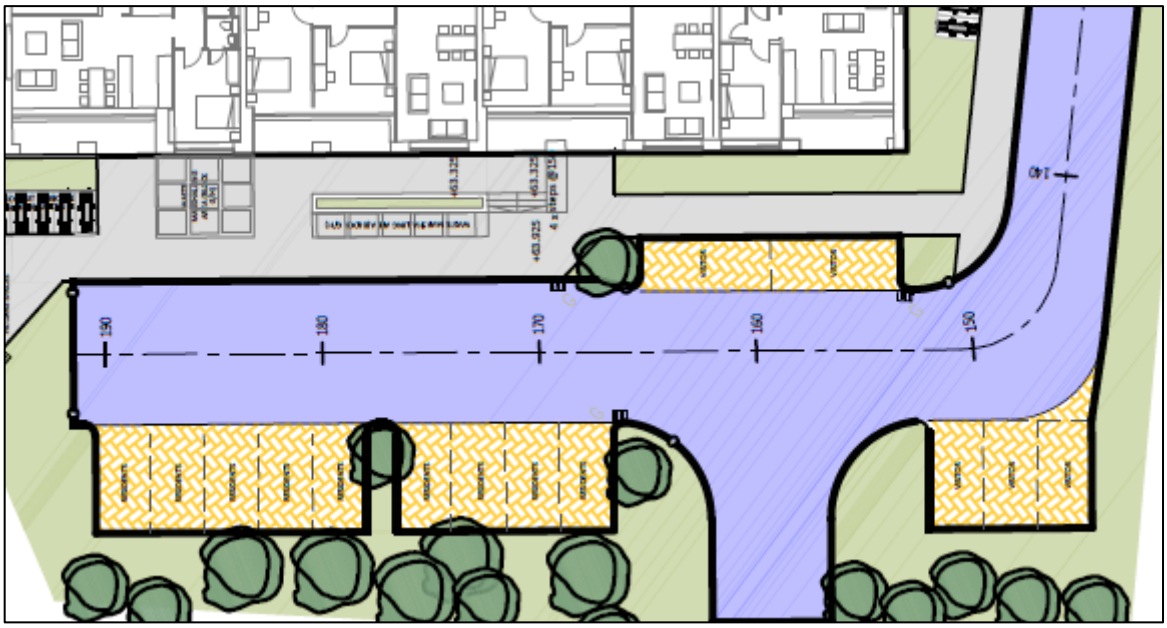


Figure 6 | *Extract from Drawing number: 21-011-P116 Road Construction Details– On street parking*

Suitable sightlines have been provided throughout the development, ensuring that localised planting does not obscure visibility as cars make turning manoeuvres, improving the pedestrian safety at crossing points. Turning radii have been minimised within reason to induce lower vehicle speeds, with cognisance to the necessary movements required by Fire Tender and refuse vehicles.

Pedestrian Activities/Facilities:

"The sense of intimacy, interest and overlooking that is created by a street that is enclosed and lined with active frontages enhances a pedestrian's feeling of security and well-being. Good pedestrian facilities (such as wide footpaths and well-designed crossings) also make walking a more convenient and pleasurable experience that will further encourage pedestrian activity."

As outlined in the items above, the proposed development has been designed to provide excellent pedestrian connectivity, with footpaths providing permeability throughout the site.

Throughout the site, pedestrian routes are generally 2m wide or greater which, as mentioned previously, provides adequate space for two wheelchairs to pass one another. DMURS identifies a 1.8m wide footpath as being suitable for areas of low pedestrian activity and a 2.5m footpath as being suitable for low to moderate pedestrian activity. An array of formal and informal routes through the open spaces have been supplied as identified on the Landscape Architect layouts and co-ordinated on the engineering layout drawings, provide links to the development, accounting for anticipated desire lines.

7.7.4 Key Design Principles

DMURS sets out four core design principles which designers must have regard to when designing roads and streets. These four core principles are set out below together with a commentary establishing how these design principles have been incorporated into the design of the proposed development.

Design Principle 1: Pedestrian Activity/Facilities:

"To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users and in particular more sustainable forms of transport."

Streets have been designed in accordance with the alignment and curvature recommendations set out in DMURS Section 4.4.6. The road layout is generally orthogonal, with suitable pedestrian desire line connections adjacent and through the open spaces, refer drawing 20-086-P105 in this regard. Section 3.3.1 of DMURS notes that street networks that are generally orthogonal in nature are the most effective in terms of permeability (and legibility). Road crossing provision for pedestrians will encourage reduced driving speeds, and wide footpaths will encourage safe and integrated pedestrian facility. We refer you to road construction details drawing 20-086-P116 which provides dimension for the footways adjacent the road network.

Design Principle 2: Multi-Functional Streets:

"The promotion of multi-functional, place-based streets that balance the needs of all users within a self-regulating environment."

The proposed shared surface zones are streets designed primarily to meet the needs of pedestrians, cyclists, children and residents, where the speeds and dominance of cars is reduced. They are shared surface streets, comprising of a shared-surface carriageway allowing for pedestrian focused areas. These zones help to create and to inform a clear hierarchy within the public realm.

It is proposed to utilise a buff-coloured chipping / macadam or similar approved surfacing in the shared surface zone, subject to Dun Laoghaire Rathdown County Council Roads and Transportation approval. Use of a shared-surface buff coloured chipping/macadam indicates to both drivers and pedestrians/cyclists that the road is a shared space. As stated in Section 4.4.2 of DMURS, paving materials can encourage a low vehicle speed shared environment.

It is stated in Section 4.3.4 of DMURS that shared surface streets and junctions are highly desirable where movement priorities are low and there is a high place value in promoting more liveable streets (i.e. home-zones), such as on Local streets within Neighbourhood and Suburbs.

Design Principle 3: Pedestrian Focus:

"The quality of the street is measured by the quality of the pedestrian environment."

The design of the scheme has placed a particular focus on the pedestrian. Connectivity throughout the scheme is weighted towards the pedestrian. There are pedestrian links to the Mount Anville Road fronting the site, adjacent to the proposed streets and various formal and informal routes through the high quality public open spaces, all demonstrated on the accompanying road hierarchy drawing 20-086-P105.

Design Principle 4: Multi-Disciplinary Approach:

"Greater communication and co-operation between design professionals through promotion plan led multidisciplinary approach to design."

The design of the proposed scheme has been developed through the design team working closely together. The proposed development design is led by OMP Architects working together with Waterman Moylan Consulting Engineers, Tom Phillips & Associates Planning Consultants and Dermot Foley Landscape Architects.

Public areas fronting and within the proposed development have been designed by a multidisciplinary design team to accommodate pedestrians and cyclists in accordance with the appropriate principles and guidelines set out in DMURS. In particular, the vehicular access and public footways within the remit of the development will incorporate the relevant DMURS requirements and guidelines as set out above.

APPENDICES

A. Stormwater Causeway Flow Design Calculations, Adjacent Phase 1 Drainage Network Layout and JBA (Stage 1) Stormwater Audit

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	20	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	18.200	Minimum Backdrop Height (m)	0.200
Ratio-R	0.277	Preferred Cover Depth (m)	1.200
CV	0.800	Include Intermediate Ground	✓
Time of Entry (mins)	3.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.072	3.00	65.915	1200	718298.952	728541.586	1.515
2	0.036	3.00	65.050	1200	718263.333	728521.114	1.975
3	0.187	3.00	62.760	1350	718235.209	728557.658	2.210
4			62.260	1200	718253.077	728579.222	1.920
5	0.113	3.00	62.025	1350	718250.172	728585.270	1.739
6			61.795	1350	718255.651	728594.598	1.583
7			61.500	1350	718266.599	728611.519	1.435
8	0.014	3.00	66.830	1200	718330.308	728559.083	1.430
9	0.132	3.00	66.570	1200	718338.386	728569.448	1.820
10	0.134	3.00	64.092	1200	718316.233	728599.429	2.027
11	0.058	3.00	71.581	1200	718424.209	728576.089	1.781
12			69.380	1200	718406.010	728600.789	1.380
13	0.009	3.00	68.520	1200	718394.001	728615.854	2.720
14	0.059	3.00	65.036	1200	718359.138	728658.012	2.236
15	0.176	3.00	63.715	1200	718329.374	728637.686	1.405
16	0.224	3.00	62.815	1350	718302.109	728617.800	2.280
17			61.200	1350	718287.237	728638.693	1.775
18			61.200	1350	718298.693	728653.776	1.915
19	0.041	3.00	61.300	1350	718318.889	728664.334	2.120
20			61.300	1350	718328.099	728652.773	3.360
20_OUT			60.000		718335.453	728658.142	2.505
outfall			60.000	1200	718331.729	728669.449	2.565

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	41.083	0.600	64.400	63.226	1.174	35.0	225	3.31	50.0
1.001	2	3	46.114	0.600	63.075	61.155	1.920	24.0	375	3.52	50.0
1.002	3	4	28.004	0.600	60.550	60.415	0.135	207.4	375	3.89	50.0
1.003	4	5	6.710	0.600	60.340	60.306	0.034	197.4	450	3.97	50.0
1.004	5	6	10.818	0.600	60.286	60.232	0.054	200.3	450	4.09	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	2.218	88.2	12.5	1.290	1.599	0.072	0.0
1.001	3.710	409.7	18.7	1.600	1.230	0.108	0.0
1.002	1.254	138.5	51.2	1.835	1.470	0.295	0.0
1.003	1.443	229.5	51.2	1.470	1.269	0.295	0.0
1.004	1.432	227.8	70.8	1.289	1.113	0.408	0.0

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.005	6	7	20.154	0.600	60.212	60.140	0.072	279.9	450	4.37	50.0
1.006	7	17	34.123	0.600	60.065	59.831	0.234	145.8	450	4.71	50.0
2.000	8	9	13.142	0.600	65.400	65.169	0.231	56.9	225	3.13	50.0
2.001	9	10	37.278	0.600	64.750	62.665	2.085	17.9	225	3.33	50.0
2.002	10	16	23.173	0.600	62.065	61.135	0.930	24.9	225	3.47	50.0
3.000	11	12	30.680	0.600	69.800	68.898	0.902	34.0	225	3.23	50.0
3.001	12	13	19.266	0.600	68.000	67.037	0.963	20.0	225	3.34	50.0
3.002	13	14	54.706	0.600	65.800	63.065	2.735	20.0	225	3.65	50.0
3.003	14	15	36.043	0.600	62.800	62.440	0.360	100.1	225	4.11	50.0
3.004	15	16	33.746	0.600	62.310	61.135	1.175	28.7	300	4.30	50.0
2.003	16	17	25.645	0.600	60.535	59.775	0.760	33.7	375	4.43	50.0
1.007	17	18	18.940	0.600	59.425	59.305	0.120	157.8	525	4.88	50.0
1.008	18	19	22.789	0.600	59.285	59.200	0.085	268.1	525	5.16	50.0
1.009	19	20	14.781	0.600	59.180	59.105	0.075	197.1	525	5.32	50.0
1.010	20	20_OUT	3.121	0.600	57.940	57.680	0.260	12.0	525	5.33	50.0
1.010_1	20_OUT	outfall	11.904	0.600	57.495	57.435	0.060	198.4	225	5.54	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.005	1.210	192.4	70.8	1.133	0.910	0.408	0.0
1.006	1.681	267.4	70.8	0.985	0.919	0.408	0.0
2.000	1.737	69.1	2.4	1.205	1.176	0.014	0.0
2.001	3.109	123.6	25.3	1.595	1.202	0.146	0.0
2.002	2.631	104.6	48.6	1.802	1.455	0.280	0.0
3.000	2.250	89.5	10.1	1.556	0.257	0.058	0.0
3.001	2.938	116.8	10.1	1.155	1.258	0.058	0.0
3.002	2.939	116.8	11.6	2.495	1.746	0.067	0.0
3.003	1.306	51.9	21.9	2.011	1.050	0.126	0.0
3.004	2.944	208.1	52.4	1.105	1.380	0.302	0.0
2.003	3.128	345.5	139.8	1.905	1.050	0.806	0.0
1.007	1.780	385.3	210.6	1.250	1.370	1.214	0.0
1.008	1.363	295.0	210.6	1.390	1.575	1.214	0.0
1.009	1.592	344.6	217.7	1.595	1.670	1.255	0.0
1.010	6.489	1404.7	217.7	2.835	1.795	1.255	0.0
1.010_1	0.924	36.8	217.7	2.280	2.340	1.255	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	41.083	35.0	225	1 STANDARD	65.915	64.400	1.290	65.050	63.226	1.599
1.001	46.114	24.0	375	1 STANDARD	65.050	63.075	1.600	62.760	61.155	1.230
1.002	28.004	207.4	375	1 STANDARD	62.760	60.550	1.835	62.260	60.415	1.470
1.003	6.710	197.4	450	1 STANDARD	62.260	60.340	1.470	62.025	60.306	1.269

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	1 STANDARD	2	1200	Manhole	1 STANDARD
1.001	2	1200	Manhole	1 STANDARD	3	1350	Manhole	1 STANDARD
1.002	3	1350	Manhole	1 STANDARD	4	1200	Manhole	1 STANDARD
1.003	4	1200	Manhole	1 STANDARD	5	1350	Manhole	1 STANDARD

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Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	10.818	200.3	450	1 STANDARD	62.025	60.286	1.289	61.795	60.232	1.113
1.005	20.154	279.9	450	1 STANDARD	61.795	60.212	1.133	61.500	60.140	0.910
1.006	34.123	145.8	450	1 STANDARD	61.500	60.065	0.985	61.200	59.831	0.919
2.000	13.142	56.9	225	1 STANDARD	66.830	65.400	1.205	66.570	65.169	1.176
2.001	37.278	17.9	225	1 STANDARD	66.570	64.750	1.595	64.092	62.665	1.202
2.002	23.173	24.9	225	1 STANDARD	64.092	62.065	1.802	62.815	61.135	1.455
3.000	30.680	34.0	225	1 STANDARD	71.581	69.800	1.556	69.380	68.898	0.257
3.001	19.266	20.0	225	1 STANDARD	69.380	68.000	1.155	68.520	67.037	1.258
3.002	54.706	20.0	225	1 STANDARD	68.520	65.800	2.495	65.036	63.065	1.746
3.003	36.043	100.1	225	1 STANDARD	65.036	62.800	2.011	63.715	62.440	1.050
3.004	33.746	28.7	300	1 STANDARD	63.715	62.310	1.105	62.815	61.135	1.380
2.003	25.645	33.7	375	1 STANDARD	62.815	60.535	1.905	61.200	59.775	1.050
1.007	18.940	157.8	525	1 STANDARD	61.200	59.425	1.250	61.200	59.305	1.370
1.008	22.789	268.1	525	1 STANDARD	61.200	59.285	1.390	61.300	59.200	1.575
1.009	14.781	197.1	525	1 STANDARD	61.300	59.180	1.595	61.300	59.105	1.670
1.010	3.121	12.0	525	1 STANDARD	61.300	57.940	2.835	60.000	57.680	1.795
1.010_1	11.904	198.4	225	1 STANDARD	60.000	57.495	2.280	60.000	57.435	2.340

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	5	1350	Manhole	1 STANDARD	6	1350	Manhole	1 STANDARD
1.005	6	1350	Manhole	1 STANDARD	7	1350	Manhole	1 STANDARD
1.006	7	1350	Manhole	1 STANDARD	17	1350	Manhole	1 STANDARD
2.000	8	1200	Manhole	1 STANDARD	9	1200	Manhole	1 STANDARD
2.001	9	1200	Manhole	1 STANDARD	10	1200	Manhole	1 STANDARD
2.002	10	1200	Manhole	1 STANDARD	16	1350	Manhole	1 STANDARD
3.000	11	1200	Manhole	1 STANDARD	12	1200	Manhole	1 STANDARD
3.001	12	1200	Manhole	1 STANDARD	13	1200	Manhole	1 STANDARD
3.002	13	1200	Manhole	1 STANDARD	14	1200	Manhole	1 STANDARD
3.003	14	1200	Manhole	1 STANDARD	15	1200	Manhole	1 STANDARD
3.004	15	1200	Manhole	1 STANDARD	16	1350	Manhole	1 STANDARD
2.003	16	1350	Manhole	1 STANDARD	17	1350	Manhole	1 STANDARD
1.007	17	1350	Manhole	1 STANDARD	18	1350	Manhole	1 STANDARD
1.008	18	1350	Manhole	1 STANDARD	19	1350	Manhole	1 STANDARD
1.009	19	1350	Manhole	1 STANDARD	20	1350	Manhole	1 STANDARD
1.010	20	1350	Manhole	1 STANDARD	20_OUT		Manhole	1 STANDARD
1.010_1	20_OUT		Manhole	1 STANDARD	outfall	1200	Manhole	1 STANDARD

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	718298.952	728541.586	65.915	1.515	1200				
						0	1.000	64.400	225
2	718263.333	728521.114	65.050	1.975	1200		1	1.000	63.226	225
						0	1.001	63.075	375

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
3	718235.209	728557.658	62.760	2.210	1350	1	1.001	61.155	375
						0	1.002	60.550	375
4	718253.077	728579.222	62.260	1.920	1200	1	1.002	60.415	375
						0	1.003	60.340	450
5	718250.172	728585.270	62.025	1.739	1350	1	1.003	60.306	450
						0	1.004	60.286	450
6	718255.651	728594.598	61.795	1.583	1350	1	1.004	60.232	450
						0	1.005	60.212	450
7	718266.599	728611.519	61.500	1.435	1350	1	1.005	60.140	450
						0	1.006	60.065	450
8	718330.308	728559.083	66.830	1.430	1200	0	2.000	65.400	225
9	718338.386	728569.448	66.570	1.820	1200	1	2.000	65.169	225
						0	2.001	64.750	225
10	718316.233	728599.429	64.092	2.027	1200	1	2.001	62.665	225
						0	2.002	62.065	225
11	718424.209	728576.089	71.581	1.781	1200	0	3.000	69.800	225
12	718406.010	728600.789	69.380	1.380	1200	1	3.000	68.898	225
						0	3.001	68.000	225
13	718394.001	728615.854	68.520	2.720	1200	1	3.001	67.037	225
						0	3.002	65.800	225
14	718359.138	728658.012	65.036	2.236	1200	1	3.002	63.065	225
						0	3.003	62.800	225
15	718329.374	728637.686	63.715	1.405	1200	1	3.003	62.440	225
						0	3.004	62.310	300

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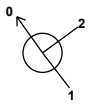
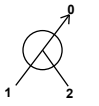
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
16	718302.109	728617.800	62.815	2.280	1350		1	2.002	61.135	225
							2	3.004	61.135	300
							0	2.003	60.535	375
17	718287.237	728638.693	61.200	1.775	1350		1	1.006	59.831	450
							2	2.003	59.775	375
							0	1.007	59.425	525
18	718298.693	728653.776	61.200	1.915	1350		1	1.007	59.305	525
							0	1.008	59.285	525
19	718318.889	728664.334	61.300	2.120	1350		1	1.008	59.200	525
							0	1.009	59.180	525
20	718328.099	728652.773	61.300	3.360	1350		1	1.009	59.105	525
							0	1.010	57.940	525
20_OUT	718335.453	728658.142	60.000	2.505			1	1.010	57.680	525
							0	1.010_1	57.495	225
outfall	718331.729	728669.449	60.000	2.565	1200		1	1.010_1	57.435	225

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	18.200	Check Discharge Rate(s)	✓
Ratio-R	0.277	1 year (l/s)	5.4
Summer CV	0.800	30 year (l/s)	10.7
Winter CV	0.840	100 year (l/s)	12.7
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year 360 minute (m³)	379

Storm Durations

15	30	60	120	180	240	360	480	600	720

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

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Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.65
Greenfield Method	IH124	Growth Factor 100 year	1.96
Positively Drained Area (ha)	1.197	Betterment (%)	0
SAAR (mm)	774	QBar	6.5
Soil Index	4	Q 1 year (l/s)	5.4
SPR	0.47	Q 30 year (l/s)	10.7
Region	11	Q 100 year (l/s)	12.7
Growth Factor 1 year	0.83		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	1.197	Storm Duration (mins)	360
Soil Index	4	Betterment (%)	0
SPR	0.47	PR	0.507
CWI	123.704	Runoff Volume (m^3)	379

Node outfall Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	57.435	Product Number	CTL-SHE-0091-5900-3000-5900
Design Depth (m)	3.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.9	Min Node Diameter (mm)	1200

Node 20_OUT Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	57.575
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	700.0	0.0	1.004	700.0	0.0	1.005	0.0	0.0

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Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 89.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	64.461	0.061	14.4	0.1262	0.0000	OK
15 minute summer	2	10	63.132	0.057	20.7	0.0846	0.0000	OK
15 minute summer	3	9	60.721	0.171	56.7	0.5337	0.0000	OK
15 minute summer	4	10	60.524	0.184	54.8	0.2083	0.0000	OK
15 minute summer	5	10	60.488	0.202	74.6	0.5515	0.0000	OK
15 minute summer	6	10	60.422	0.210	75.6	0.3008	0.0000	OK
15 minute summer	7	10	60.237	0.172	76.4	0.2457	0.0000	OK
15 minute summer	8	9	65.431	0.031	2.8	0.0410	0.0000	OK
15 minute summer	9	9	64.825	0.075	29.0	0.1924	0.0000	OK
15 minute summer	10	9	62.186	0.121	54.6	0.2976	0.0000	OK
15 minute summer	11	9	69.855	0.055	11.6	0.0972	0.0000	OK
15 minute summer	12	9	68.047	0.047	11.1	0.0535	0.0000	OK
15 minute summer	13	10	65.850	0.050	12.5	0.0600	0.0000	OK
15 minute summer	14	10	62.908	0.108	23.2	0.1793	0.0000	OK
15 minute summer	15	10	62.418	0.108	55.6	0.3927	0.0000	OK
15 minute summer	16	9	60.722	0.187	150.5	0.6335	0.0000	OK
15 minute summer	17	10	59.769	0.344	221.1	0.4928	0.0000	OK
15 minute summer	18	10	59.654	0.369	221.5	0.5279	0.0000	OK
15 minute summer	19	10	59.525	0.345	227.3	0.6273	0.0000	OK
15 minute summer	20	10	58.151	0.211	222.5	0.3026	0.0000	OK
720 minute winter	20_OUT	660	57.935	0.440	23.7	252.0538	0.0000	SURCHARGED
720 minute winter	outfall	660	57.934	0.499	4.1	0.5639	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	13.5	1.596	0.153	0.3481	
15 minute summer	2	1.001	3	20.0	1.942	0.049	0.4753	
15 minute summer	3	1.002	4	54.8	1.169	0.396	1.3130	
15 minute summer	4	1.003	5	55.2	0.913	0.241	0.4062	
15 minute summer	5	1.004	6	75.6	1.158	0.332	0.7173	
15 minute summer	6	1.005	7	76.4	1.119	0.397	1.3773	
15 minute summer	7	1.006	17	74.6	1.428	0.279	1.8063	
15 minute summer	8	2.000	9	2.7	0.831	0.039	0.0422	
15 minute summer	9	2.001	10	27.9	2.485	0.226	0.4191	
15 minute summer	10	2.002	16	53.1	2.547	0.508	0.4836	
15 minute summer	11	3.000	12	11.1	1.519	0.123	0.2233	
15 minute summer	12	3.001	13	10.7	1.818	0.092	0.1143	
15 minute summer	13	3.002	14	12.6	1.925	0.108	0.3572	
15 minute summer	14	3.003	15	23.1	1.256	0.445	0.6639	
15 minute summer	15	3.004	16	54.4	2.450	0.261	0.7499	
15 minute summer	16	2.003	17	146.4	2.886	0.424	1.3133	
15 minute summer	17	1.007	18	221.5	1.465	0.575	2.8644	
15 minute summer	18	1.008	19	220.3	1.455	0.747	3.4472	
15 minute summer	19	1.009	20	222.5	1.618	0.646	2.0498	
15 minute summer	20	1.010	20_OUT	221.4	3.525	0.158	0.1977	
720 minute winter	20_OUT	1.010_1	outfall	4.1	0.277	0.111	0.4734	
720 minute winter	outfall	Hydro-Brake®		4.0				214.7

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Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 89.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	64.494	0.094	31.9	0.1954	0.0000	OK
15 minute summer	2	9	63.160	0.085	46.4	0.1272	0.0000	OK
15 minute summer	3	9	60.846	0.296	127.4	0.9233	0.0000	OK
15 minute summer	4	10	60.674	0.334	119.9	0.3773	0.0000	OK
15 minute summer	5	10	60.639	0.353	167.0	0.9640	0.0000	OK
15 minute summer	6	10	60.567	0.355	166.6	0.5076	0.0000	OK
15 minute summer	7	10	60.526	0.461	158.9	0.6598	0.0000	SURCHARGED
15 minute summer	8	9	65.446	0.046	6.2	0.0615	0.0000	OK
15 minute summer	9	9	64.868	0.118	64.5	0.3054	0.0000	OK
15 minute summer	10	10	62.640	0.575	122.1	1.4116	0.0000	SURCHARGED
15 minute summer	11	9	69.884	0.084	25.7	0.1491	0.0000	OK
15 minute summer	12	9	68.073	0.073	24.8	0.0822	0.0000	OK
15 minute summer	13	10	65.876	0.076	28.3	0.0906	0.0000	OK
15 minute summer	14	10	62.997	0.197	52.8	0.3271	0.0000	OK
15 minute summer	15	9	62.486	0.176	125.4	0.6406	0.0000	OK
15 minute summer	16	10	61.287	0.752	323.7	2.5552	0.0000	SURCHARGED
15 minute summer	17	10	60.427	1.002	454.3	1.4334	0.0000	SURCHARGED
15 minute summer	18	10	60.147	0.862	450.9	1.2335	0.0000	SURCHARGED
15 minute summer	19	10	59.836	0.656	465.2	1.1926	0.0000	SURCHARGED
720 minute winter	20	720	58.466	0.526	45.2	0.7529	0.0000	SURCHARGED
720 minute winter	20_OUT	720	58.464	0.969	45.2	622.9861	0.0000	SURCHARGED
720 minute winter	outfall	720	58.464	1.029	4.1	1.1635	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	30.4	1.987	0.345	0.6291	
15 minute summer	2	1.001	3	44.5	2.440	0.109	0.8447	
15 minute summer	3	1.002	4	119.9	1.397	0.866	2.4210	
15 minute summer	4	1.003	5	122.0	0.969	0.531	0.8447	
15 minute summer	5	1.004	6	166.6	1.322	0.731	1.4056	
15 minute summer	6	1.005	7	158.9	1.344	0.826	2.8092	
15 minute summer	7	1.006	17	163.2	1.704	0.610	5.4066	
15 minute summer	8	2.000	9	6.0	1.046	0.087	0.0751	
15 minute summer	9	2.001	10	62.6	3.053	0.507	0.7646	
15 minute summer	10	2.002	16	112.4	2.827	1.074	0.9216	
15 minute summer	11	3.000	12	24.8	1.893	0.277	0.4016	
15 minute summer	12	3.001	13	24.3	2.263	0.208	0.2067	
15 minute summer	13	3.002	14	28.0	2.409	0.239	0.6347	
15 minute summer	14	3.003	15	51.7	1.464	0.996	1.3067	
15 minute summer	15	3.004	16	121.3	2.976	0.583	1.3806	
15 minute summer	16	2.003	17	316.1	3.125	0.915	2.8286	
15 minute summer	17	1.007	18	450.9	2.088	1.170	4.0917	
15 minute summer	18	1.008	19	449.5	2.081	1.524	4.9232	
15 minute summer	19	1.009	20	463.0	2.152	1.344	3.0631	
720 minute winter	20	1.010	20_OUT	45.2	2.257	0.032	0.6740	
720 minute winter	20_OUT	1.010_1	outfall	4.1	0.290	0.111	0.4734	
720 minute winter	outfall	Hydro-Brake®		4.0				202.8

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Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 89.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	64.510	0.110	41.5	0.2282	0.0000	OK
15 minute summer	2	9	63.173	0.098	60.5	0.1463	0.0000	OK
15 minute summer	3	10	61.283	0.733	166.1	2.2906	0.0000	SURCHARGED
15 minute summer	4	10	61.135	0.795	156.2	0.8990	0.0000	SURCHARGED
15 minute summer	5	10	61.100	0.814	217.3	2.2225	0.0000	SURCHARGED
15 minute summer	6	10	61.025	0.813	208.7	1.1640	0.0000	SURCHARGED
15 minute summer	7	10	60.938	0.873	175.7	1.2488	0.0000	SURCHARGED
15 minute summer	8	9	65.453	0.053	8.1	0.0709	0.0000	OK
15 minute summer	9	9	64.884	0.134	84.0	0.3463	0.0000	OK
15 minute summer	10	10	63.523	1.458	160.3	3.5759	0.0000	SURCHARGED
15 minute summer	11	9	69.897	0.097	33.5	0.1734	0.0000	OK
15 minute summer	12	9	68.084	0.084	32.3	0.0953	0.0000	OK
15 minute summer	13	9	65.886	0.086	36.9	0.1032	0.0000	OK
15 minute summer	14	10	63.217	0.417	69.0	0.6915	0.0000	SURCHARGED
15 minute summer	15	10	62.560	0.250	158.6	0.9079	0.0000	OK
15 minute summer	16	10	61.960	1.425	400.5	4.8387	0.0000	SURCHARGED
15 minute summer	17	10	60.797	1.372	540.9	1.9640	0.0000	SURCHARGED
15 minute summer	18	10	60.401	1.116	536.7	1.5965	0.0000	SURCHARGED
15 minute summer	19	10	59.964	0.784	553.9	1.4252	0.0000	SURCHARGED
720 minute winter	20	675	58.665	0.725	56.1	1.0372	0.0000	SURCHARGED
600 minute winter	20_OUT	600	58.580	1.085	86.5	703.4486	0.0000	SURCHARGED
720 minute winter	outfall	645	58.602	1.167	6.8	1.3196	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	39.7	2.124	0.450	0.7679	
15 minute summer	2	1.001	3	58.3	2.617	0.142	1.2598	
15 minute summer	3	1.002	4	156.2	1.417	1.128	3.0888	
15 minute summer	4	1.003	5	152.1	1.008	0.663	1.0632	
15 minute summer	5	1.004	6	208.7	1.397	0.916	1.7140	
15 minute summer	6	1.005	7	175.7	1.335	0.913	3.1933	
15 minute summer	7	1.006	17	180.3	1.830	0.674	5.4066	
15 minute summer	8	2.000	9	7.8	1.128	0.114	0.0915	
15 minute summer	9	2.001	10	83.0	3.061	0.672	1.2011	
15 minute summer	10	2.002	16	122.9	3.090	1.175	0.9216	
15 minute summer	11	3.000	12	32.3	2.027	0.361	0.4894	
15 minute summer	12	3.001	13	31.7	2.426	0.271	0.2518	
15 minute summer	13	3.002	14	35.9	2.546	0.307	1.1553	
15 minute summer	14	3.003	15	63.0	1.585	1.212	1.3967	
15 minute summer	15	3.004	16	153.9	2.896	0.739	2.2456	
15 minute summer	16	2.003	17	366.5	3.324	1.061	2.8286	
15 minute summer	17	1.007	18	536.7	2.485	1.393	4.0917	
15 minute summer	18	1.008	19	537.8	2.490	1.823	4.9232	
15 minute summer	19	1.009	20	551.9	2.556	1.602	3.1298	
720 minute winter	20	1.010	20_OUT	54.3	2.237	0.039	0.6742	
600 minute winter	20_OUT	1.010_1	outfall	4.1	0.213	0.112	0.4734	
720 minute winter	outfall	Hydro-Brake®		4.0				209.4

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ON ORIGINAL

0 5 10 15 20 30 40 50mm

PROPOSED DUBLIN EASTERN BYPASS (DEBP) CURRENTLY BEING DESIGNED BY THOIR CONSULT (JV).

DESIGNATED CONSTRUCTION ACCESS ROUTE NOT REQUIRED FOLLOWING OPENING OF DEBP

NOTES:

1. FOUL SEWERS TO BE uPVC EXCEPT FOR TUNNEL SECTION.
2. ALL SURFACE WATER SEWERS TO BE uPVC UP TO 225mm. CONCRETE PIPE TO BE USED FOR LARGER DIAMETERS.
3. SPECIALIST CLAYWARE OR CONCRETE PIPES TO BE USED FOR TUNNEL SECTIONS.
4. WATERMAIN TO BE 150/100 DIA. PVC-A EXCEPT UNDER ROADWAYS WHERE DUCTILE IRON IS TO BE USED.
   - 4.1. AT 90 DEG. TURNS USE 2 No. 45 DEG. BENDS.
   - 4.2. COVER TO WATERMAIN TO BE MIN. 900mm IN FOOTPATH/VERGE.
   - 4.3. SPIGOT SOCKET CONNECTIONS TO BE USED AT PVC-A/DUCTILE IRON JUNCTIONS.
   - 4.4. ANCHOR BLOCKS TO BE POSITIONED AT DEAD ENDS, TEES, BENDS AT EACH SIDE OF HYDRANTS AND VALVES.
   - 4.5. HYDRANT OUTLET TO BE 200mm BELOW GROUND LEVEL UNLESS REQUESTED OTHERWISE.
5. WHERE COVER TO PIPE IS LESS THAN 900mm IN GREEN AREAS OR 1200mm IN TRAFFICKED AREAS, ENCASE PIPE IN NEW 150mm CONCRETE WITH MOVEMENT JOINTS.
6. ALL LEVELS ARE IN METERS AND ARE RELATED TO ORDINANCE DATUM MALIN HEAD.
7. ALL DRAINAGE TO BE IN LINE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.
8. ALL SURFACE WATER FILTER DRAINS SHOULD BE 225ø @ 1:150 U.N.O.

LEGEND:

- F9 IL 99.99 — PROPOSED FOUL SEWER
- IL 99.99 — PROPOSED FOUL DRAIN
- S9 IL 99.99 — PROPOSED SURFACE WATER SEWER
- OVERFLOW/DIFFUSER BOX
- G — ROAD GULLY
- 87.950 — FINISHED FLOOR LEVEL
- 85.50 — ROAD LEVEL
- 1:50 — ROAD GRADIENT
- POROUS PAVING
- GREEN ROOF
- S10-1 65.06 — BIO RETANTION UNIT

ORDNANCE SURVEY IRELAND LICENCE
No EN 0017916
© ORDNANCE SURVEY IRELAND
GOVERNMENT OF IRELAND

REV.	DATE	DESCRIPTION	BY	CHKD

CONSTRUCTION

DESIGNED	KJS	PREPARED	GMC
DATE	MAR 2016	CHECKED	KJS

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PROJECT
PROPOSED DEVELOPMENT AT KNOCKRABO, DUBLIN 14.

DRG. TITLE
SITE SERVICES LAYOUT

ARCHITECT
O'MAHONY PIKE

SCALE	1:500 @A1	FILE REF.	132059-3000

DRG. NO. 132059-3000 C

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2021s0859
Contract	Development at Knockrabo, Dublin 14
Client	Knockrabo Investments DAC
Date	21st October 2021
Author	Michael O'Donoghue
Subject	**Stormwater Audit - Stage 1 Report**

1 Residential Development at Knockrabo, Dublin 14

1.1 Introduction

JBA Consulting have been contracted by Knockrabo Investments DAC to undertake a Stage 1 audit of the surface water drainage design by Waterman-Moylan Engineering Consultants for the proposed development at Knockrabo, Dublin 14.

The results of the audit are set out in the table below.

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The subject site is located on the north of Mount Anville Road, Goatstown, Dublin 14. The proposed development will comprise of 227 No. residential apartment units within four separate blocks, along with associated communal space and residential on street and podium parking. The proposed development will comprise 426 no. residential units, including 237 no. houses; 56 no. duplex apartments; and 133 no. apartments; the development of a 545 m2 creche facility and associated outdoors play areas and parking; construction of a 430m section of new distributor road inking Coosan and Cornamaddy; and all associated infrastructure and services. The site location and proposed site layout are shown below.  The existing site has a total area of 1.78ha and is predominantly greenfield. The site falls in a north to south direction from 76.5m AOD to 59.6m AOD. The development is Phase 2 of a larger multi-phase development. Phase 1 located to the east of the site has already been constructed. Some of the drainage works required for Phase 2 were installed in advance with the Phase 1 scope of works. The subject site already has an existing grant of planning, (D17A/1124). The Knockrabo Way entrance road will remain as granted on the initial application and does not form part of this revised application. The 1.78ha referenced above is the total area within the planning site

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	boundaries. Site investigations were undertaken by Ground Investigations Ireland in February 2019, and it has been concluded that a Soil Index of 0.47 is appropriate for the site. The development will consist of 1.08ha of positively drained hardstanding area. This area, combined with the site Soil Index, results in a subsequent QBar value of 5.94 l/s. The storm network will drain to the north-eastern corner of the site, where sub-surface attenuation will contain stormwater run-off. This will drain, via a flow control device, to a previously installed outlet to the east of the development. This outlet was designed to cater for both Phase 1 & 2 and was installed as part of Phase 1. The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development with any proposed amendments to the design to be incorporated into the construction stage drawings.
Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • The SuDS Manual (CIRIA C753); • Recommendations for Site Development Works for Housing Areas (DoEHLG); • Greater Dublin Strategic Drainage Strategy (GDSDS); • Greater Dublin Regional Code of Practice for Drainage Works; • DLRCC Green Roof Guidance Document (Appendix 16 of the County Development Plan 2016-2022); • BRE Digest 365
Key Considerations & Benefits of SUDs	The key benefits and objectives of SuDS considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.
Site Characteristics	**Soil:** The soil at the site has been indicated as being Soil Type 4 (SPR 0.47) in accordance with HR Wallingford procedures. A site investigation was carried out by GII Ltd. in February 2019, consisting of mechanically excavated trial pits and dynamic probes. In-situ infiltration tests were undertaken in three of the trial pits to investigate subsoil soakage characteristics. The following exploratory works were carried out: • 19 no. mechanically excavated trial pits to a depth of 3.3m; • 26 no. dynamic probes; • 3 no. in-situ infiltration tests in trial pits; • 2 No. Rotary Core Boreholes to a maximum depth of 8.30m; A further 4 No. soakaway tests were undertaken by Site Investigations Ltd. in January 2021. The strata encountered were deemed to be consistent across the site, with topsoil/made ground underlain with cohesive deposits which were further underlain with a granite bedrock. The cohesive deposits are described as *brown sandy gravelly clay.* This is consistent with Soil Type 4.

In both the 2019 and 2021 infiltration tests, no successful infiltration test was achieved. No sufficient water drop was observed, and groundwater ingress was evident in two of the trial holes.

Any proposed underground attenuation units should be lined in instances where the groundwater levels are within 1m of the invert levels of the proposed systems.

Given the lack of infiltration observed during the testing, the QBAR calculation based on Soil Type 4 seems prudent.

Rainfall (basis for surface water pipeline network design):
Rainfall parameters can be estimated using Met Éireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Éireann method can be more representative of a site if selected correctly. A comparison of values estimated by Waterman - Moylan and JBA is shown below:

	WM value	**JBA Value**
Rainfall model:	Met Éireann	Met Éireann
M5-60 (mm):	18.2 mm	18.3mm
Ratio R:	0.217	0.277
SAAR:	774	774

It is expected that the R value used is a typo. This can be amended as part of the detailed design but will have little impact on overall layout.
The development will discharge into an existing storm network to the north-east of the site. This existing network was installed as part of first phase of this development and is designed so as to account for Phase 2.

The SOIL index for the site is designated as Soil Type 2 on Irish GSI maps. However, following site investigation results, it was proposed to use an SPR. of 0.47. This more accurately reflected the poor ground conditions on the site. Using this SPR value, the greenfield run-off rate (QBAR) was calculated to be 6. 5 l/s (5.430 l/s/ha for 1.21Ha). The 1.21Ha allows for all impermeable areas contributing to the network, as well as the green area to the south of Block B. The remaining green space is to be constructed so as to not contribute to the system. The detailed design will need to ensure this is the case, otherwise the QBAR value will need to be amended.

The site topography of the site is approx. 1 in 12, falling south to north.

SuDS Measures Considered

Waterman-Moylan have included the following SUDs measures within the proposed development. No reference has been made to any other measures considered.

SUDS Technology	Comments
Green Roofs	3640m2 of green roof has been provided for within the development. Given the total roof area is 4,550m2, this equates to 85% provision of green roof. This is in excess of the 60% minimum requirement.
Swale/ Filter Drain / Infiltration trench	120m of 225mm Ø filter drain is proposed within the development. To the north, a filter drain receives catchment from the adjacent road via gully connections. A further filter drain is included to the south of Block F. The latter filter drain is incorrectly included in the calculation for treatment volume on the site. This filter drain caters for greenspace run-off only and thus does not contribute to the treatment of impermeable surface run-off.

Permeable Paving	Permeable paving has been proposed to the in-curtilage driveways for each house-type and all car-parking areas. The permeable paving is not intended to provide interception, due to the poor ground conditions present on the site. An impermeable membrane is proposed beneath the paving to prevent cross-contamination from groundwater.
Petrol Interceptor	A "downstream defender" has been proposed at the outfall of the site, downstream of the proposed attenuation storage. It is good practise to locate bypass interceptors upstream of any proposed attenuation feature to reduce maintenance requirements.
Surface Water Attenuation	Sub-surface attenuation will be provided beneath the green space to the north-east corner of the site. This proprietary cellular storage system will provide 725m3 of storage.
Site Run-off Rates	W-M propose to limit discharge to a rate of 5.430 l/s/ha, which is the greenfield run-off rate for the site.
Detention Basins, Retention Ponds, Stormwater Wetlands	N/A
Tree Root Structural Cell Systems, Bio-retention, rain garden	Bio-retention tree pits are proposed throughout the development. Roadside gullies discharge into the tree pits, which then overflow into the main sub-surface network.

Surface Water Drainage Design

Surface water flows generated by the development will be attenuated within sub-surface attenuation before being discharged into the existing storm network at 6.5 l/s, based on the greenfield run-off rate of 5.43 l/s/ha.

The surface water design has been presented using Causeway Flow software.

SuDS Management Train

Source Control and **Site Control** are addressed by the use of SuDS devices (interception storage) and attenuation with outflow controlled by Hydro-Brakes. Petrol interceptors have been proposed prior to discharge from site.

As recommended within the SUDs Manual (Table 26.7) assuming effective pre-treatment is in place the following number of treatment train components are recommended:

	No. of treatment train components recommended	**Comment/Proposals**
Roof areas	1	85% of the roof space on the development has been designed as green roof.

	Residential roads, parking areas, commercial zones — 2 — Pervious paving has been proposed to all in-curtilage driveways and car-parking spaces throughout the site. Where road gullies are proposed, these all discharge into bio-retention tree pits prior to entering the sub-surface network. **Refuse collection, industrial areas, loading bays, lorry parks and highways.** — 3 — N/A The above table summarises the SuDS Management Train for the site. Hydro-Brakes designed for a linear discharge profile will be provided at the outfalls of the attenuation structure to limit flow to a maximum of 6.5 l/s.
Climate Change	An allowance of 20% increase in flows has been included for climate change for the rainfall intensities for the purposes of sizing the attenuation storage. This is in compliance with the requirements of the GDSDS.
Volume Storage	Waterman - Moylan have provided attenuation calculations using Flow for the attenuation volumes provided. None of the manholes provided are deemed to be at FLOOD RISK. The critical storm events for these flood risk events is the 15-minute 100-year Winter event + 20% for climate change. The storage is designed as per River Protection Criteria 4.3 of the GDSDS, namely discharge rates are to mimic QBAR or 2l/s/ha. Volumes account for the 100-year return storm event + 20% climate change.
Volume Run-off	A comparison between pre and post construction was provided in the first iteration of the Engineer's Report. This is now redundant as the contributing areas have been amended. The supply of this calculation was not necessary due to the subsequent means of determining the attenuation volume.
Treatment Volume / Water Quality Improvement	Interception storage is proposed by way of pervious paving, silt traps, filter drains, bio-retention tree pits and green roofs.
Return Period	A 100-year return period plus 20% for climate change has been used in the design for the attenuation systems. It is stated that the network has been designed for the 5-year return period, however, the rainfall intensities have been capped at 50mm/hr. A 50mm/hr intensity is not entirely reflective of a 5-year return period, but it's capping will not be a determining factor on the overall design.
Exceedance flows	W-M have considered exceedance flows and included for the same within the Flood Risk Assessment.
Health & Safety and Maintenance Issues	The proposed drainage system comprises SuDS devices, traditional road gullies, attenuation systems and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation.

	Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. A preliminary optional maintenance regime has been included in Appendix I and is sourced from the SuDS Manual, CIRIA C753. Regular maintenance of the flow control devices will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptor be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance are recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.
Design Review Process	Upon review of the detailed drainage design, JBA Consulting provided feedback to W-M, namely: • The interception and treatment receptors were not calculated or distributed correctly and required to be amended. Filter drain and bio-retention details require to be amended at detailed design stage to ensure they match the capacity provided for in the design, and that suitable outlets are provided. • Green areas not contributing to the storm drainage network are to be shaped and constructed so as to not drain into the network • Issues relating to cover and vertical / horizontal separation requirements; A summary of comments and record of the audit trail are appended to this report.
Audit Result	JBA Consulting considers that the surface water drainage design for the proposed development is acceptable and meets the requirements of the Stage 1 Stormwater Audit.

Audit Report Prepared by: Michael O'Donoghue BEng (Hons) CEng MIEI
Senior Engineer

Approved by: Leanne Leonard BEng (Hons) MIEI)
Design Engineer

Note:

JBA Consulting Engineers & Scientists Ltd. role on this project is as an independent reviewer/auditor. JBA Consulting Engineers & Scientists hold no design responsibility on this project. All issues raised and comments made by JBA are for the consideration of the Design Engineer. Final design, construction supervision, with sign-off and/or commissioning of the surface water system so that the final product is fit for purpose with a suitable design, capacity and life-span, remains the responsibility of the Design Engineers.

Appendix A – Audit Trail Record

JBA Consulting Stormwater Audit - Stage 1 Feedback Form	
Project:	Development at Knockrabo, Dublin 14 - Stage 1 SWA
Date:	08/10/2021
JBA Reviewers	Michael O'Donoghue
Project Number:	2021s0859

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	08/10/2021	**08/10/2021**	**14/10/2021**	
	Reference Documents 20-086-P116A Road Construction Details 20-086-P120A Proposed Foul & Storm Water Drainage GA 20-086-P121A Drainage Layout Sheet 1 20-086-P122A Drainage Layout Sheet 2 20-086-P123A Storm Water Longitudinal Section 20-086-P126 Storm Water Drainage Construction Details 20-086-P127 Storm Water Attenuation Details 20-086-P140A SUDS Layout 20-086-P141A SUDS Details Sheet 1 20-086-P142 SUDS Details Sheet 2 20-086r.002 EAR - Issue 3 20-086r.005 Flood Risk Assessment-Issue 2 Drainage Report Annex A1 GDSDS Calcs - Knockrabo Annex D - ADS Stormwater Attenuation - Knockrabo Appendix B - Infiltration Tests - 5802 Knockrabo SI Report Appendix C - Final GI Report - Knockrabo			
1	20-086r.002 EAR + Annex A1 GDSDS Calcs - Knockrabo + network calculations 1. The values presented for interception and storage in the appendix do not match those presented in Section 4.6.1 of the EAR. The % of paved areas differs in both cases. 2. In both the interception and treatment calculations, the area is reduced to 75% of the contributing area. It is further reduced to 80% of its run-off in the next column. It is unclear why this has been applied. Table 4 also references the paved surfaces being drained to a river. It isn't clear what this refers to. 3. The treatment volume requires heavily on the volume provided by the green roof. This can only cater for the rainfall within the roof catchment, and can't be used as a means of offsetting volume from elsewhere. 4. The accepting volumes for interception are not clearly defined, and it not clear how the first 5mm falling on the proposed roads or hardstands will be intercepted. 5. A calculation for Long Term Storage is provided in the appendix, but it is proposed in the EAR (Section 4.6.4) that Criteria 4.3 is to be used for River Flood Protection. This Criteria requires that any attenuation design be based on a limited discharge of QBAR or 2l/s/ha. 6. The attenuation calculations provided in the appendix appear to have a variable discharge volume capacities. It is unclear how these calcs determine the attenuation volumes and how it compares to the microdrainage calculations. 7. The network and the attenuation has been designed separately. This doesn't allow for an assessment on the impact of the variable head/flow discharge or the extent of surcharging of the system during extreme events. 8. It is unclear as to what the contributing areas for each node are within the microdrainage calculations. 9. The contributing area in the network calculation doesn't correlate to the positively drained areas stated in the EAR. 10. The associated contributing areas referred to in Table 5 are not shown on any drawing.	1. Review calculation and amend within appendix or report as required. 2. Clarify where the additional 75% reduction is drawn from. 3. Indicate on a sketch the distribution of areas relative to the provided treatment methods. 4. Provide calculation, similar to the those for treatment, for the interception volume. 5. Explain why long term storage has been calculated if Criteria 4.3 is being used for attenuation calculation. If long term storage is being planned, then its extent needs to be clearly identified. 6. Provide clarity on how the attenuation calculations work and how they relate to the values determined in the network (microdrainage) calculations. 7. It is recommended that both the network and attenuation be modelled together so as to assess how one impacts on the other. Provide details on the level of surcharge within the network for various flood events. 8. Provide a sketch indicating contributing areas to each node. 9. Clarify which contributing area is correct. 10. Provide a sketch indicating the locations of the associated contributing areas as referred to in the table.	1.0 Amended within report. GDSDS Calcs now supplied in report and network modelled through Casuway Flow to determine Storage requirements . 2.0 Additonal deduction included in error. Now omitted. 3.0 Please refer drawing P140 and calcs within EAR 4.0 Refer interception storage calcualtion within report, section 4.6 5.0 Criteria 4.3 used for river flood protection, based upon a limited discharge QBAR or 2l/s/ha. Refer updated report 6.0 Network and attenuation calculations reworked through Causeway Flow have been determined via Casueway flow through the parameters defined in the Flow design output report. 7.0 Design network and attenuation modelled in tandem through Causeway Flow. Refer Causeway Flow design report 8.0 Refer SK001 indicating contributing areas 9.0 Contributing Area within red line is 10,939m2. A contribution allowance in the network has been inlcuded for building footprint area with in adjacent site to the south (580m2). This has been accounted for in the network and also attenuation provision. 10.0 Please refer drawing P140	See Note 7
2	20-086-P121 Drainage Layout Sheet 1 of 2 + 20-086-P122 Drainage Layout Sheet 2 of 2 1. There is a large green area to the south of Block F with its topography falling from south to north. There appears to be no drainage proposed at the building interface to positively drain this area. 2. The attenuation indicates 508m3, which varies from the volumes stated in the EAR and the design report. 3. A swale is proposed adjacent to the attenuation with two open grated manholes. It isn't clear as to the purpose of these as it is an open swale. 4. There appears to be a clash between the foul and storm drainage at S11. Irish Water require a 250mm clearance between all other utilities. 5. S8 (S2.001 in the microdrainage calcs) has a contributing area of 0.014Ha, and a note that a spur has been left for future connections. This would seem small for any future development. Is the scope or extent of this development known? 6. The pipes and manholes have differing labels to that of the network design, which makes it difficult to review.	1. Clarify if this area is to be positively drained. 2. Amend drawing to correspond to calculation. 3. What is the purpose of the open grated manholes at either end of the open swale? 4. Undertake a clash detection review at this junction. 5. Clarify the extent of the contributing area for any future development and to what extent this has been included within the design of the network. 6. Amend the drawing to correspond to the microdrainage calcs.	1.0 Postive filter drainage supplied, as indicated on drawing P122 2.0 Attention Volume revised to suit causeway flow modelled requirements. A provision of 725m3 has been provided, and model results indicate no "flood" or "flood risk" associated with this provision. 3.0 The swale here has been replaced by filter drain 4.0 No clash noted, refer P122 drainage layout 5.0 - As noted in item 9 above, provision for the building footprint area has been afforded in the design. 6.0 matching labels now within layout and model	See Note 8
3	20-086 Long Sections 1. S3.000 has a cover depth of 257mm where it enters the manhole S12. 2. S3.004 has a cover depth of 842mm where it enters the manhole S11.	1&2. Provide information on how shallow pipework will be protected.	1.0 All shallow pipework to be protected in accordance with detail and note 6 requirements supplied on details drawing P126	See Note 9
4	20-086-P116 Road Construction Details 1. The carriageway construction is a 10mm SMA on an AC binder. The EAR proposes that a permeable asphalt will be used.	1. Clarify if proposed asphalt is porous. DLRCC normally don't permit porous asphalt, has this been agreed with them?	1.0 DLRCC Maintenance have since confirmed to transport planning that porous asphalt not permitted on carriagway proposed for TIC. Omitted.	Acceptable
5	20-086-P127 Attenuation 1. No liner is shown around the attenuation. As per C753, attenuation is to be lined in the event that the invert is within 1m of the groundwater table.	1. It is likely that the groundwater table will be within 1m of the invert of the tank. Therefore the attenuation should be lined to protect from groundwater infiltration.	1.0 Impermeable Liner now indicated on attenutaion cross section P127	Acceptable
6	General 1. Exceedance flows don't seem to have been considered. 2. The SAAR and M5-60 values used differ from the latest Met Eireann values. JBA understand that these should be 825 & 18.3 respectively. 3. Drawings 120 & 127 are referred to in the EAR, but not provided.	1. Clarify if exceedance flows have been considered. 2. Provide rationale for the M5-60 and SAAR values.	1.0 Exceedance flows have been considered and provision for which has been detailed in the Flood Risk Assessment, in particualr Section 3.6 & 4.6. 2.0 Refer supplied SAAR figures and rainfall data for the proposed site. SAAR chosen for eastings/northings of site. Nearest easting/northing to development location selected. 3.0 Refer 120 & 127 included	See Note 8
	15/10/2021	**15/10/2021**	**20/10/2021 Rev1**	
7	1. The tree pits don't have an outfall, but are deemed to be within the contributing areas and have gully inlets. If the tree pits don't have a low level outfall, the ground will become saturated and create anerobic conditions which will limit oxygen to the tree root structure. 2. The Qbar calc. is based on a hardstanding area of 1.09 Ha, as per initial calcs. However, the green area to the south of Block F is now positively draining into the network. 3. 120m of Filter drain has been included, in the infiltration calcs. However, not all of the filter drains shown have run-off discharging into them. Therefore, not all of the filter drains can be used in the calculation. 4. The filter drain adjacent to the attenuation isn't included in the contributing area sketch, though it has gullies discharging into it.	1. At detailed design, whether the tree pits have a gully inlet or not, a low level overflow should be included to ensure root-balls aren't saturated. 2, 3, 4. Clarify the positively drained area vs. non-contributing green areas. Note, increasing the positively drained area will be beneficial for the allowable QBar calc. Where green areas are not deemed to be contributing, they should be shaped so as not to discharge into the network. Only SuDs elements that are catering for impermeable run-off treatment can be used for calculating the same. Any filter drains catering for green area run-off can't be included in the treatment calculations. Similarly, only tree pits receiving run-off can be included as providing treatment. Please amend calcs to only include treatment measures directly connected to the positively drained areas.	1. Agree. Low Level overflow to be supplied. 2/3/4. South of Block F, footpath (285m2) and runoff from the remaining open space (2,200 Soil type 4 - 0.47 = 1034m2) has been catered for at node 9 (285+1034=1319m2) in the SW network design. Adjusted causeway flow design report attahced. Also, only SuDs elements that are catering for impermeable run-off treatment are inlcuded in treatment calculations. Treatment volume adjusted for tree pits to reflect areas draining to them, per sketch mark up sent 19-10-21. Hardstanding calc adjusted to reflect run off from green open space south of block F. Hardstnading now calculated to be 1.197ha, resulting in QBar of 6.5l/s. Refer Causeway Design report attahced.	Acceptable
8	1. As stated in Note 7 above, the Qbar should be amended to include all positively drained areas. This will benefit the system and allow for a greater discharge. 2. P140 still references a swale adjacent to the attenuation. 3. M5-60 value in the calcs is 14.2mm, this should be 18.2mm as provided. 4. 700m3 has been included in the calculations, but 725m3 has been included in the drawings. 5. S16, Inlet B has an invert of 61.135m. The invert of inlet A on the adjacent foul manhole is 60.725m. The top of this pipe is 60.960m. This gives a clearance of 175mm, less than 250mm minimum clearance stated within IW's code of practice.	1. Confirm the Qbar calc. includes all positively drained areas. 2. Amend drawing to remove reference to swale. 2. Amend calcs to account for correct M5-60 value. 3. Confirm correct attenuation volume. 4. At the detailed design phase, ensure that clearances between services comply with IW CoP.	**1. Hardstanding adjusted as noted above, QBar increased to 6.5l/s to cater for all postively drained areas. 2. Noted, now removed. 3 Agree, clercial input error, now adjusted. 4. 700m3 is the modelled figure determined in Causeway Flow. The configuration of Stormtech units proposed affords 725m3, ie we are 20m3 in excess of the required 700mm. 5. Noted, separation adjusted such that this clearances complies with IW CoP**	Acceptable
9	1. Where the cover provided is 257mm, this will result in the pipe surround being located within the asphalt build-up, which may not be accepted by DLRCC.	1. Can you provide updated long sections corresponding to latest design. These can be generated from the network calculations. This will allow the locations of the shallow pipework to be identified. Has the situation where the pipework is within the road build-up been reviewed by DLRCC?	**1. Long section udpated. As regards the services within the road bulid-up, it is the ESB Hv that is shown in this build up. This HV line is indicative as we have not reached design stage with the ESB. It is possible that HV ducting within the will not be required. Section adjusted to remove ESB from the pavement build-up.**	Acceptable

B. Ground Investigations – Soil Infiltration Report

S.I. Ltd Contract No: 5802

Client:	Knockrabo Investments DAC
Engineer:	Waterman Moylan
Contractor:	Site Investigations Ltd

Knockrabo,
Mount Anville Road, Goatstown, Dublin 14
Soakaway Investigation

Prepared by:

.....

Stephen Letch

Issue Date:	08/01/2021
Status	Final
Revision	1

Contents:

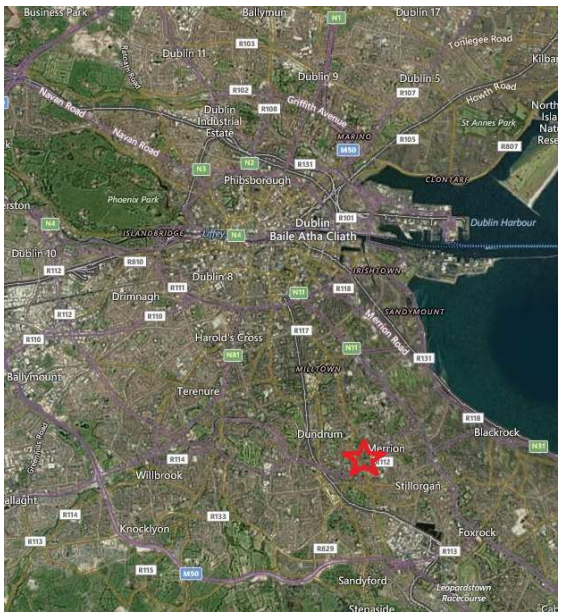
Appendices:

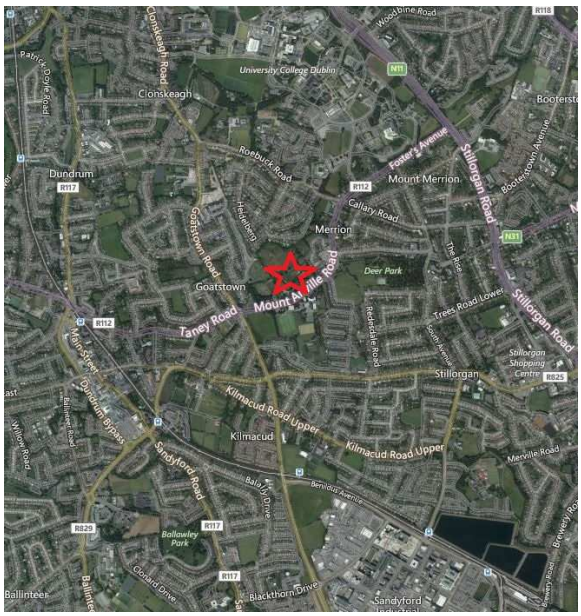
1. Introduction

On the instructions of Waterman Moylan, Site Investigations Ltd (SIL) were appointed to complete a site investigation at Knockrabo, Mount Anville Road, Goatstown, Dublin 14. The investigation was completed in January 2021 on behalf of the client, Knockrabo Investments DAC.

2. Site Location

The site is located on the Mount Anville Road, Goatstown, Dublin 14. The map on the left shows the location of Goatstown in south Dublin and the second map shows the site location in the local area.





3. Fieldwork

4 No. soakaway tests were completed and carried out in accordance with BRE Special Digest 365. The soakaway tests were completed using a tracked excavator and was logged by a SIL geotechnical engineer. The soakaway test is used to identify possible areas for storm water drainage. The pit was filled with water and the level of the groundwater was recorded over time. The time taken for the water level to fall from 75% volume to 25% volume is required to calculate the rate of infiltration.

The soakaway results and photographs are presented in Appendix 1.

4. Recommendations and Conclusions

Please note the following caveats:

The recommendations given, and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between the exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for adjacent unexpected conditions that have not been revealed by the exploratory holes. It is further recommended that all bearing surfaces when excavated should be inspected by a suitably qualified Engineer to verify the information given in this report.

The soakaway tests at SA01 and SA02 recorded no infiltration and therefore, failed the specification. The BRE Digest stipulates that the pit should half empty within 24hrs, and extrapolation indicates this condition would not be satisfied. The test was terminated at the end of the first (of a possible three) fill/empty cycle since further testing would give even slower fall rates due to increased soil saturation. The unsuitability of the soils for soakaways is further suggested by the soil descriptions of the materials in this area of the site where the soakaway was completed, i.e., well compacted clay/silt soils.

The pits excavated at SA03 and SA04 recorded ingresses of groundwater into the pits and therefore the soils are already saturated and unsuitable for soakaway design.

Appendix 1

Soakaway Test Results and Photographs

SOAKAWAY TEST

Project Reference:	5802
Contract name:	Knockrabo
Location:	Goatstown, Dublin 16
Test No:	SA01
Date:	06/01/2021

Ground Conditions

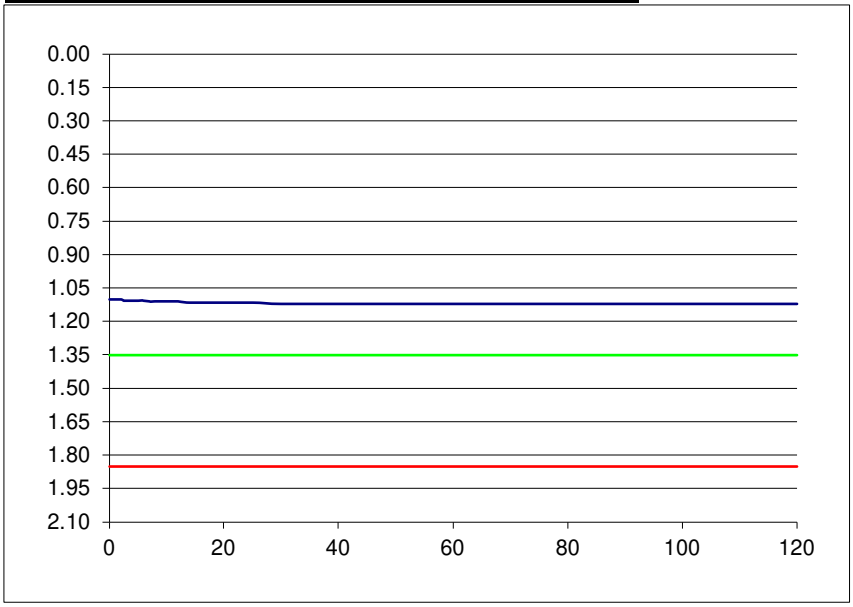
From	To	
0.00	0.40	MADE GROUND: brown slightly sandy slightly gravelly silty clay with low cobble content and some red brick and timber fragments.
0.40	2.10	Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY with medium cobble content.

Remarks:

-

Elapsed Time (mins)	Fall of Water (m)
0	1.10
0.5	1.10
1	1.10
1.5	1.10
2	1.10
2.5	1.11
3	1.11
3.5	1.11
4	1.11
4.5	1.11
5	1.11
6	1.11
7	1.11
8	1.11
9	1.11
10	1.11
12	1.11
14	1.12
16	1.12
18	1.12
20	1.12
25	1.12
30	1.12
40	1.12
50	1.12
60	1.12
75	1.12
90	1.12
120	1.12

Pit Dimensions (m)		
Length (m)	2.90	m
Width (m)	0.70	m
Depth	2.10	m
Water		
Start Depth of Water	1.10	m
Depth of Water	1.00	m
75% Full	1.35	m
25% Full	1.85	m
75%-25%	0.50	m
Volume of water (75%-25%)	**1.02**	m3
Area of Drainage	**15.12**	m2
Area of Drainage (75%-25%)	**5.63**	m2
Time		
75% Full	N/A	min
25% Full	N/A	min
Time 75% to 25%	**N/A**	min
Time 75% to 25% (sec)	**N/A**	sec



f = **Fail** **m/min** or **Fail** **m/s**

SOAKAWAY TEST

Project Reference:	5802
Contract name:	Knockrabo
Location:	Goatstown, Dublin 16
Test No:	SA02
Date:	06/01/2021

Ground Conditions

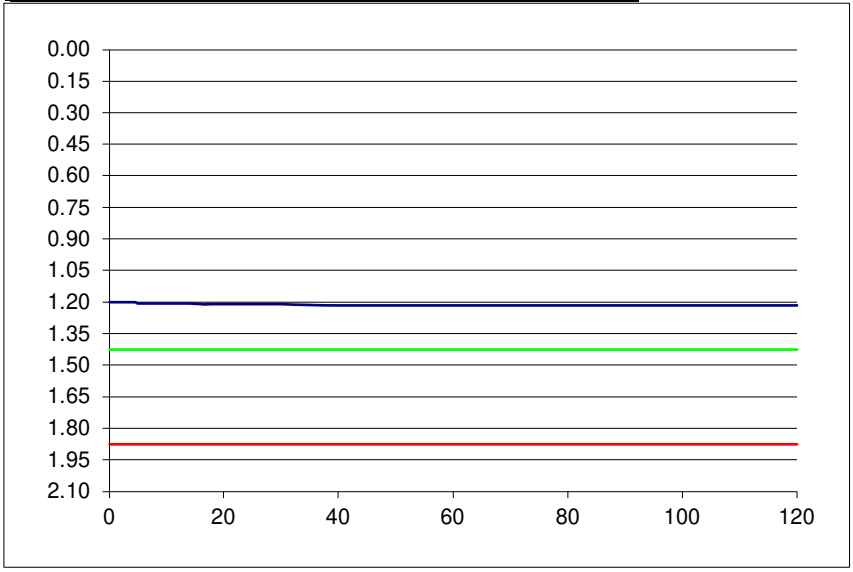
From	To	
0.00	0.10	MADE GROUND: grey silty sandy gravel.
0.10	1.20	MADE GROUND: brown sandy slightly gravelly silty clay with high cobble content and some red brick fragments.
1.20	1.70	Firm becoming stiff grey brown slightly sandy slightly gravelly silty CLAY with medium cobble content.

Remarks:

Obstruction at 1.70mbgl - possible boulders or weathered bedrock.

Elapsed Time (mins)	Fall of Water (m)
0	1.20
0.5	1.20
1	1.20
1.5	1.20
2	1.20
2.5	1.20
3	1.20
3.5	1.20
4	1.20
4.5	1.20
5	1.21
6	1.21
7	1.21
8	1.21
9	1.21
10	1.21
12	1.21
14	1.21
16	1.21
18	1.21
20	1.21
25	1.21
30	1.21
40	1.22
50	1.22
60	1.22
75	1.22
90	1.22
120	1.22

Pit Dimensions (m)		
Length (m)	3.10	m
Width (m)	0.70	m
Depth	2.10	m
Water		
Start Depth of Water	1.20	m
Depth of Water	0.90	m
75% Full	1.43	m
25% Full	1.88	m
75%-25%	0.45	m
Volume of water (75%-25%)	**0.98**	m3
Area of Drainage	**15.96**	m2
Area of Drainage (75%-25%)	**5.59**	m2
Time		
75% Full	N/A	min
25% Full	N/A	min
Time 75% to 25%	**N/A**	min
Time 75% to 25% (sec)	**N/A**	sec



f = Fail m/min or **Fail** m/s

SOAKAWAY TEST

Project Reference:	5802
Contract name:	Knockrabo
Location:	Goatstown, Dublin 16
Test No:	SA03
Date:	06/01/2021

Ground Conditions

From	To	
0.00	0.10	TOPSOIL.
0.10	0.90	Firm brown slightly sandy slightly gravelly silty CLAY with low cobble content.
0.90	2.00	Light brown sandy GRAVELwith high cobble content. (Possible weathered granite).

Remarks:

Obstruction at 2.00mbgl - possible boulders or weathered bedrock.
Medium water ingress at 1.10mbgl - area unsuitable for soakaway design.

Elapsed Time (mins)	Fall of Water (m)
-	-
-	-
-	-
-	-
-	-
-	-
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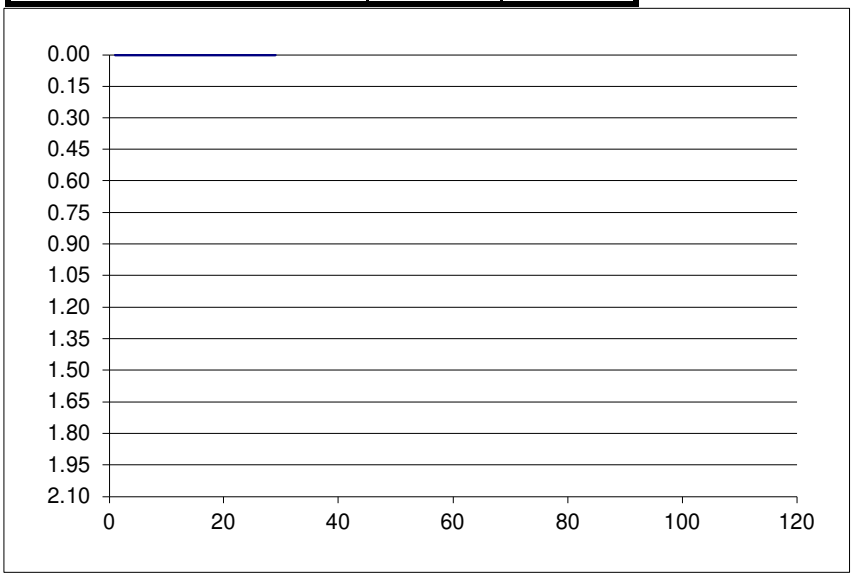
Pit Dimensions (m)		
Length (m)	2.80	m
Width (m)	0.70	m
Depth	2.10	m
Water		
Start Depth of Water	-	m
Depth of Water	-	m
75% Full	-	m
25% Full	-	m
75%-25%	-	m
Volume of water (75%-25%)	**-**	m3
Area of Drainage	**-**	m2
Area of Drainage (75%-25%)	**-**	m2
Time		
75% Full	N/A	min
25% Full	N/A	min
Time 75% to 25%	**N/A**	min
Time 75% to 25% (sec)	**N/A**	sec



f = **Fail** **m/min** or **Fail** **m/s**

SOAKAWAY TEST

Project Reference:	5802
Contract name:	Knockrabo
Location:	Goatstown, Dublin 16
Test No:	SA04
Date:	06/01/2021

Ground Conditions

From	To	
0.00	0.10	MADE GROUND: grey silty sandy gravel.
0.10	0.30	MADE GROUND: grey brown sandy slightly gravelly silty clay with medium cobble content and some red brick fragments.
0.30	0.60	Firm brown slightly sandy slightly gravelly silty CLAY with medium cobble content.
0.60	1.55	Firm grey brown slightly sandy slightly gravelly silty CLAY with medium cobble and low boulder content.

Remarks:

Obstruction at 1.55mbgl - possible boulders or weathered bedrock.
Medium water ingress at 1.50mbgl - area unsuitable for soakaway design.

Elapsed Time (mins)	Fall of Water (m)
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
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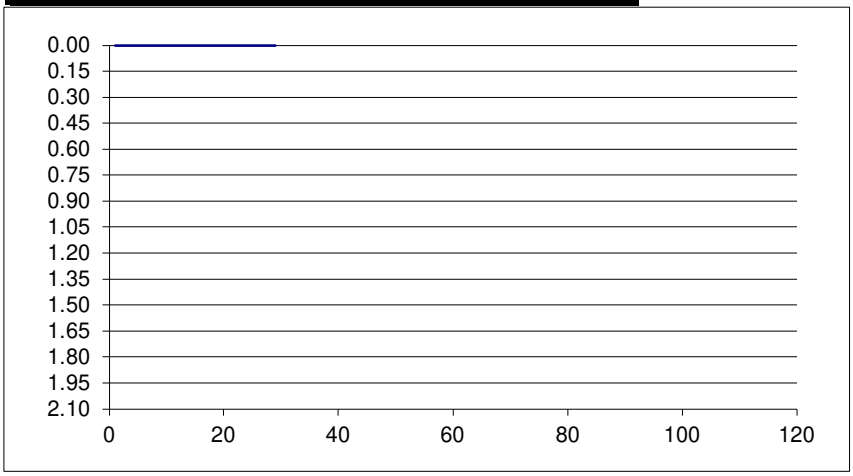
-	-
-	-

Pit Dimensions (m)		
Length (m)	2.90	m
Width (m)	0.70	m
Depth	2.10	m
Water		
Start Depth of Water	-	m
Depth of Water	-	m
75% Full	-	m
25% Full	-	m
75%-25%	-	m
Volume of water (75%-25%)	**-**	m3
Area of Drainage	**-**	m2
Area of Drainage (75%-25%)	**-**	m2
Time		
75% Full	N/A	min
25% Full	N/A	min
Time 75% to 25%	**N/A**	min
Time 75% to 25% (sec)	**N/A**	sec



f = **Fail** **m/min** or **Fail** **m/s**

SA01 Sidewall

SA01 Spoil

SA02 Sidewall

SA02 Spoil

SA03 Sidewall

SA03 Spoil

SA04 Sidewall

SA04 Spoil

Appendix 2

Survey Data

Survey Data

Location	Irish Transverse Mercator		Elevation	Irish National Grid	
	Easting	Northing		Easting	Northing
Soakaway Tests					
SA01	718242.859	728541.905	63.92	318317.806	228514.430
SA02	718344.916	728655.091	63.05	318419.884	228627.641
SA03	718318.367	728591.943	64.13	318393.330	228564.479
SA04	718404.057	728559.783	71.43	318479.039	228532.312

Legend Key

Locations By Type - IP

Contract No:	5802
Contract Name:	Knockrabo
Location:	Goatstown, Dublin 16
Client:	Knockrabo Investments DAC
Engineer:	Waterman Moylan
Title:	Site Plan
Scale:	1:1000
Drawn By:	SL

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Co. Dublin
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e: info@siteinvestigations.ie

C. Ground Investigations – GII Ground Investigations Report

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Ground Investigations Ireland

Knockrabo, Mount Anville Road

Ground Investigation Report

DOCUMENT CONTROL SHEET

Project Title	Knockrabo, Mount Anville Road
Engineer	DBFL
Project No	8188-10-18
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B	Final	S. Connolly	C. Finnerty	C. Finnerty	Dublin	06 February 2019

GROUND INVESTIGATIONS IRELAND

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CONTENTS

APPENDICES

1.0 Preamble

On the instructions of DBFL Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., in November 2018 at the site of the proposed residential development in Knockrabo, Mount Anville, Dublin 14.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently occupied by a disused residential building and gardens and is situated on Mount Anville Road, Dublin 14. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 19 No. Trial Pits to a maximum depth of 3.30m BGL
- Carry out 1 No. Foundation Inspection Pits to determine existing foundation details
- Carry out 3 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Carry out 26 No. Dynamic Probes to determine soil strength/density characteristics
- Carry out 2 No. Rotary Core Boreholes to a maximum depth of 8.30m BGL
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by a Geotechnical Engineer/Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Foundation Pits

The foundation inspection pit was excavated at the location shown in the exploratory hole location plan in Appendix 1. The exposed foundation was logged and sketched prior to backfilling and reinstatement. The log and sketch are provided in Appendix 3 of this Report.

3.4. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 4 of this Report.

3.5. Dynamic Probing

The dynamic probe tests (DPH) were carried out at the locations shown in the location plan in Appendix 1 in accordance with B.S. 1377: Part 9 1990. The test consists of mechanically driving a cone with a 50kg weight in 100mm intervals and monitoring the number of blows required. An equivalent Standard Penetration Test (SPT) 'N' value may be calculated by dividing the total number of blows over a 300mm drive length by 1.5. The dynamic probe logs are provided in Appendix 5 of this Report.

3.6. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where

noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.
The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 6 of this Report.

3.7. Surveying

The exploratory hole locations have been recorded using a Trimble R10 GNSS System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.8. Insitu Plate Bearing Test

The plate bearing tests were carried out by Testall Ltd. The results of which are provided on the test reports in Appendix 7 of this Report.

3.9. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.
Environmental testing, including Waste Acceptance Criteria (WAC) and pH and sulphate testing was carried out by Jones Environmental Laboratory in the UK.
Geotechnical testing consisting of moisture content, Atterberg limits and Particle Size Distribution (PSD) tests were carried out in NMTL's Geotechnical Laboratory in Carlow.
Rock strength testing including Point Load (Is_{50}) and Unconfined Compressive Strength (UCS) testing was carried out in Trinity College Dublin's Geotechnical Laboratory

The results of the laboratory testing are included in Appendix 8 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil
- Made Ground
- Cohesive Deposits
- Weathered Rock
- Bedrock

TOPSOIL: Topsoil was encountered in the majority of the exploratory holes and was present to a maximum depth of 0.50m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil in TP08, TP10, TP13, TP16, TP17 and TP19, and was present to a maximum depth of 2.50m BGL. These deposits were described generally as *brown slightly sandy gravelly Clay with many fragments of red brick, glass and plastic.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground and were described typically as *brown sandy gravelly CLAY with occasional cobbles*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits typically increased with depth and was firm or firm to stiff below 1.00m BGL in the majority of the exploratory holes. These deposits had occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

WEATHERED BEDROCK: In the majority of exploratory holes weathered rock was encountered which was digable with the large excavator to a depth of up to 1.20m below the top of the stratum. The trial pits were terminated upon encountering the more competent bedrock, in which further excavation became more difficult. This material was recovered typically as sandy fine to coarse angular GRAVEL with occasional cobbles of Granite however there was some variability in the fracture spacing and the ease at which the excavator could progress.

BEDROCK: The rotary core boreholes recovered Weak to medium strong brown/white coarse grained Granite.
The depth to rock is at 2.30m BGL in both boreholes. The total core recovery is typically poor, with some of the uppermost runs dropping to 25% or 67%. The SCR and RQD both are poor, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Insitu Strength Testing

The correlated DPH blow counts indicate that the overburden deposits are firm or firm to stiff to depths of between 0.20m to 1.70m BGL and become stiff with depth.

4.3. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors.

4.4. Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 17% and 46% generally with fines contents of 17 to 38%.
The pH and sulphate testing carried out indicate that pH results are near neutral and that the water soluble sulphate results is low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.
The results of the Waste Acceptance Criterial Test Suite are presented with the individual parameter limits for “Inert” “Non Hazardous” and “Hazardous” as outlined within European Council Directive 1999 131/EC Article 16 Annex II, “Criteria and procedures for the acceptance of waste at landfills”. The intended disposal site should be consulted to ensure compliance with their specific requirements.
The results indicate that the total organic carbon content is above the inert limits at 1.50m BGL in TP17 (4.02% vs 3%). Asbestos was detected at 0.50m BGL in TP10, <0.001% as Chrysotile fibre bundles, which was quantified by the lab. Consultation is advised with a specialist environmental consultant or local landfill operators regarding the disposal of this material.
The results from the completed laboratory testing is included in Appendix 7 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

An allowable bearing capacity of 125 kN/m^2 is recommended for conventional strip or pad foundations on the firm to stiff cohesive deposits at a depth of between 0.50m to 1.70m BGL in the majority of the exploration holes, please see Table below. Where the cohesive deposits are deeper, such as at the location of DP15, lean mix trench fill to a depth of 2.50m BGL is recommended to achieve the recommended allowable bearing capacity. An allowable bearing capacity in excess of 250 kN/m^2 is recommended on the bedrock deposits, where present at shallow depths. If a higher allowable bearing capacity is required, 500 kN/m^2 is available on the competent intact granite bedrock as indicated in the rotary core borehole records where total core recovery is greater than 90%.

Allowable Bearing Capacities (ABC) - Dynamic Probe Locations

Probe No.	ABC kN/m2	Depth m BGL	Probe No.	ABC kN/m2	Depth m BGL
DP01	125	1.40	DP10A	125	0.80
DP02	125	2.20	DP11	125	0.80
DP03	125	2.20	DP12	125	0.80
DP04	100	1.40	DP13	125	0.50
DP05	125	1.40	DP13A	125	0.50
DP06	125	1.20	DP14	125	0.50
DP07	125	2.50	DP14A	125	0.50
DP07A	125	2.50	DP15	200	2.50
DP08	125	1.00	DP16	125	1.00
DP08A	125	1.20	DP18	200	1.70
DP09	125	0.80	DP19	125	0.50
DP09A	125	0.80	DP19A	125	0.50
DP10	125	0.80	DP21A	125	1.50

The possibility for variation in the depth of the made ground or soft cohesive deposits in the vicinity of these foundations should be considered and foundation inspections should be carried out. Any soft spots encountered at the proposed foundation depths should be excavated and replaced with lean mix concrete. In any part of the site, should part of the foundation be on rock we would recommend that all the foundations of the unit in question be lowered to the competent rock stratum to avoid differential settlement.
A ground bearing floor slab is recommended to be based on the firm to stiff cohesive deposits with an appropriate depth of compacted hardcore specified by the consulting engineer and in accordance with the limits and guidelines in SR21:2014+A1:2016 and/or NRA SRW CL808 Type E granular stone fill.
The pH and sulphate testing completed on samples recovered from the trial pits indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack.

5.3. External Pavements

The proposed pavements are recommended to be designed in accordance with the CBR test results included in the Appendixes of this Report. The low CBR test results indicate that a capping layer or a sufficient depth of crushed stone fill may be required. Plate bearing tests are recommended at the time of construction to verify the design assumptions for the proposed pavement make up and to verify adequate compaction has been achieved.

5.4. Excavations

Excavations in the Made Ground Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.
Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.
Any excavations which penetrate the granular deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.
The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations. Generally, where significant excavations are required in water bearing granular deposits a cut-off wall may be more cost effective than extensive dewatering. An assessment by a specialist dewatering contractor is recommended to determine the most cost effective approach to the proposed excavation.
Excavations in the upper cohesive and weathered rock deposits are expected to be excavatable with conventional excavation equipment, with zones of more intact bedrock below this depth requiring rock breaking techniques. The JCB 3CX excavator was generally able to excavate to depths of up to 1.20m below the top of the weathered rock, and became difficult to excavate within the confines of the trial pit on encountering the more competent rock.

Any material to be removed off site should be disposed of to a suitably licenced landfill.

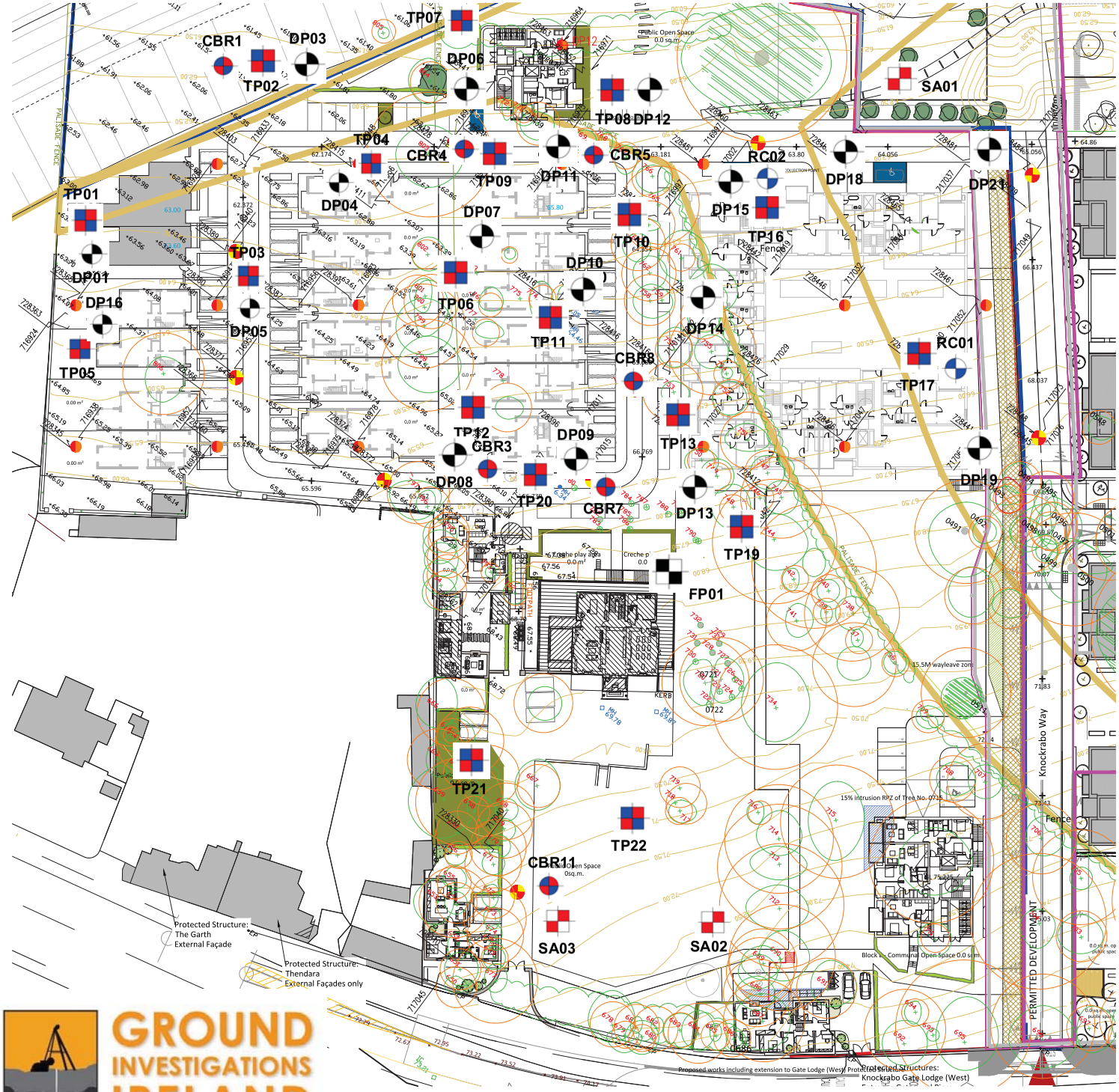
5.5. Soakaway Design

At the locations of SA01, SA02 and SA03, the water level dropped too slowly to allow calculation of ‘f’ the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan

KNOCKRABO, MOUNT ANVILLE - SITE LOCATION PLAN



- Dynamic Probe Locations
- Trial Pit Locations
- Soakaway Locations
- Rotary Core Borehole Locations
- Foundation Pit Locations
- Plate Test Locations

GROUND INVESTIGATIONS IRELAND

D. Attenuation Design – Chamber Specifications, Drawings and Details

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteASSIST™
FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

KNOCKRABO
DUBLIN, DUBLIN

MC-4500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-4500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-4500 CHAMBER SYSTEM

1. STORMTECH MC-4500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUB-GRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm).
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS AS TO NOT DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIAL BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
12. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUB-SURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-4500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILISED OVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

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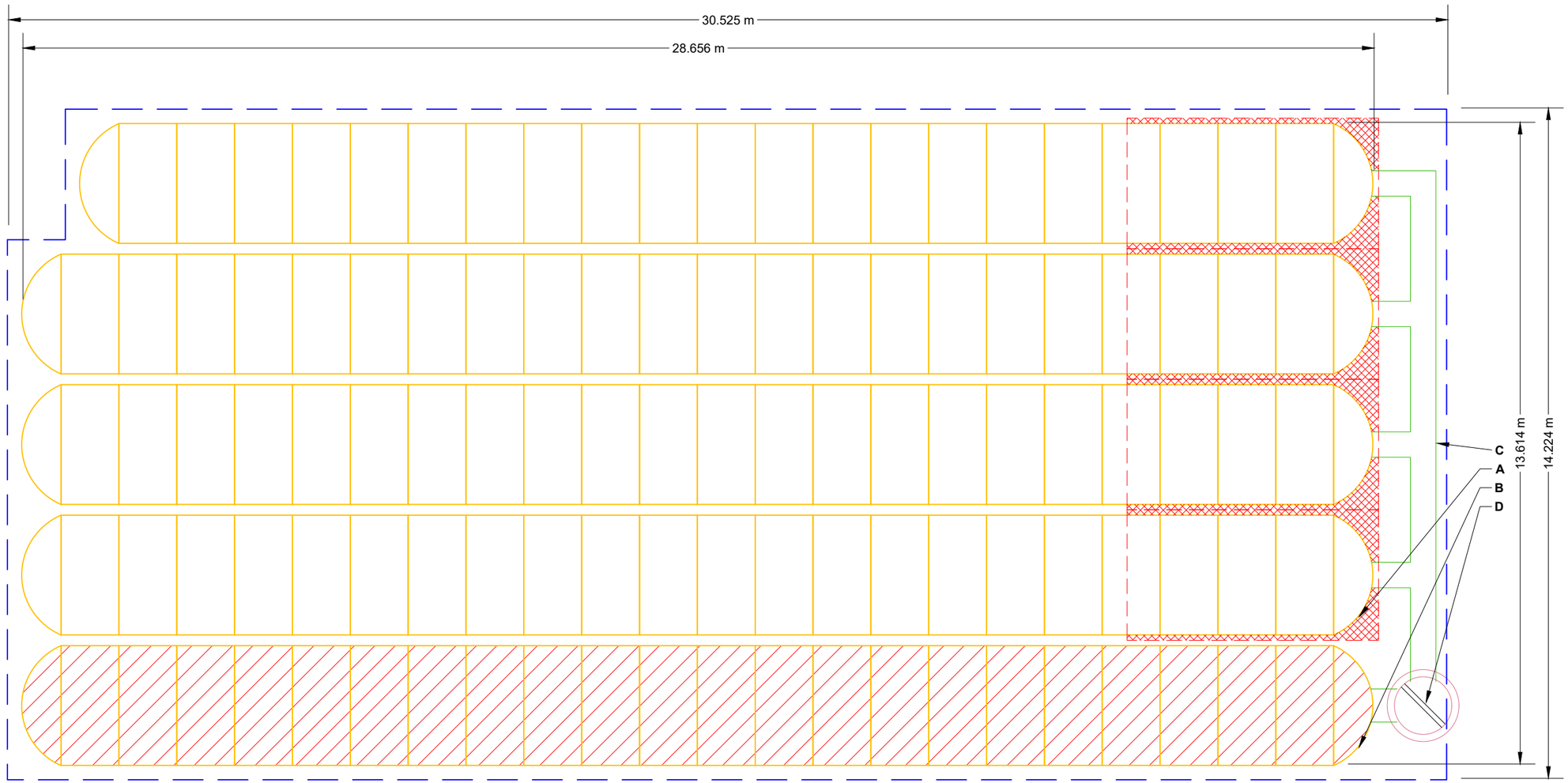
PROPOSED LAYOUT		CONCEPTUAL ELEVATIONS	
109	STORMTECH MC-4500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	4.058
10	STORMTECH MC-4500 END CAPS	TOP OF STONE:	3.024
1100	STONE ABOVE (mm)	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	2.686
400	STONE BELOW (mm)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	2.534
40	STONE VOID	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	2.534
724.8	INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	2.534
		TOP OF MC-4500 CHAMBER:	1.924
		600 mm ISOLATOR ROW PLUS INVERT:	0.457
		450 mm x 450 mm BOTTOM MANIFOLD INVERT:	0.450
430.8	SYSTEM AREA (m^2)	BOTTOM OF MC-4500 CHAMBER:	0.400
89.5	SYSTEM PERIMETER (m)	BOTTOM OF STONE:	0.000

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	450 mm BOTTOM PARTIAL CUT END CAP, PART#: MC4500IEPP18B / TYP OF ALL 450 mm BOTTOM CONNECTIONS	50 mm	
PREFABRICATED END CAP	B	600 mm BOTTOM PARTIAL CUT END CAP, PART#: MC4500IEPP24B / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	57 mm	
MANIFOLD	C	450 mm x 450 mm BOTTOM MANIFOLD, ADS N-12	50 mm	
CONCRETE STRUCTURE W/WEIR	D	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		623 L/s IN



ISOLATOR ROW PLUS
(SEE DETAIL)

PLACE MINIMUM 5.334 m OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

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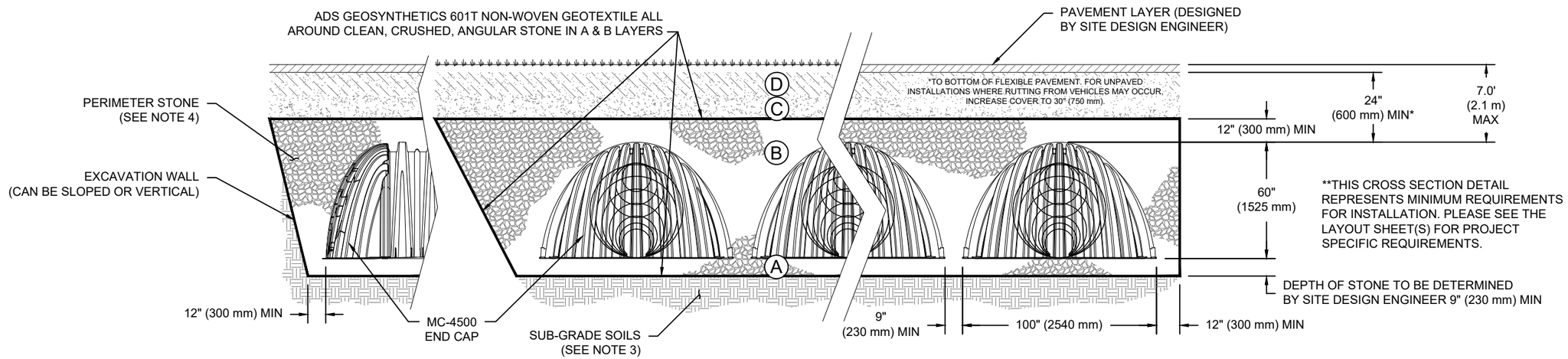
ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUB-BASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUB-GRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUB-BASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUB-BASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUB-GRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUB-BASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101
2. MC-4500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUB-GRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23°, AND C) CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.

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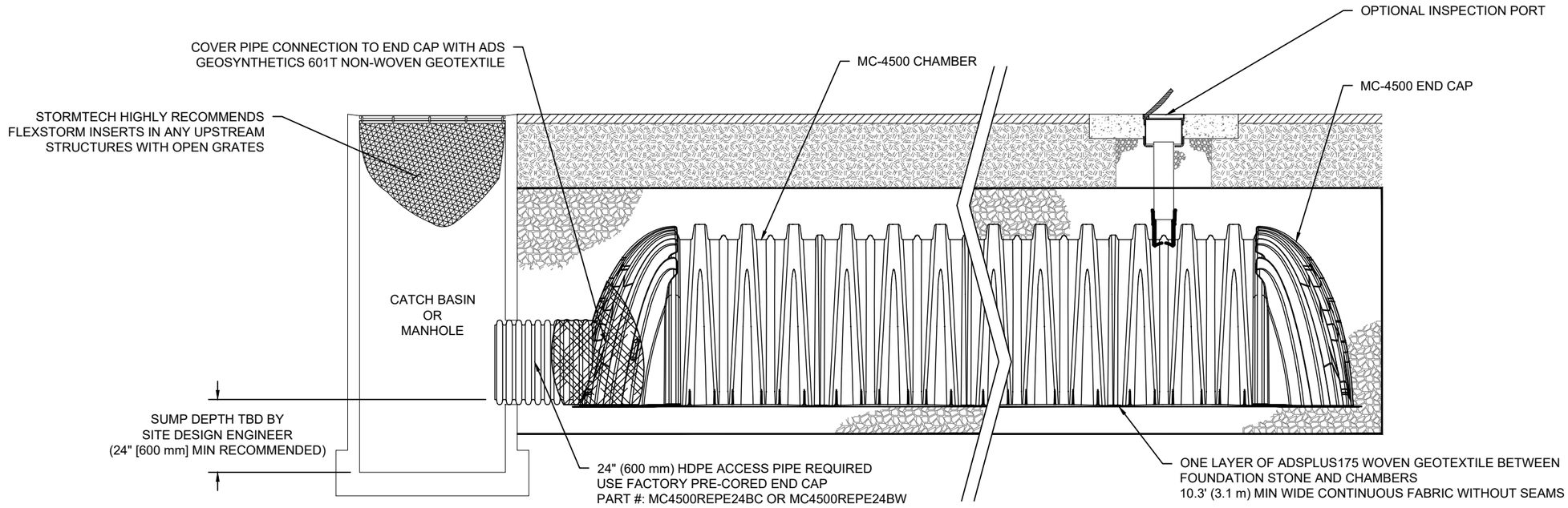

MC-4500 ISOLATOR ROW PLUS DETAIL

NTS

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH-WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

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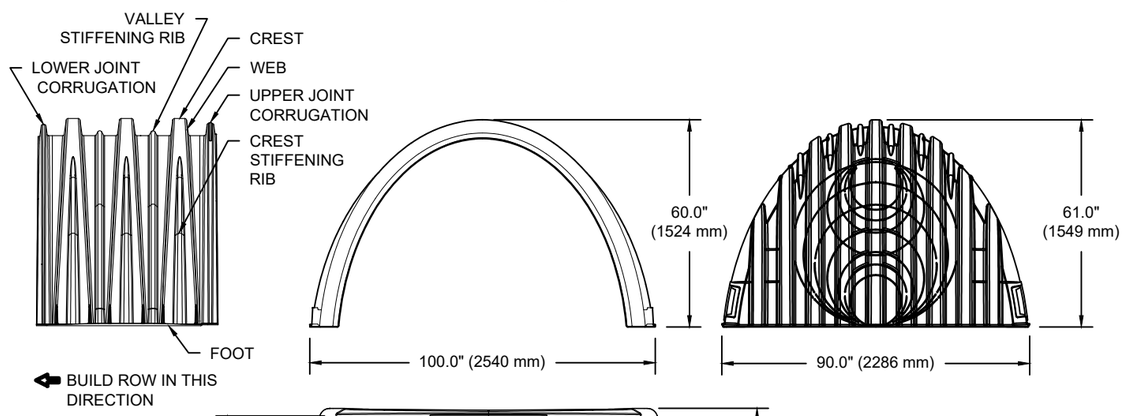
MC-4500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 48.3"	(2540 mm X 1524 mm X 1227 mm)
CHAMBER STORAGE	106.5 CUBIC FEET	(3.01 m³)
MINIMUM INSTALLED STORAGE*	162.6 CUBIC FEET	(4.60 m³)
WEIGHT (NOMINAL)	125.0 lbs.	(56.7 kg)

NOMINAL END CAP SPECIFICATIONS

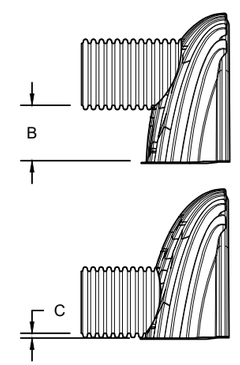
SIZE (W X H X INSTALLED LENGTH)	90.0" X 61.0" X 32.8"	(2286 mm X 1549 mm X 833 mm)
END CAP STORAGE	39.5 CUBIC FEET	(1.12 m³)
MINIMUM INSTALLED STORAGE*	115.3 CUBIC FEET	(3.26 m³)
WEIGHT (NOMINAL)	90 lbs.	(40.8 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC4500IEPP06T	6" (150 mm)	42.54" (1081 mm)	---
MC4500IEPP06B		---	0.86" (22 mm)
MC4500IEPP08T	8" (200 mm)	40.50" (1029 mm)	---
MC4500IEPP08B		---	1.01" (26 mm)
MC4500IEPP10T	10" (250 mm)	38.37" (975 mm)	---
MC4500IEPP10B		---	1.33" (34 mm)
MC4500IEPP12T	12" (300 mm)	35.69" (907 mm)	---
MC4500IEPP12B		---	1.55" (39 mm)
MC4500IEPP15T	15" (375 mm)	32.72" (831 mm)	---
MC4500IEPP15B		---	1.70" (43 mm)
MC4500IEPP18T	18" (450 mm)	29.36" (746 mm)	---
MC4500IEPP18TW			
MC4500IEPP18B		---	1.97" (50 mm)
MC4500IEPP18BW			
MC4500IEPP24T	24" (600 mm)	23.05" (585 mm)	---
MC4500IEPP24TW			
MC4500IEPP24B		---	2.26" (57 mm)
MC4500IEPP24BW			
MC4500IEPP30BW	30" (750 mm)	---	2.95" (75 mm)
MC4500IEPP36BW	36" (900 mm)	---	3.25" (83 mm)
MC4500IEPP42BW	42" (1050 mm)	---	3.55" (90 mm)

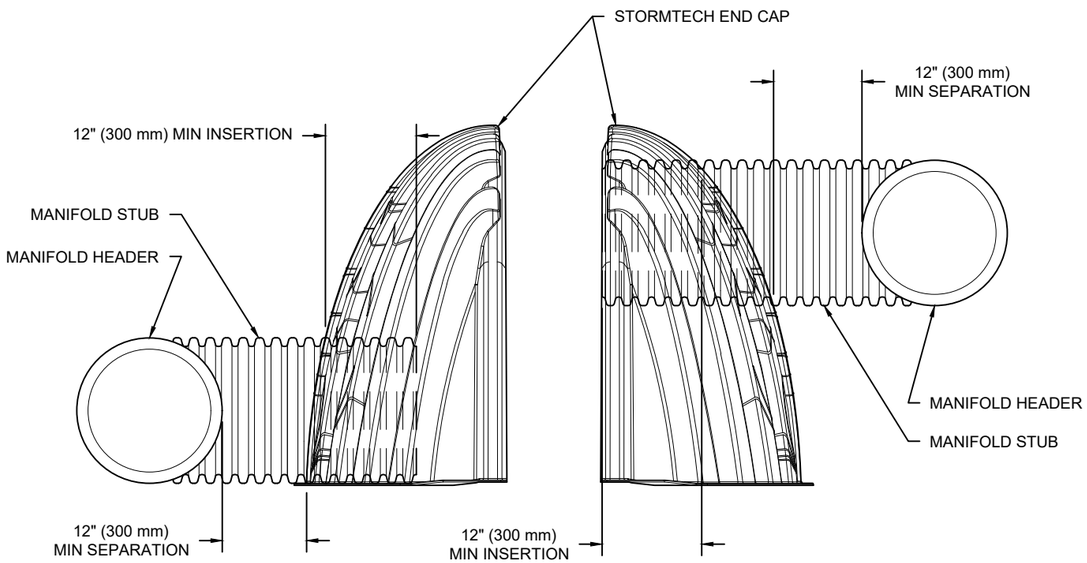
NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-4500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

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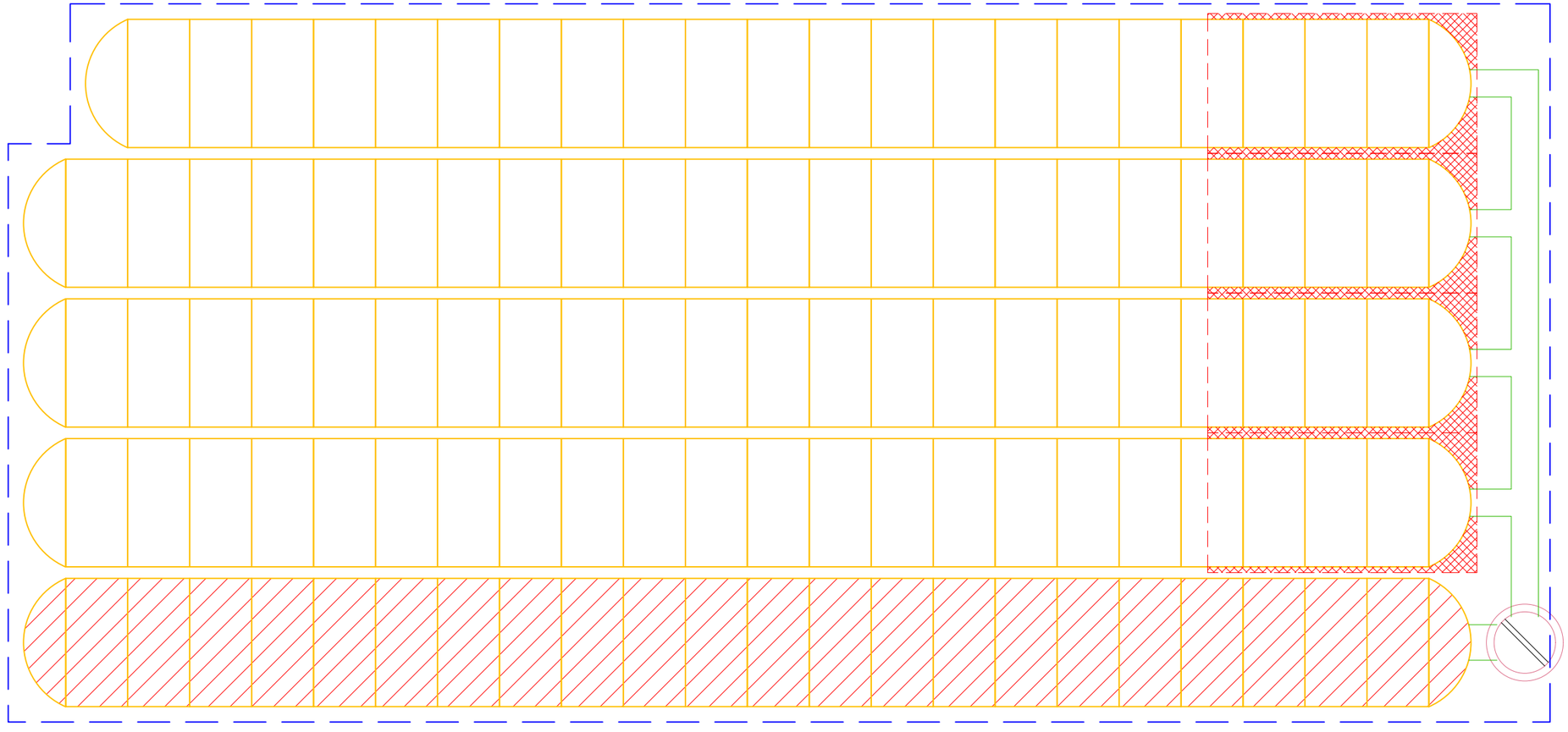

E. Bruton Consulting – Road Quality Audit

Title: **QUALITY AUDIT (Stage 1)**

For;

Knockrabo Phase 2, Goatstown, Dublin 14

Client: **Waterman Moylan**

Date: **January 2021**

Report reference: **0947R01**

VERSION: **FINAL**

Prepared By:

Bruton Consulting Engineers Ltd

Glaspistol
Clogherhead
Drogheda
Co. Louth.

Tel: 041 9881456
Mob: 086 8067075
E: admin@brutonceng.ie
W: www.brutonceng.ie

CONTENTS SHEET

Contents

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1.0 Introduction

This report was prepared in response to a request from Mr. Richard Miles of Waterman Moylan Consulting Engineers for a Quality Audit of Phase 2 of the proposed residential development at Knockrabo, Goatstown, Dublin 14.

The Quality Audit has been carried out in accordance with the guidance in the Design Manual for Urban Roads and Streets (DMURS), produced by Department of Transport Tourism and Sport in March 2013 and as updated in June 2019.

This Quality Audit is a Stage 1 audit includes a road safety audit (in accordance with TII Publication GE-DTY-01024), an access audit, a walking audit, a cycle audit and a non-motorised use audit.

The Road Safety and Quality Audit Team comprised of;

Team Leader: **Norman Bruton**, BE CEng FIEI, Cert Comp RSA.

Team Member: **Owen O'Reilly** B.SC. Eng Dip Struct. Eng NCEA Civil Dip Civil.Eng CEng MIEI

The Quality Audit involved the examination of drawings and other material provided by Waterman Moylan and a site visit by the Audit Team, together, on 25th February 2020. A more recent site visit could not be carried out due to Covid-19 Travel restrictions.

The weather at the time of the initial site visit was dry and the road surface was dry.

The problems raised in this Quality Audit may belong to more than one of the categories of Audit named above. A table has been provided at the start of Section 3 of this report detailing which category of audit each problem is associated with.

Recommendations have been provided to help improve the quality of the design with regard to the areas described above. A feedback form has also been provided for the designer to complete indicating whether or not he/she will accept those recommendations or provide alternative recommendations for implementation.

The information supplied to the Audit Team is listed in **Appendix A.**

A feedback form for the Designer to complete is contained in **Appendix B.**

A plan drawing showing the problem locations is contained in **Appendix C**.

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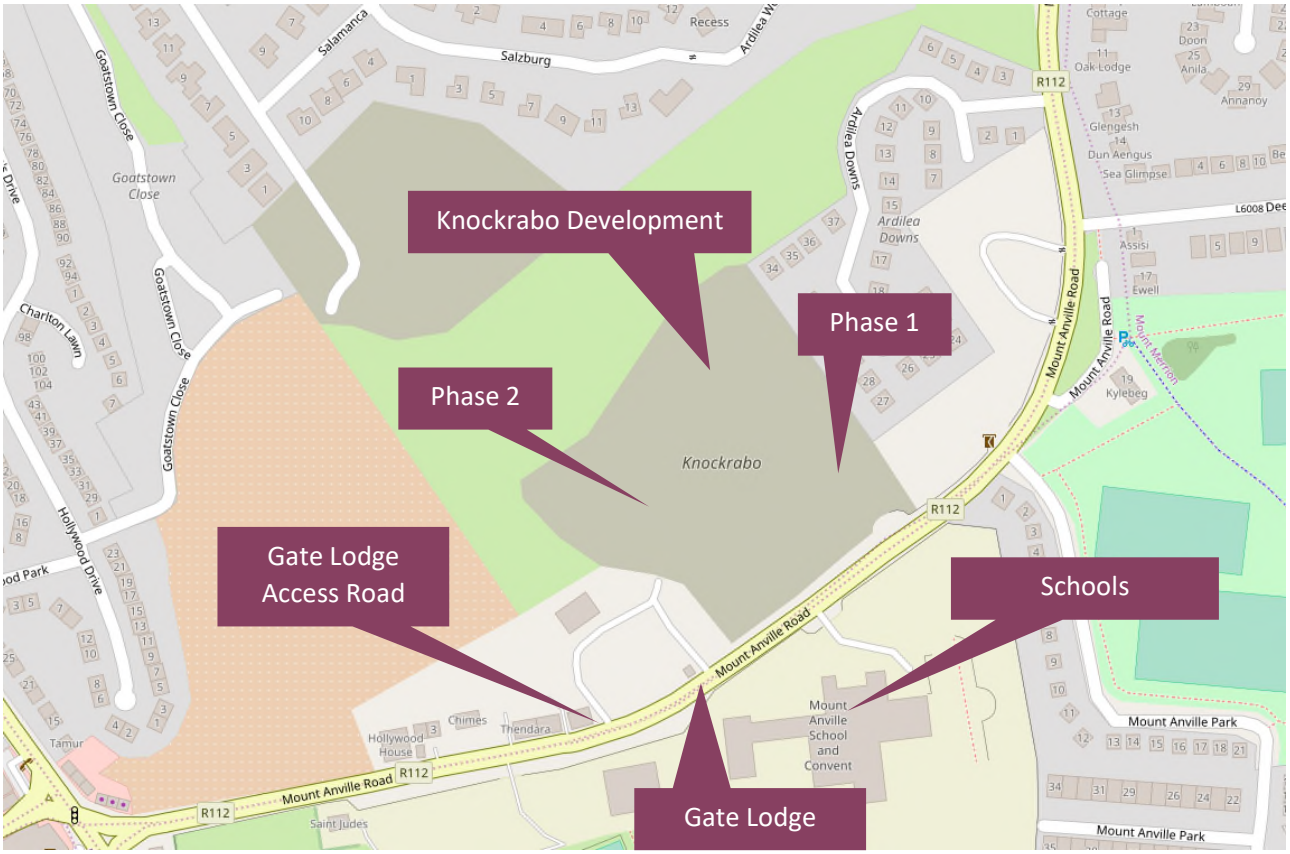
2.0 Background

It is proposed to develop Phase 2 of the Knockrabo development in Goatstown which consists of apartment blocks and housing units. This Quality Audit takes into consideration the interaction with Phase 1 of the development which was under construction at the time of the site visit.

The Knockrabo development is accessed off the R112, Mount Anville Road via a new access known as Knockrabo Way. This has been partially constructed during the Phase 1 works. The Gate lodge access road is being upgraded as part of the proposed works. The gate lodge (West) existing vehicular access is being maintained.

There are a number of schools on the opposite side of Mount Anville Road and a signalised pedestrian crossing is provided. Mount Anville road is a single carriageway road with a footpath on both sides. There are currently no dedicated cycling facilities.



Site Location Map (image courtesy of www.maps.openstreetmap.ie)

There is a reservation to the north west of the site for the Dublin Eastern Bypass. A construction access right of way is to be incorporated into the design works(through agreement with DLRCC) for Phase 2 of the Knockrabo development.

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3.0 Main Report

Summary Table of Problem Categories

Problem Reference	Access Audit	Walking Audit	Cycling Audit	Non-motorised User Audit	Road Safety Audit	Quality Audit
3.1	✓	✓		✓	✓	✓
3.2	✓	✓	✓	✓	✓	✓
3.3	✓	✓	✓			✓
3.4	✓				✓	✓

3.1 Problem

LOCATION

Drawing 20-086 P110

PROBLEM

It is proposed to have a combination of resident and visitor parking along the central road which has a gradient of 1:12.5. This steep gradient will result in accessibility issues for mobility impaired (elderly, buggy pushers etc.) to the car parking spaces from the residential units.

RECOMMENDATION

It is recommended that parking be provided in areas away from the roads with steep gradients. If this is not feasible then landing bays should be provided at regular intervals.

3.2 Problem

LOCATION

Drawing 20-086 P110

PROBLEM

The main Knockrabo Way carriageway and central road will have gradients of approximately 8%. This will make it difficult for vehicles to get traction during periods of ice or snow, especially as the slope is north facing. This could lead to collisions with vehicles, pedestrians or roadside furniture.

RECOMMENDATION

It is recommended that the surfacing course have an aggregate with a high PSV and that salt storage containers be provided where they do not block pedestrian or cyclist routes.

3.3 Problem

LOCATION

Drawing 20-086 P110

PROBLEM

There is no clear path for cyclists or pedestrians to get from the main access at Knockrabo Way to the visitor cycle parking spaces at the south western side of the site or block accesses on the southern side of the development.

RECOMMENDATION

It is recommended that a path be provided for cyclists without having to undertake sudden changes in direction and conflict with vehicular parking.

3.4 Problem

LOCATION

Drawing 20-086 P110

PROBLEM

There may be difficulty for drivers to use the most easterly parking bay for childcare on the internal road due to the approach angle of vehicles. This may lead to vehicles being parked where they protrude into the carriageway resulting in side-swipe collisions.

RECOMMENDATION

It is recommended that a swept path analysis be undertaken to ensure that this space can be easily accessed when the adjacent space is occupied.

4.0 Observations

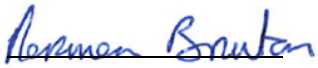
4.1 Observation

The basement layouts have not been provided to the Audit Team.

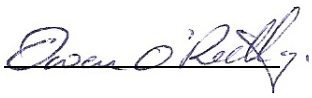
5.0 Quality Audit Statement

This quality Audit has been carried out in accordance with the guidance given in DMURS and takes into consideration the principles approaches and standards of that Manual.

The quality audit has been carried out by the persons named below who have not been involved in any design work on this scheme as a member of the Design Team.

Norman Bruton **Signed:** 

(Quality Audit Team Leader) **Dated: 9/2/2021**

Owen O'Reilly **Signed:** 

(Quality Audit Team Member) **Dated: 9/2/2021**

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Appendix A

List of material Supplied for this Quality Audit;

- Drawing 20-086 P110
- Drawing 1307F-OMP-00-00-DR-A-1000 O'Mahony Pike
- Drawing 1307F-OMP-00-00-DR-A-1010 O'Mahony Pike

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Appendix B

Feedback Form

QUALITY AUDIT FORM – FEEDBACK ON QUALITY AUDIT REPORT

Scheme: Knockrabo, Phase 2
Quality Audit- Stage 1
Date Audit (site visit) Completed 25-2-2020

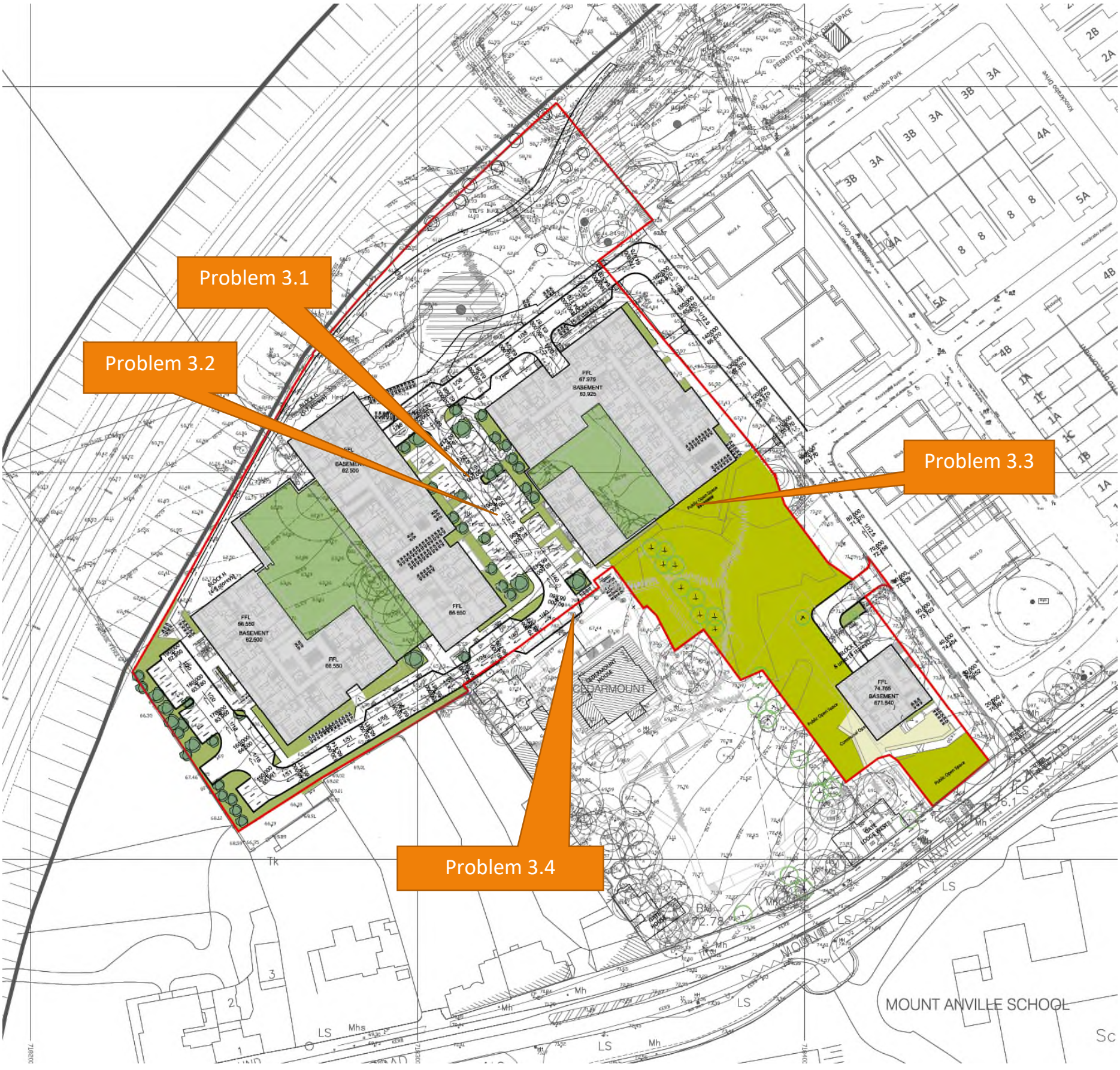
Paragraph No. in Quality Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Alternative measures (describe)	Alternative measures accepted by Auditors (Yes/No)
3.1	Yes	Yes	It is proposed to retain parking along this central road. Disabled spaces are not proposed on this steep section of road. Disabled space parking and parking for mobility impaired shall be afforded at podium level and along flatter gradient east/west road to allow for safe access for all. The potential for landing bays shall be reviewed on steeper sections of road through detail design stage.	Yes
3.2	Yes	Yes		
3.3	Partial	Partial	A path network exists for pedestrians/cyclists through the public open space indicated. This shall be detailed clearly on final issue submitted planning drawings.	Yes
3.4	Yes	Yes	Swept path to be undertaken to demonstrate function, and necessary adjustments shall be made if required.	Yes

Signed…… **Date …08-02-2021……**
Design Team Leader

Signed…… **Date**: …9/2/2021……
Audit Team Leader

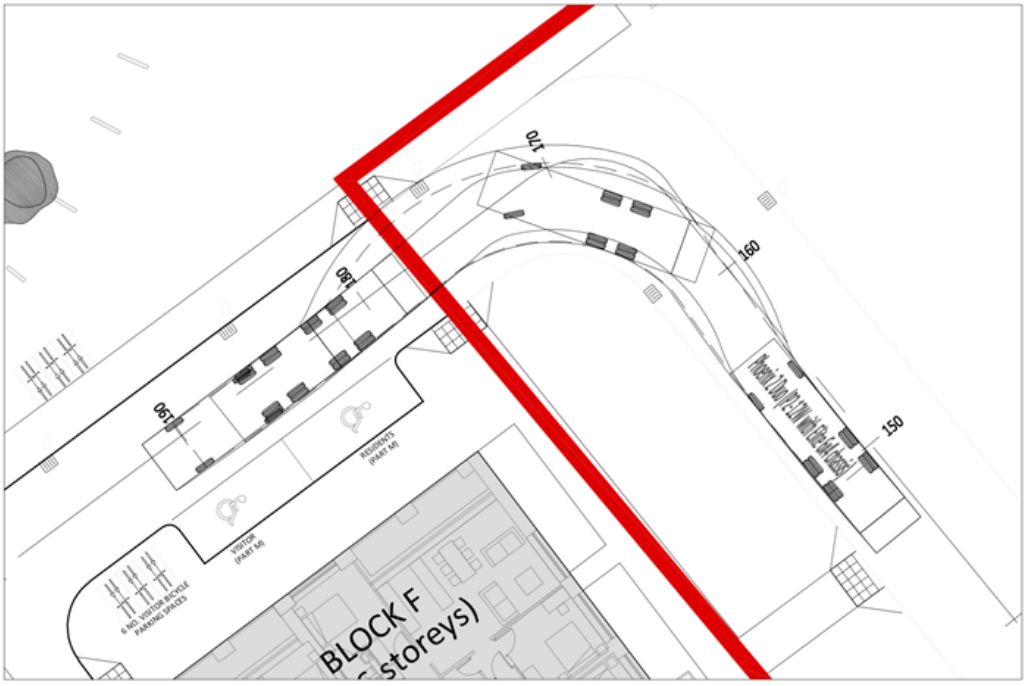
Appendix C

Problem Location Plan.


Problem 3.1
Problem 3.2
Problem 3.3
Problem 3.4
MOUNT ANVILLE SCHOOL
CEDARMOUNT
Knockrabo Park
Knockrabo Drive
Knockrabo Avenue
Knockrabo Court
ANVILLE
MOUNT
FFL 67.979
BASEMENT 63.925
FFL 66.550
BASEMENT 62.500
FFL 74.765
BASEMENT 671.540
Public Open Space
Tk
LS
Mh
Mhs

F. Refuse, Fire & Creche Parking Tender Swept Path Analysis

Refuse

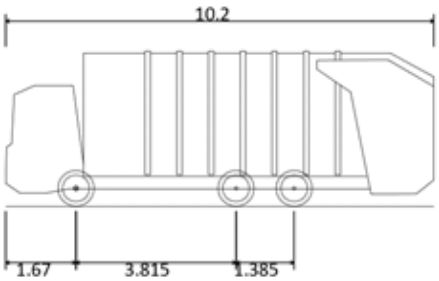


ACCESS ROAD PHASE 2 ENTRANCE

SHARED SURFACE ENTRANCE

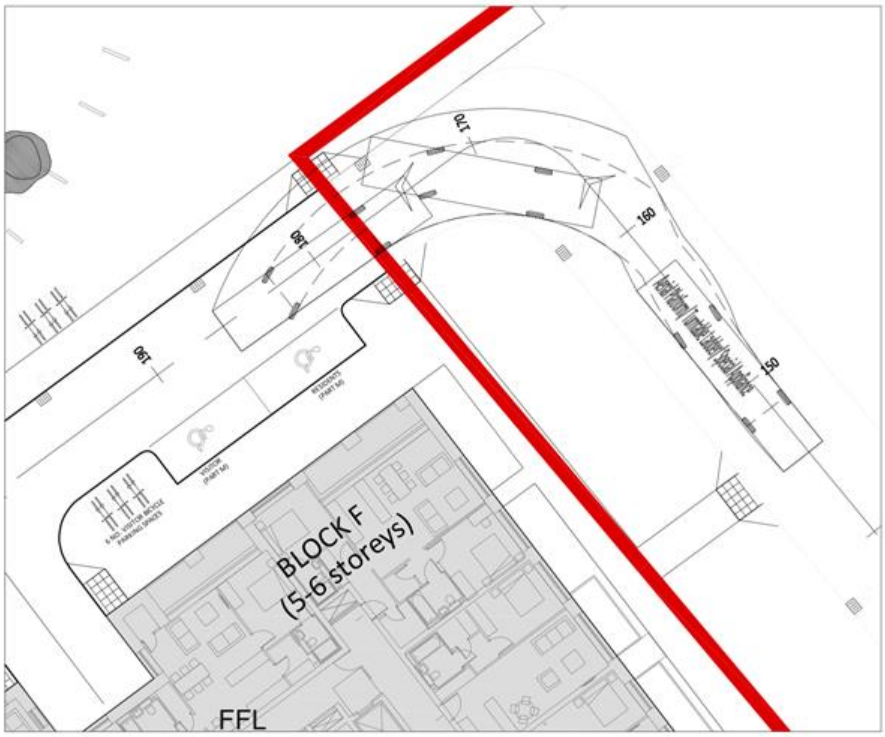
SHARED SURFACE LEFT HAND BEND

3 POINT TURN AT TURNING HEAD



Phoenix 2 Duo (P2-12W with Elite 6x4 chassis)	
Overall Length	10.200m
Overall Width	2.530m
Overall Body Height	3.751m
Min Body Ground Clearance	0.304m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	7.800m

High Reach Fire Tender

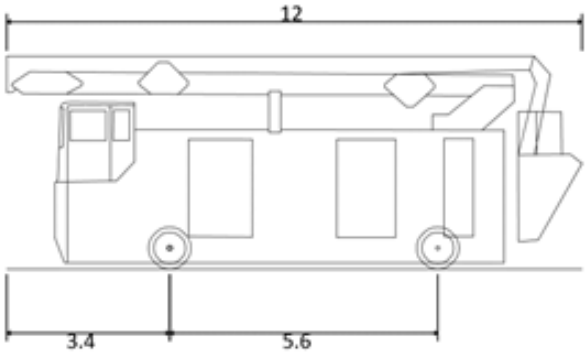


ACCESS ROAD PHASE 2 ENTRANCE

SHARED SURFACE ENTRANCE

SHARED SURFACE LEFT HAND BEND

3 POINT TURN AT TURNING HEAD



Aerial Platform/ Turntable Ladder/ Special Appliance	
Overall Length	12.000m
Overall Width	2.550m
Overall Body Height	4.500m
Min Body Ground Clearance	0.130m
Track Width	2.550m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	13.750m

Creche Staff Parking Movements In & Out

G. Irish Water Confirmation of Feasibility Letter & Statement of Design Acceptance

Stephen Dent-Neville

Eastpoint Business Park,
Block S, Alfie Byrne Road
Dublin 3
Co. Dublin
D03H3F4

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

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

www.water.ie

10 Jun 2021

Re: CDS21002520 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 227 units at Knockrabo, Mount Anville Road, Dublin

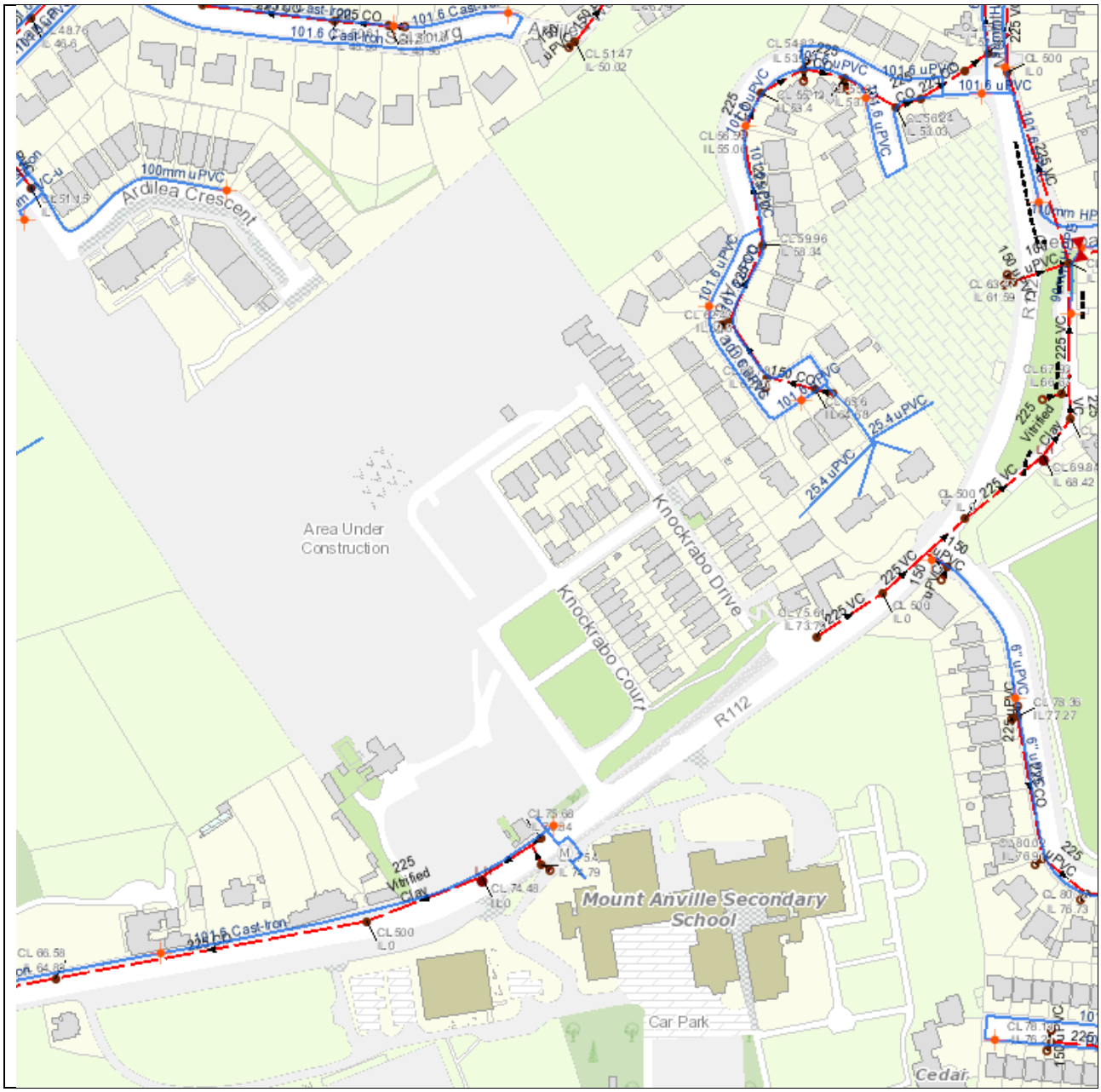
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Knockrabo, Mount Anville Road, Dublin (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Where any connection is proposed to private infrastructure all relevant wayleave and permissions would need to be obtained by the Developer. Please be advised that at connection application stage you have to provide written confirmation from the owner of the infrastructure that you have received legal permission to connect to and that the infrastructure is fit for purpose and has capacity to cater for the additional load. The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Maria O'Dwyer
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
IW-HP-BUS
REV012

The map included below outlines the current Irish Water infrastructure adjacent to your site:



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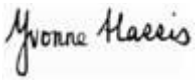
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish 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.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

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

Yours sincerely,



Yvonne Harris

Head of Customer Operations

Stephen Dent-Neville
Eastpoint Business Park,
Block S, Alfie Byrne Road
Dublin 3, Co. Dublin D03H3F4

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

4 October 2021

Re: Design Submission for Knockrabo, Mount Anville Road, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS21002520

Dear Stephen Dent-Neville,

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: Marina Byrne
Phone: 01 89 25991/ 087619321
Email: mzbyrne@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Maria O'Dwyer
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

IW-HP-MD
REV012

Appendix A

Document Title & Revision

- [20-086-P121A Drainage Layout Sheet 1 of 2, 20-086-P122A Drainage Layout Sheet 2 of 2, 20-086-P124 Waste Water Longitudinal Sections]

- [20-086-P130A Watermains Layout Plan,]

*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.

NOTES

"It is the Contractors responsibility to ensure that all works are constructed in accordance with the Irish Water Code of Practice and Standard Details. The Code of Practice and Standard Details are available to download from the Irish Water web site at www.water.ie/connections/developer-services/ Where the details contained on this drawing differ from the Irish Water Code of Practice or Standard Details this must be brought to the attention of the engineer immediately. Irish Water standards will take precedence"

F4
CL 61.055
IL IN A 58.831
IL IN B 60.231
IL OUT 59.811

S8
CL 61.200
IL IN A 59.575
IL IN B 59.775
IL OUT 59.550

S15
CL 63.715
IL A IN 62.385
IL B IN 62.385
IL OUT 62.210

PREVIOUSLY APPROVED FOUL DRAINAGE SYSTEM D17A/1124

PREVIOUSLY APPROVED FOUL IN KNOCKRABO WAY TO BE CONSTRUCTED CONCURRENTLY TO FACILITATE DRAINAGE OF ENTRANCE BLOCK E. NO BLIND MANHOLE REQUIRED.

Knockrabo Way

Public Open Space

S11
CL 62.815
IL A IN 61.255
IL B IN 61.135
IL C IN 61.234
IL OUT 60.535

S7
CL 61.500
IL IN 60.140
IL OUT 60.065

F5
CL 61.259
IL IN 60.020
IL OUT 60.000

F6
CL 61.700
IL IN 60.125
IL OUT 60.100

S6
CL 61.795
IL IN 60.260
IL OUT 60.240

S5
CL 62.025
IL IN 60.338
IL OUT 60.316

F7
CL 62.140
IL IN 60.935
IL OUT 60.915

S4
CL 62.260
IL IN 60.520
IL OUT 60.370

S10.1 BLOCK H OUTFALL
CL 62.395
IL 60.978

F8 BLOCK H OUTFALL
CL 62.395
IL 60.975

225ø SW OUTFALL FROM BLOCK H

225ø FW OUTFALL FROM BLOCK H

S3
CL 62.760
IL IN 61.260
IL OUT 60.660

FFL 66.550
BASEMENT 62.500
BLOCK G (5-7 storeys)

FFL 66.550
BASEMENT 62.500
BLOCK H (4-5 storeys)

FFL 66.550

FFL 67.975
BASEMENT 63.925
BLOCK F (5-6 storeys)

SH.1
CL 62.760
IL IN A 60.725
IL IN B 61.335
IL IN C 60.745
IL OUT 60.700

F4.1
CL 63.461
IL IN 61.560
IL OUT 60.960

F4.2
CL 64.298
IL IN 62.875
IL OUT 62.275

S10
CL 64.092
IL IN 62.665
IL OUT 62.065

F4.3
CL 66.617
IL IN 65.119
IL OUT 64.520

S9
CL 66.570
IL IN 65.170
IL OUT 64.750

F4.4
CL 66.805
IL IN 65.353
IL OUT 65.378

S8
CL 66.830
IL IN 65.425
IL OUT 65.400

BLANKED 225ø SPURS FOR FUTURE CONNECTION

BLIND MANHOLE IN ACCORDANCE WITH SECTION 1.23 OF CODE OF PRACTICE

S1
CL 65.915
IL 64.400

S2
CL 65.050
IL IN 63.225
IL OUT 63.200

Childcare play area

CEDERMOUNT HOUSE

CEDARMOUNT

COACH HOUSE

Public Open Space

NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.

LEGEND:

- EXFSMH CL X IL X — EXISTING FOUL SEWER WITH PIPE SIZE, MANHOLE REF. AND INVERT LEVEL
- EXSWMH CL X IL X — EXISTING SURFACE WATER SEWER WITH PIPE SIZE, MANHOLE REF. AND INVERT LEVEL
- FX CL X IL X — PROPOSED uPVC SN8 FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL 500mm RING OFFSET INDICATED
- SX CL X IL X — PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- PROPOSED PERFORATED PIPE
- PROPOSED GULLY AND CONNECTION
- PROPOSED PERMEABLE PAVED PARKING BAY
- EXISTING TREE TO BE RETAINED WITH ROOT PROTECTION ZONE INDICATED
- EXTENT OF STORMWATER ATTENUATION STORAGE

NOTE:
ALL PROPOSED PUBLIC STORM WATER DRAINAGE WORKS TO BE IN ACCORDANCE WITH DUN LAOGHAIRE RATHDOWN REQUIREMENTS FOR TAKING IN CHARGE AND IN ACCORDANCE WITH THE GREATER DUBLIN REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS.

ALL PROPOSED PUBLIC FOUL WATER DRAINAGE WORKS TO BE IN ACCORDANCE WITH IRISH WATER REQUIREMENTS.

ALL PRIVATE DRAINAGE WORKS SHALL BE IN ACCORDANCE WITH THE BUILDING REGULATIONS PART H.

ALL COVER LEVELS ARE INDICATIVE ONLY AND SHOULD BE SET TO SUIT THE FINISHED ROAD OR PAVED LEVEL.

WHERE COVER TO FOUL SEWER IS LESS THAN 1.2m CONCRETE SURROUND TO BE PROVIDED IN ACCORDANCE WITH IRISH WATER STANDARDS SEE SECTION 3.9 OF COP

BASEMENTS TO DRAIN VIA GRAVITY TO FOUL NETWORK. NO PUMPING REQUIRED.
NO STORMWATER CONNECTION TO FOUL PROPOSED.

MANHOLE COVERS LOCATED IN SOFT LANDSCAPED/GRASS AREAS ARE TO BE SURROUNDED BY A CONCRETE PLINTH, 200MM ALL ROUND AND 100MM DEEP FORMED WITH C20/25 CONCRETE, 20MM AGGREGATE SIZE, BEDDED IN CLAUSE 804 MATERIAL.

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REV.	DATE	AMENDMENT	DRN	APPD
A	01/10/21	REVISED TO IRISH WATER COMMENTS	NS	RM

STATUS
PLANNING

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD, DUBLIN D03 H3F4 IRELAND. Tel: (01) 664 8900
Email: info@waterman-moylan.ie www.waterman-moylan.ie

CLIENT KNOCKRABO INVESTMENTS DAC
ARCHITECT OMP ARCHITECTS
PROJECT
PHASE 2 RESIDENTIAL DEVELOPMENT AT KNOCKRABO, Mt. ANVILLE Rd. DUBLIN 14
TITLE
DRAINAGE LAYOUT SHEET 1 OF 2

DRAWN	DESIGNED	APPROVED	DATE
NS	RM	MD	FEB 2021
SCALE	JOB NO.	DRG. NO.	REVISION
1:250 @ A1	20-086	P121	A

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S0
CL 60.000
IL 57.435

DOWNSTREAM DEFENDER ON STORM WATER SPUR CONSTRUCTED UNDER PHASE 1

EXISTING OUTFALL SEWERS CONSTRUCTED FOR FUTURE CONNECTION

F0 END OF EXISTING SPUR CONSTRUCTED UNDER PHASE 1
IL 57.120

F1
CL 60.000
IL IN 58.550
IL OUT 57.145

F2
CL 60.000
IL 58.600

S1 STORAGE OUTLET WITH FLOW CONTROL AT 5.943L/s AND PENSTOCK
CL 60.000
IL 57.495

225ø SWS @ 1/200 ->

SURFACE WATER UNDERGROUND STORAGE INTORMTEC MC-4500 UNITS TO PROVIDE FOR STORAGE OF STORAGE: 5 ROWS OF 17 CHAMBERS 1 ROW OF 12 CHAMBERS

IL 57.575

FALL @ 1/200

IL 57.690

ISOLATOR ROW @ 1/200 ->

<-225ø PERFORATED PIPE @ 1/50 IN SWALE

6.451
OPEN GRATED MANHOLE

F3
CL 61.200
IL IN 59.700
IL OUT 59.680

450ø SWS @ 1/200 ->

S3
CL 61.300
IL IN 59.320
IL OUT 59.295

S9
CL 61.200
IL IN 59.455
IL OUT 59.435

S2 STORAGE INLET
CL 61.390
IL IN 59.225
IL OUT 57.665

OPEN GRATED MANHOLE

F4
CL 61.055
IL IN A 58.831
IL IN B 60.231
IL OUT 59.811

S8
CL 61.200
IL IN A 59.575
IL IN B 59.775
IL OUT 59.550

225ø FWS @ 1/200 ->

450ø SWS @ 1/200 ->

<-225ø FWS @ 1/60

<-375ø SWS @ 1/26

375ø SWS @ 1/69 ->

Public Open Space

S15
CL 63.715
IL A IN 62.385
IL B IN 62.385
IL OUT 62.310

<-225ø SWS @ 1/25 (90)

<-225ø FWS @ 1/25 (90)

F4.1A
CL 63.585
IL IN 62.354
IL OUT 61.754

<-225ø SWS @ 1/60

<-225ø PERFORATED PIPE @ 1/32

<-300ø SWS @ 1/28

<-225ø FWS @ 1/151

F4.1
CL 63.461
IL IN 61.560
IL OUT 60.960

<-225ø FWS @ 1/60

S11
CL 62.815
IL A IN 61.255
IL B IN 61.135
IL C IN 61.235
IL OUT 60.535

225ø SWS @ 1/100 ->

225ø FWS @ 1/60 ->

F5.1
CL 62.760
IL IN A 60.725
IL IN B 61.335
IL IN C 60.745
IL OUT 60.700

<-225ø SWS @ 1/25

<-225ø FWS @ 1/24

S10
CL 64.092
IL IN 62.665
IL OUT 62.065

F4.2
CL 64.298
IL IN 62.875
IL OUT 62.275

<-225ø SWS @ 1/20

<-225ø FWS @ 1/20

S9
CL 66.570
IL IN 65.170
IL OUT 64.750

F4.3
CL 66.617
IL IN 65.119
IL OUT 64.520

225ø FWS @ 1/60 ->

225ø SWS @ 1/75 ->

S8
CL 66.830
IL IN 65.425
IL OUT 65.400

F4.4
CL 66.805
IL IN 65.353
IL OUT 65.378

PLANKED 225ø SPURS

61.500
IN 60.140
OUT 60.065

FFL
66.550
BASEMENT
62.500
BLOCK G
(5-7 storeys)

FFL
66.550

BLOCK H
(4-5 storeys)

FFL
67.975
BASEMENT
63.925
BLOCK F
(5-6 storeys)

Public Open Space

Childcare play area

PREVIOUSLY APPROVED MANHOLE D17A/1124
S14
CL 65.036
IL 62.800

PREVIOUSLY APPROVED MANHOLE D17A/1124
F4.1.3
CL 65.020
IL 63.925

CONNECTION POINT TO PREVIOUSLY APPROVED STORM DRAINAGE SYSTEM D17A/1124

CONNECTION POINT TO PREVIOUSLY APPROVED FOUL DRAINAGE SYSTEM D17A/1124

PREVIOUSLY APPROVED FOUL IN KNOCKRABO WAY TO BE CONSTRUCTED CONCURRENTLY TO FACILITATE DRAINAGE OF ENTRANCE BLOCK E. NO BLIND MANHOLE REQUIRED.

F5.2
CL 68.631
IL 66.252

F5.3
CL 71.331
IL 69.900

F5.4
CL 72.010
IL 70.210

F5.3
CL 71.730
IL 70.410

<-225ø FWS @ 1/60

Block A

APARTMENTS UNDER CONSTRUCTION

Block B

Block C

Knockrabo Court

Knockrabo Way

Knockrabo Avenue

3B

4A

N

NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.

LEGEND:

- EXFSMH CL X IL X — EXISTING FOUL SEWER WITH PIPE SIZE, MANHOLE REF. AND INVERT LEVEL
- EXSWMH CL X IL X — EXISTING SURFACE WATER SEWER WITH PIPE SIZE, MANHOLE REF. AND INVERT LEVEL
- FX CL X IL X — PROPOSED uPVC SN8 FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL 500mm RING OFFSET INDICATED
- SX CL X IL X — PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- PROPOSED PERFORATED PIPE
- PROPOSED GULLY AND CONNECTION
- PROPOSED PERMEABLE PAVED PARKING BAY
- EXISTING TREE TO BE RETAINED WITH ROOT PROTECTION ZONE INDICATED
- EXTENT OF STORMWATER ATTENUATION STORAGE

NOTE:
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REV.	DATE	AMENDMENT	DRN	APPD
A	01/10/21	REVISED TO IRISH WATER COMMENTS	NS	RM

STATUS
PLANNING

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD, DUBLIN D03 H3F4 IRELAND. Tel: (01) 664 8900
Email: info@waterman-moylan.ie www.waterman-moylan.ie

CLIENT KNOCKRABO INVESTMENTS DAC

ARCHITECT OMP ARCHITECTS

PROJECT
PHASE 2 RESIDENTIAL DEVELOPMENT AT KNOCKRABO, Mt. ANVILLE Rd. DUBLIN 14

TITLE
DRAINAGE LAYOUT
SHEET 2 OF 2

DRAWN	DESIGNED	APPROVED	DATE
NS	RM	MD	FEB 2021
SCALE	JOB NO.	DRG. NO.	REVISION
1:250 @ A1	20-086	P122	A

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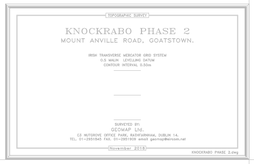
NOTE:– WATER METERS FOR APARTMENTS SHALL BE INSTALLED INTERNALLY WITHIN THE PREMISES IN ACCORDANCE WITH THE BUILDING CONTROL AUTHORITY'S REQUIREMENTS AND SUBJECT TO REVIEW BY IRISH WATER AS PER SECTION 3.15.2 OF THE CODE OF PRACTICE.

COMMUNAL BOUNDARY BOX, EACH DWELLING SHALL HAVE ITS OWN SUPPLY PIPE, METER AND STOP VALVE. ALL METERS IN THE MANIFOLD SHALL BE TAGGED TO INDICATE WHICH PROPERTY IS SUPPLIED AND ANY UNUSED OUTLETS ARE TO BE BLANKED OFF. SEE SECTION 3.15.3 OF THE WATER CODE OF PRACTICE.

AIR VALVE AND HYDRANT COVERS, WHERE LOCATED IN GRASS, SHALL BE SURROUNDED BY A CONCRETE PLINTH, 200MM ALL ROUND AND 100MM DEEP, FORMED WITH C20/25 CONCRETE, 20MM AGG SIZE, AND BEDDED IN CL804 MATERIAL. THE PLINTH SHALL INCORPORATE MILD STEEL REINFORCEMENT LINKS AND SHALL HAVE A BULL–NOSE FINISH AROUND ITS EXTERNAL PERIMETER. SEE SECTION 3.18 OF WATER CoP (APPLICABLE TO H05 AND H06)



NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.
3. ALL PROPOSED PIPE MATERIALS SHOWN ARE HDPE, UNLESS STATED OTHERWISE, AND SHALL COMPLY WITH SECTION 3.9 OF THE IRISH WATER'S CODE OF PRACTICE.

LEGEND

100mmø ID – HDPE	PROPOSED HDPE WATERMAIN
SV	PROPOSED SLUICE VALVE
H	PROPOSED HYDRANT
AV	PROPOSED AIR VALVE
B	PROPOSED BOUNDARY BOX
M	PROPOSED METER BOX
150mm ø WATERMAIN	EXISTING WATERMAIN AND PIPE SIZE

NOTES:

1. ALL PIPE MATERIALS TO BE IN ACCORDANCE WITH IRISH WATER STANDARDS AND SPECIFICATIONS.
2. ALL WATERMAINS UNDER ROADS OR AT ROAD CROSSINGS TO BE HDPE OR DUCTILE IRON.
3. HDPE DISTRIBUTION PIPES TO BE PE–100(SDR–17).
4. DUCTILE IRON PIPES TO IS EN 545 WITH C40 POWER RATING.
5. SEPARATION DISTANCES BETWEEN WATERMAINS ASSOCIATED WITH THE WORKS FROM OTHER UTILITY PIPES AND ACCESSORIES SHALL BE IN ACCORDANCE WITH SECTION 3.6 OF THE CODE OF PRACTICE AND STD–W–11.
6. MINIMUM SEPARATION DISTANCES FOR GAS NETWORKS IRELAND INFRASTRUCTURE SHALL BE IN ACCORDANCE WITH IS329 'GAS DISTRIBUTION MAINS' AND IS328 'CODE OF PRACTICE FOR GAS TRANSMISSION MAINS' AS AMENDED UPDATED.

NOTES

"It is the Contractors responsibility to ensure that all works are constructed in accordance with the Irish Water Code of Practice and Standard Details. The Code of Practice and Standard Details are available to download from the Irish Water web site at www.water.ie/connections/developer-services/ Where the details contained on this drawing differ from the Irish Water Code of Practice or Standard Details this must be brought to the attention of the engineer immediately. Irish Water standards will take precedence"

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REV.	DATE	AMENDMENT	DRN	APPD
A	01/10/21	REVISED TO IRISH WATER COMMENTS	NS	RM

STATUS **PLANNING**

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CLIENT	KNOCKRABO INVESTMENTS DAC
ARCHITECT	OMP ARCHITECTS
PROJECT	PHASE 2 RESIDENTIAL DEVELOPMENT AT KNOCKRABO, Mt. ANVILLE Rd. DUBLIN 14
TITLE	PROPOSED WATERMAINS

DRAWN	DESIGNED	APPROVED	DATE
NS	NS	MD	OCT 2020
SCALE	JOB NO.	DRG. NO.	REVISION
1:500	20–086	P130	A

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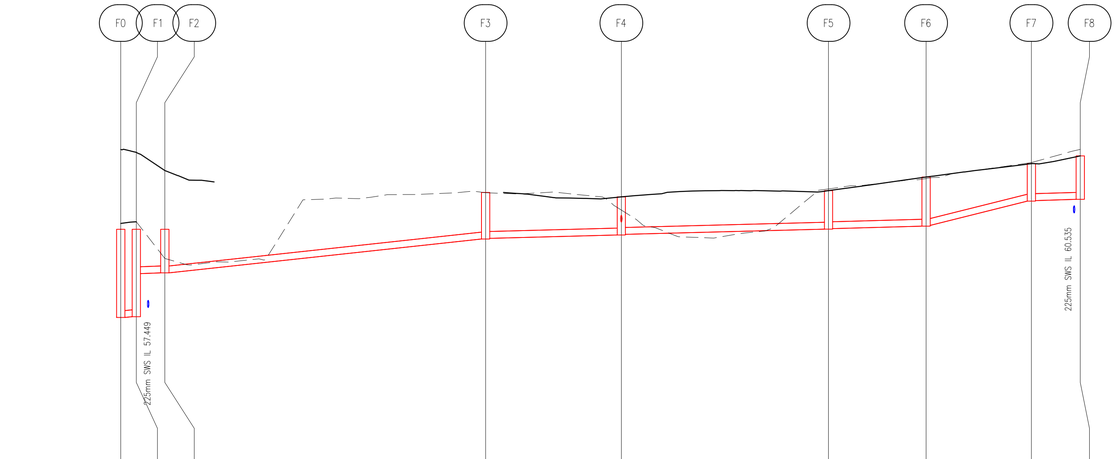
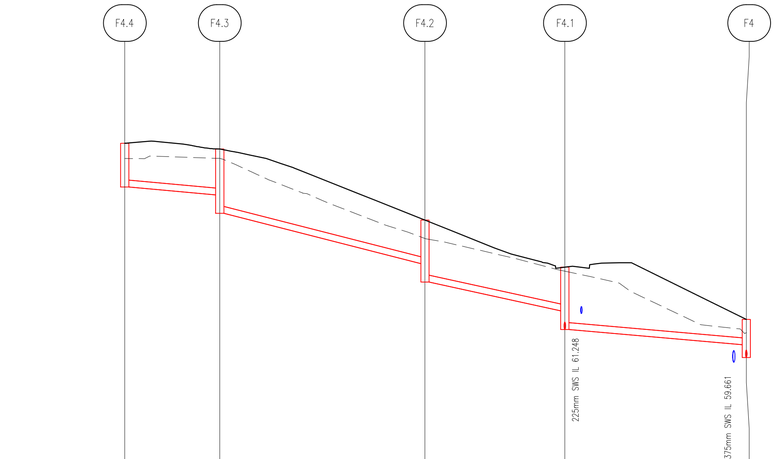
NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.



DATUM R.L. 52.000																	
GRADE		1in101		1in186		1in47		1in200		1in200		1in200		1in22		1in200	
DIAMETER		225		225		225		225		225		225		225		225	
DEPTH TO INVERT OF SEWER	2.880	2.865	1.425		1.520	1.500		1.243	1.223		1.259	1.239	1.602	1.577	1.225	1.205	1.419
INVERT LEVEL	57.120	57.145	58.575		59.680	59.700		59.811	59.831		60.000	60.020	60.100	60.125	60.915	60.935	60.975
DESIGN SURFACE LEVEL	60.000	60.000	60.000		61.200	61.200		61.055	61.055		61.259	61.259	61.702	61.702	62.140	62.140	62.394
EXISITNG GROUND LEVEL	60.190	60.242	59.045		61.192	61.192		60.625	60.625		61.314	61.314	61.652	61.652	62.176	62.176	62.604
RUNNING CHAINAGE	0.000	2.535	4.658	7.193	52.367	59.560	22.158	81.718	33.824	115.542	15.921	131.463	17.197	148.660	7.981	156.641	

SCALE 1:500 HORIZONTAL @ A1
1:100 VERTICAL @ A1



DATUM R.L. 56.000									
GRADE		1in60		1in20		1in24		1in60	
DIAMETER		225		225		225		225	
DEPTH TO INVERT OF SEWER	1.425	1.425	1.497	2.697	1.423	2.023	1.425	2.035	1.243	0.823
INVERT LEVEL	65.378	65.119	64.520		62.875	62.275	61.135	60.725	59.811	60.231
DESIGN SURFACE LEVEL	66.803	66.617			64.298		62.760		61.055	
EXISITNG GROUND LEVEL	66.307	66.315			63.699		62.630		60.625	
RUNNING CHAINAGE	0.000	15.503	15.503	33.502	49.005	22.834	71.839	29.619	101.458	

SCALE 1:500 HORIZONTAL @ A1
1:100 VERTICAL @ A1

DATUM R.L. 55.000							
GRADE		1in25		1in147		1in68	
DIAMETER		225		225		225	
DEPTH TO INVERT OF SEWER	1.695		1.641	2.241	1.613	2.213	2.035
INVERT LEVEL	63.325		62.354	61.754	61.560	60.960	60.725
DESIGN SURFACE LEVEL	65.020		63.995		63.173		62.760
EXISITNG GROUND LEVEL	63.497		63.580		63.461		62.630
RUNNING CHAINAGE	0.000	24.456	24.456	28.490	52.946	15.885	68.831

SCALE 1:500 HORIZONTAL @ A1
1:100 VERTICAL @ A1

REV.	DATE	AMENDMENT	DRN	APPD

STATUS
PLANNING

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CLIENT **REGENCY**

ARCHITECT **OMP ARCHITECTS**

PROJECT
PHASE 2 RESIDENTIAL DEVELOPMENT AT KNOCKRABO, Mt. ANVILLE Rd. DUBLIN 14

TITLE
WASTE WATER LONGITUDINAL SECTIONS

DRAWN	DESIGNED	APPROVED	DATE
NS	NS	MD	FEB 2021
SCALE	JOB NO.	DRG. NO.	REVISION
AS SHOWN	20-086	P124	

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