Warehousing / Logistics, Office, and Cafe / Restaurant Development at Calmount Road

Engineers Response to Further Information Request

210175-DBFL-TR-XX-RP-C-0004

TRANSPORTATION

September 2022

DBFL CONSULTING ENGINEERS

Project Title:	**Warehousing / Logistics, Office, and Cafe / Restaurant Development at Calmount Road**		
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Rev.	Date	Description	Prepared	Reviewed	Approved
0	29/08/22	Design Team Review	Vivek Joy	Thomas Jennings	Thomas Jennings
1	06/09/22	Planning FI Draft	Vivek Joy	Thomas Jennings	Thomas Jennings
2	09/09/22	Planning FI	Vivek Joy	Thomas Jennings	Thomas Jennings

Contents

1 INTRODUCTION

1.1 BACKGROUND

DBFL Consulting Engineers (DBFL) have been retained by Blackwin Limited to prepare the necessary engineering response to a Further Information Request (FIR) issued by the South Dublin County Council (SDCC) Planning and Development Department in June 2022 with regard to the subject Warehouse / Logistics / Office and Café development at Calmount Rd and Ballymount Avenue, Dublin 12 (Ref no. SD22A/0099).

The proposed development consists of the following key elements:

- Construction of 5 no. warehouse / logistics units (Units 1, 2 3, 4 and 6), including ancillary office use and entrance / reception areas, car parking to the front, and rear service yards (GFA 20,158 sq.m);
- Construction of 3 no. 3 storey own-door office buildings (Block 5A, 5B and 5C - a combined GFA of 4,194 sq.m) to the southeast of the site with internal car parking spaces and cycle parking spaces;
- Construction of a café/restaurant unit (GFA of 213 sq.m) located in the south western section of the site with outdoor seating, car and bicycle parking spaces
- The development is to be accessed off Ballymount Avenue and Calmount Road and includes for alterations and upgrades to the public footpaths and road. The development provides for internal access roads, circulation areas and footpaths in parallel with comprehensive landscaping and planting, new boundary treatments, lighting, PV panels, green roofs, underground foul and storm water drainage network, including connections to the foul and surface water drainage network on the public roads, attenuation areas and all associated site works and development.

Whilst this report should be considered in reference to the submitted Traffic and Transportation Assessment (TTA) Report and Mobility Management Report, as a result of a number of amendments to the scheme proposals (as incorporated to address the planning authorities FIR) the following documentation compiled by the design team should also be reviewed in parallel with this engineering focused report.

- John Spain & Associates – Statement of Consistency (dated September 2022)
- TOT Architects – Architectural Design Statement (dated September 2022)

- TOT Architects – Coordinated Design Team Response Report
- Murray & Associates Landscape Architects – Green Infrastructure Report
- Bruton Consulting Engineers – Stage 1 Quality Audit Report (as appended to this report)

Furthermore, the following DBFL drawings have been compiled to demonstrate how the scheme proposals fully address the queries raised within the planning authorities FIR;

- 210175-DBFL-TR-SP-DR-C-1019 entitled ***Calmount Road Site – Prior to NTA Core Bus Corridor Enhancement.***
- 210175-DBFL-TR-SP-DR-C-1020 entitled ***NTA Core Bus Corridor Enhancement Works***
- 210175-DBFL-TR-SP-DR-C-1021 entitled ***Calmount Rd / Ballymount Avenue Junction Enhancements***
- 210175-DBFL-TR-SP-DR-C-1022 entitled ***Calmount Road Site Access Junction Options***
- 210175-DBFL-TR-SP-DR-C-1023 entitled ***Ballymount Avenue – Eastern Site Access***
- 210175-DBFL-TR-SP-DR-C-1024 entitled ***Swept Path Analysis – 16.5m Articulated Vehicle***
- 210175-DBFL-TR-SP-DR-C-1025 entitled ***Swept Path Analysis – 7.7m Fire Tender***
- 210175-DBFL-SW-SP-DR-C-1300 entitled ***Surface Water Layout Plan***
- 210175-DBFL-FW-SP-DR-C-1302 - ***Foul Sewer Layout Plan***
- 210175-DBFL-WM-SP-DR-C-1001 - ***Watermain Layout Plan***
- 210175-DBFL-RD-SP-DR-C-1101 - ***Roads Layout Plan***
- 210175-DBFL-RD-SP-DR-C-5018 – ***Typical Road Cross Section***

During the course of addressing the specific queries raised within the SDCC FI the scheme proposals have been amended which includes a very modest increase in the Warehouse / Logistics element ancillary office floorspace. This slight increase in ancillary office floorspace as a result of the changes incorporated as part of the FI response does not materially impact on the MMP or TTA as originally submitted with the planning application.

1.2 STRUCTURE OF REPORT

Following this introduction each of the following report chapters are assigned to responding to the engineering focused queries raised within the SDCC FIR. Accordingly, the following chapters each address specific query of the FIR as summarised below;

- Chapter 2 – FIR Item 1(a), 1(b), 1(c) and 1(d)
- Chapter 3 – FIR Item 2
- Chapter 4 – FIR Item 3(i) and 3(ii),
- Chapter 5 – FIR Item 7(i)(a), 7(i)(b), 7(i)(c), 7(i)(d), 7(i)(e), & 7(i)(f)
- Chapter 6 – In addressing the above queries the scheme proposals have been modified slightly which in turn has necessitated changes to the proposed design / analysis of an element of the developments civil infrastructure. Whilst not specifically requested in the SDCC FIR these civil engineering focused changes are discussed in Chapter 6.

2 FURTHER INFIRMATION REQUEST ITEM 1

2.1 SDCC FI Query No. 1

"The applicant is requested to provide the following additional information: 1. A Street Design Statement that accords with the requirements of Section 5.2.2 DMURS (2019) and should include details that demonstrate the process that was undertaken to inform the design of the proposed road through the application site and its outcome including:

a) analysis of relevant plans and policies (national, regional, and local), spatial characteristics, movement patterns and consultation with the roads authority (SDCC).

b) Strategic level drawings that (i) demonstrate the key routes and links that the road would connect with and (ii) the typology or conceptual street design.

c) The movement function of the road having regards to Section 3.2.1 and 3.2.2 of DMURS.

d) Detailed street layouts that clearly illustrate all relevant geometric standards and other treatments aimed at promoting a sense of place, sustainable forms of transportation and traffic calming."

2.2 DBFL Response to Item 1 (a)

Analysis of relevant plans and policies (national, regional, and local), spatial characteristics, movement patterns and consultation with the roads authority (SDCC)

The relevant plans and policies have been referenced in the applications initial reports by each respective discipline (e.g. Architecture, Landscape Architecture, Civil Engineering and Transportation etc). As an example, the key traffic and transport focused plans and policies, as introduced in the applications Traffic and Transportation Assessment Report included:

- SDCC Development Plan (2016-2022)
- Draft SDCC Development Plan (2022-2028) which has since been adopted.
- Transport Strategy for the Great Dublin Area (2016-2035)
- Draft Greater Dublin Area Transport Strategy (2022-2028)
- NTA's Bus Connects Core Bus Corridor Proposals (November 2020)
- City Edge Project Documentation

In terms of site location, and further to the strategic development management objectives outlined in the recently adopted SDCC Development Plan 2022-2028 (which includes the identification of a Roads Objective north-south though the subject Calmount Road site) the most up to date area specific plan for the general area is the **City Edge Projects Strategic Framework** documentation dated May 2022. Within this ambitious area wide plan the subject Calmount Road site is identified as part of the Urban Industry Zone within the Greenhills District. It states that lower density employment will be accommodated to the west of Ballymount Avenue with a pocket of Mixed Use/Urban Industry Residential to the north of Ballymount Road Lower. To the east of Ballymount Avenue, a Residential Led Mixed Use neighbourhood will be enlivened by a local centre and high street.

Chapter 8 of the City Edge Project's Strategic Framework document considers the topic of 'Movement' with the adopted movement strategy graphically presented in Figure 118 (reproduced below as Figure 1 with subject site superimposed). This figure also includes details in regard to the SDCC Roads Objective north-south

Figure 1 – City Edge Movement Framework

In addition to the above Movement Strategy, Figure 292 (reproduced as Figure 2 below) of the City Edge Strategy Framework report introduces a 'Primary Movement Network' with a hierarchy of different roads / street types identified in relation to their respective movement and place functions.

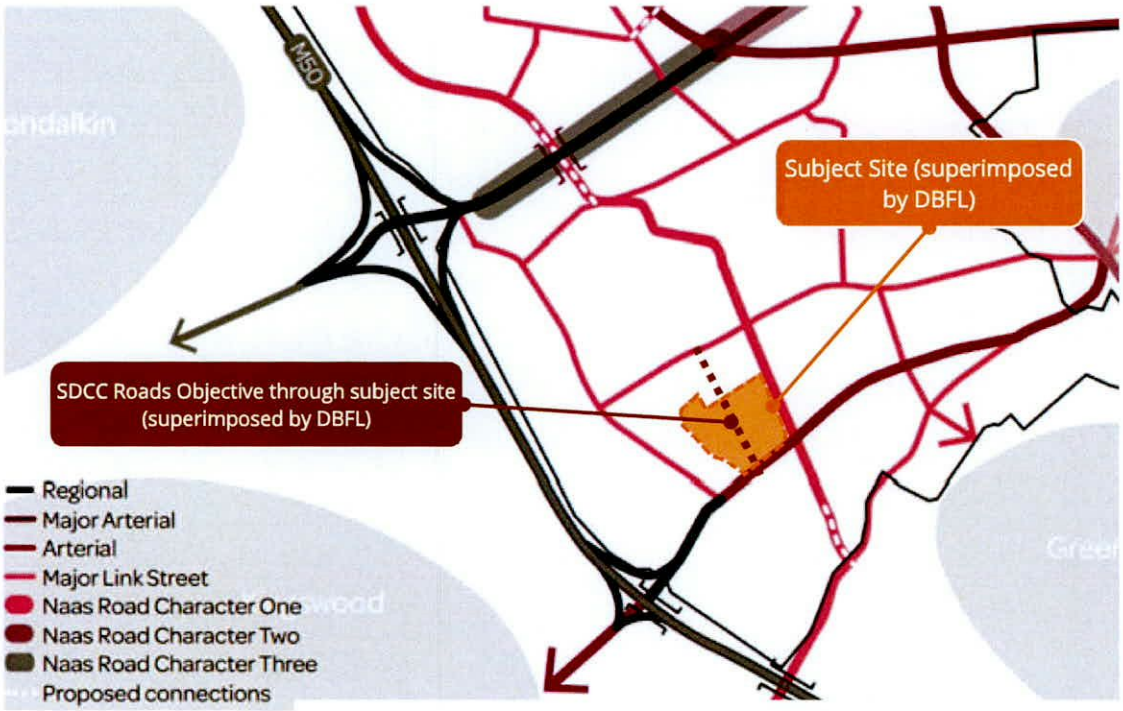


Figure 2 – City Edge Primary Movement Network

In direct reference to this City Edge movement network the immediate roads and streets adjoining the subject site can be classified as follows;

- **Calmount Road** (Between Ballymount Rd Upper and Greenhills Rd) – **Major Arterial** Street
- **Ballymount Ave** (Between Greenhills Rd and Ballymount Rd Lower) – **Major Link** Street
- **Ballymount Rd Upper** (Between Calmount Rd and Walkinstown) – **Major Link** Street
- **Ballymount Rd Lower** (Between Ballymount Rd Upper and Ballymount Rd Lower) – **Major Link Street**

In the context of the above City Edge projects street hierarchy the proposed developments internal streets including the SDCC Roads Objective (Table 6.6 of current SDCC Development Plan) aligned north-south through the subject site would be classified as a '**LOCAL**' street in reference to DMURS.

The movement characteristics of **LOCAL** Streets according to DMURS are to "*provide access within communities and to Arterial and Link Streets.*" (DMURS Page 36).

In addition to the above movement functions of both the proposed internal and external adjoining streets DMURS explicitly considers the CONTEXT and PLACE values of streets located within "*Business Parks / Industrial Estates*" which is considered applicable to the subject developments Warehousing / Logistics and Office based land uses. In Figure 3.5 DMURS reveals that "*Business Parks / Industrial Estates are areas that are primarily focused on (and often purpose built for) providing areas of commercial and industrial activity outside of Centres. Streets within these areas generally have a low place status as buildings have little street presence and they are largely devoid of pedestrian activity.*"

In the same section DMURS suggests that "*Many of these areas are in a state of transition toward more intensive commercial and residential uses replacing older industrial ones. As this transition occurs, the status of these places will rise. Place status in existing campus style Business Parks also tends to be higher and Pedestrians can be highly active in these areas during business hours.*"

DMURS also acknowledges that the design of streets much consider a wide range of different demands as directly influenced by the site-specific adjoining lands uses and associated characteristics that the streets service and provide access to. Accordingly, DMURS reveals that "*Urban roads and streets can traverse many areas with very different characteristics, such as industrial areas, residential areas, mixed use neighbourhoods and city, town and village centres (see Figure 3.4). This clearly requires different design solutions within each of these different contexts."* This is very much relevant to the subject development with land uses that fall under the generic DMURS category of "*Business Parks / Industrial Estates*" with the proposed Warehouse / Logistics units generating very distinctive, yet challenging movement demands as driven by the need to accommodate the larger sized articulated goods vehicles on a daily basis. Responding to this unique context the design team have sought to adopt a design approach that achieves an

appropriate balance between DMURS guidance and the need to physically accommodate the manoeuvring requirements of large commercial vehicles in a safe manner.

During the compilation of this response DBFL reached out to the local roads authority with the objective of (i) presenting the above development context, (ii) the scheme designs synergies with both the SDCC Development Plan objectives and the aspirations and strategies of the **City Edge Projects Strategic Framework** documentation, and (iii) agreeing a consensus on how best to reach an appropriate balance between DMURS street design guidance with the specific challenges arising from the movement demands generated by a Warehouse / Logistics focused development. Unfortunately, with this consultation exercise occurring over the peak summer holiday period, it was not possible for the SDCC officers to confirm their availability and schedule a meeting prior to this formal response submission being finalised. However, we trust that the response addresses the concerns raised and any further details can be agreed via a condition of planning.

2.3 DBFL Response to Item 1 b)

Strategic level drawings that (i) demonstrate the key routes and links that the road would connect with and (ii) the typology or conceptual street design

Influenced by both the City Edge Projects Strategic Framework documentation (of which the proposed movement strategics are summarised in Figure 1 and 2 above) and the SDCC Development Plan (2022-2028) Roads objectives, Figure 3 below presents the road / street hierarchy in the general area of the subject Calmount Rd development site. The proposed internal north-south street link aligned through the Warehouse / Logistic element of the proposed development site partially delivers a section of the SDCC Roads Objective and actively safeguards the opportunity to be extended through the adjoining third party lands to the north (by others) thereby providing a new permeable connection between Calmount Road and Ballymount Road Lower corridors as per the roads objectives detailed within Map 5 of both the previous and current SDCC Development Plans. The alignment identified in the SDCC development plan (2022-2028) enables this new north-south street to tie directly into the north/south access road serving Merrywell Business Park thereby providing an extended street corridor in its entirely between Calmount Rd (to the south) and Merrywell Business Park. This same general alignment is mirrored in the City Edge

Projects Strategic Framework documentation as demonstrated in Figure 1 above which is an extract of the SDCC's Strategic Framework report.

As this extended north-south corridor does not provide onward direct connections to strategic streets of the immediate street hierarchy its movement function is subsequently very much that of a LOCAL street as described in DMURS thereby predominately providing access to adjoining plots and local businesses.

Figure 3 – Proposed Developments Adjoining Street Hierarchy

Whilst the proposed north-south street connection (which mirrors the Development Plan alignment) through the proposed Warehouse / Logistics plot of the development will be primarily focused on providing access to areas of commercial activity, with limited to no through traffic to external strategic destinations, DMURS suggests that "*these areas generally have a low place status.*"

Nevertheless, the integrated multidiscipline design solution presented in the scheme proposals seeks to deliver internal streets that not only successfully accommodates the street movement function (of all users, abilities and modes of travel) in the context of the proposed Warehouse / Logistics / Office land uses but also maximises the place making characteristics as part of a balanced design solution and one which retains flexibility for

the continued future evolution of the street in accordance with the long term aspirations outlined in the City Edge project. This has been achieved through the integration of a number of design initiatives which include;

- maximising the active frontage of the street resulting in good passive surveillance levels as afforded by the street connections being overlooked by adjoining buildings,
- providing a compact enclosed street (compared to other warehouse / office development schemes) by bringing the active elements of the proposed warehouse and office buildings as close as practical to the street edge,
- providing attractive and connected active travel infrastructure along desire lines including (i) prioritisation of active travel modes with pedestrian / cycle only connections provided to offer shorter and more convenient linkages, and (ii) permeable connections to public transport interchange facilities (in response to NTA's CBC and City Edge proposals),
- considering the proposed warehouse / logistical lands uses (and resulting higher than normal volumes of HGV traffic) providing segregated dedicated infrastructure for active modes of travel setback from the street carriageways by high quality landscaped verges within which significant tree planning has been identified to further enclose the street and offer associated traffic calming and place making benefits.
- Delivering built-in flexibility along the internal streets considering the potential future long term objectives of City Edge project such as (i) the specification of 2.9m wide landscaped verges which could if ever desired (as part of a future redevelopment) accommodate on-street parallel car parking bays in addition to an appropriate buffer with the proposed bicycle tracks, and (ii) whilst the specification of carriageway widths (to accommodate the manoeuvring swept path requirement of large HGV's) may be wider than that normally specified for urban street by DMURS the proposals safeguard the flexibility for the carriageway to be easily narrowed (and reassigned) as part of any long term redevelopment proposal for the subject site in its entirety or on a gradual individual plot by plot basis over time.

In reference to the movement network detailed in Figure 2 above, subsection 11.3 of the **City Edge Projects Strategic Framework** document introduces a number of

indicative street typology's in terms of cross section and how street space could be shared by different modes of movement. The framework document states that "*such street typologies should be examined in further detail at statutory plan stage from the perspective of appropriate carriageway, footpath and cycle lane widths and Taking in Charge Standards etc.*"

In respect of (i) the LOCAL street function identified for the proposed developments internal *Business Parks / Industrial Estates* streets, (ii) associated functions and place meaking for this type of street detailed in DMURS, and (iii) the unique vehicle manoeuvring requirements generated by *Business Parks / Industrial Estates* focused developments, the closest street type identified within the **City Edge Projects Strategic Framework** document that respects the proposed developments specific context is that of a 'minor link street' as graphically presented in Figure 4 below. The geometric characteristics of this street typology which incorporates (i) segregated cycle tracks set back byway if landscaped verges from the carriageway, and 3.0m wide traffic lanes in each direction very much mirrors the proposed developments updated street layouts now being presented in response to the FIR.

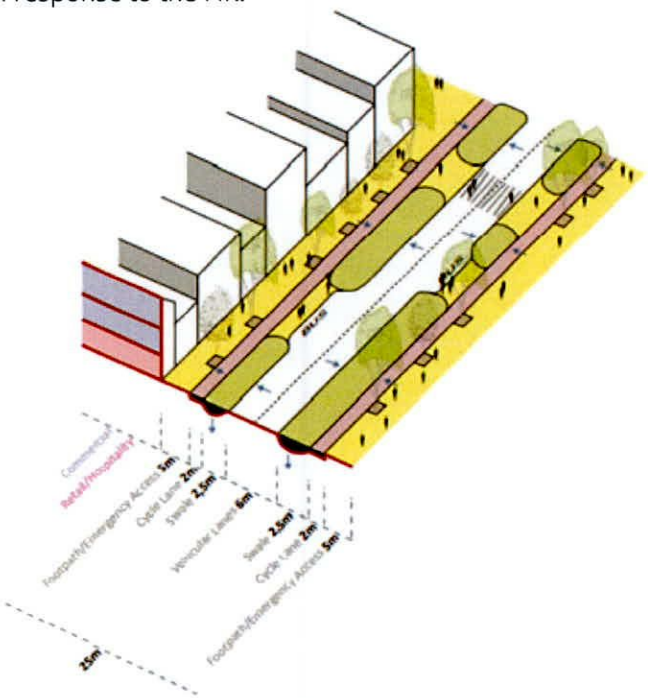


Figure 4 – Proposed Development Street Typology

2.4 DBFL Response to Item 1 (c)

The movement function of the road having regards to Section 3.2.1 and 3.2.2 of DMURS.

In reference to the response outline above in regard to FI items 1(a) and 1(b) the movement function of the proposed internal streets has been identified as being comparable to a DMURS LOCAL street with geometric characteristics reflecting the Minor Link Street typology from the **City Edge Projects Strategic Framework** documentation (due to the need to accommodate swept path / manoeuvring requirements of large commercial vehicles). The streets are relatively short in length and link the broader street network to predominantly the internal development plots within which Warehouse / Logistics / Office business will be based.

With reference to section 3.2.2 of DMURS the context of the developments internal streets can be classified as *Business Parks / Industrial Estates*, whilst **City Edge Projects Strategic Framework** documentation identifies the area as an Urban Industry Zone within the Greenhills District.

DMURS acknowledges that *Business Park/Industrial Estate* focused developments can present a series of challenges to designers stating that as "*development within these areas intensifies, designers are encouraged to move toward standards that are better suited to densely populated urban areas (i.e. Centres and / or Neighbourhoods). However, the implementation of standards which seek to slow vehicular movement and increase pedestrian mobility (such as narrower carriageways or tighter corner radii), may be more difficult to implement due to the manoeuvrability requirements of larger vehicles. Under such circumstances designers may consider additional mitigation measures.*" This very much describes the challenges encountered as part of the design of the proposed development and the need to take a balanced approach with the inclusion of additional mitigation measures as per DMURS recommendations (and the advice raised within the commissioned Quality Audit).

2.5 DBFL Response to Item 1 d)

Detailed street layouts that clearly illustrate all relevant geometric standards and other treatments aimed at promoting a sense of place, sustainable forms of transportation and traffic calming.

The design of the proposed developments internal streets and site access proposals are the result of a collaboration between an integrated multi-disciplinary design team including TOT Architects, and Murray & Associates Landscape Architects in addition to DBFL Consulting Engineers. Accordingly, reference should be made to the coordinated response report summarised in the accompanying FIR documentation.

The adopted design philosophy has been influenced by the need to successfully achieve an appropriate balance between a number of conflicting demands in the *Business Park/Industrial Estate* context of the proposed developments specific land uses and associated travel demands of larger commercial vehicles (and the frequency that these vehicles will be traveling to/from the proposed development). The approach has been informed by DMURS guidance which states that

"In circumstances where there are regular turning movements by articulated vehicles, the corner radii may be increased to 9m (i.e. such as in Industrial Estates).

Designers may have concerns regarding larger vehicles crossing the centre line of the intersecting street or road. Such manoeuvres are acceptable when turning into/or between Local or lightly trafficked Link streets as keeping vehicle speeds low is of higher priority. Where designers find it difficult to apply the radii referred to above, or to further reduce corner radii where pedestrian activity is high (such as within centres) designers may also:

- *Increase the carriageway width at junctions to provide additional manoeuvrability without signalling to drivers that the corner can be taken at greater speeds.*

In the context of the relatively large number of internal vehicle access junctions (leading to/from segregated car parking areas and 'rear' HGV service areas) along the Warehouse / Logistics plots access roads it has not been possible for the design team to adopt the above mitigation measures of increasing *the carriageway width at junctions to provide additional manoeuvrability* due to the combination of (i) the extent that such additional widening would require on the minor arms to accommodate articulated HGV swept paths (without encroaching into opposing traffic lanes) and (ii) the need to maintain slow vehicle speeds through all internal plot access junctions (both car parking and rear service areas) due to the presence of pedestrians and cyclists using dedicated active travel infrastructure across the minor arm of each plots access / egress junction. Accordingly, with the objective of

ensuring that all junctions respect the design guidance detailed in DMURS the main road carriageway was widened to accommodate the necessary vehicle swept paths.

This specific design approach has been further developed in response to the independent Quality Audit undertaken on the scheme proposals and further mitigation measures incorporated (including the introduction of 3.0m wide traffic lanes) as detailed in the following DBFL drawings;

- 210175-DBFL-TR-SP-DR-C-1019 entitled ***Calmount Road Site – Prior to NTA Core Bus Corridor Enhancement.***
- 210175-DBFL-TR-SP-DR-C-1021 e ***Calmount Rd / Ballymount Avenue Junction Enhancements***
- 210175-DBFL-TR-SP-DR-C-1022 entitled ***Calmount Road Site Access Junction Options***

Warehouse / Logistics Site North-South Internal Access Road

The principal geometric characteristics of the proposed developments internal north-south access road thought the Warehouse / Logistics zone of the site are detailed in Figure 5 below and can be summarised as follows;

- Footpaths – 1.8m wide,
- Each One-Way Cycle Track – 1.75m wide
- Landscaped Verges (between Cycle Tracks and carriageway edge) – 2.9m
- Road carriageway – 9m (incorporating two no. 3m through lanes and 3m right turning lanes / central ghost island.
- Kerb Radius as internal junctions to / from car parking areas – 4.5m
- Kerb Radius as internal junctions to / from HGV service areas – 6m

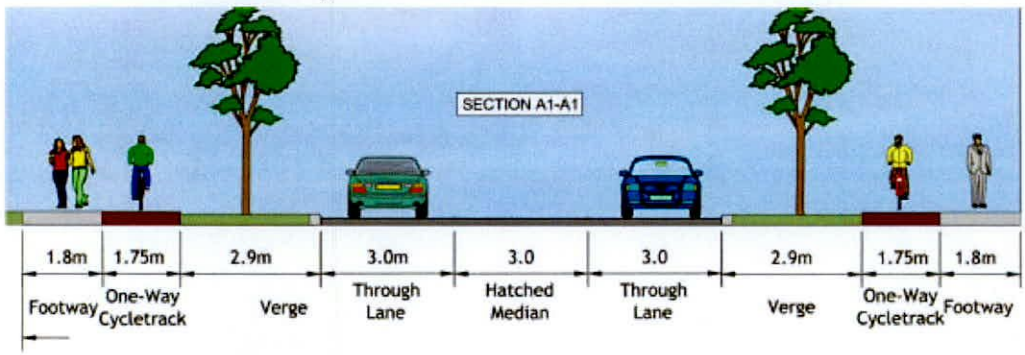


Figure 5 – Street Geometry: Warehouse / Logistics North-South Aligned Access Road

Warehouse / Logistics Site East-West Aligned Internal Access Road

The principal geometric characteristics of the proposed developments internal east-west access road thought the Warehouse / Logistics zone of the site are detailed in Figure 6 below and can be summarised as follows;

- Footpaths – 1.8m wide,
- Two-Way Cycle Track – 3.0m wide
- Landscaped Verges (between Cycle Tracks and carriageway edge) – 1.2m
- Road carriageway – 8m (incorporating two no. 3.65m through lanes and central ghost island.
- Kerb Radius as internal junctions to / from car parking areas – 4.5m
- Kerb Radius as internal junctions to / from HGV service areas – 6m

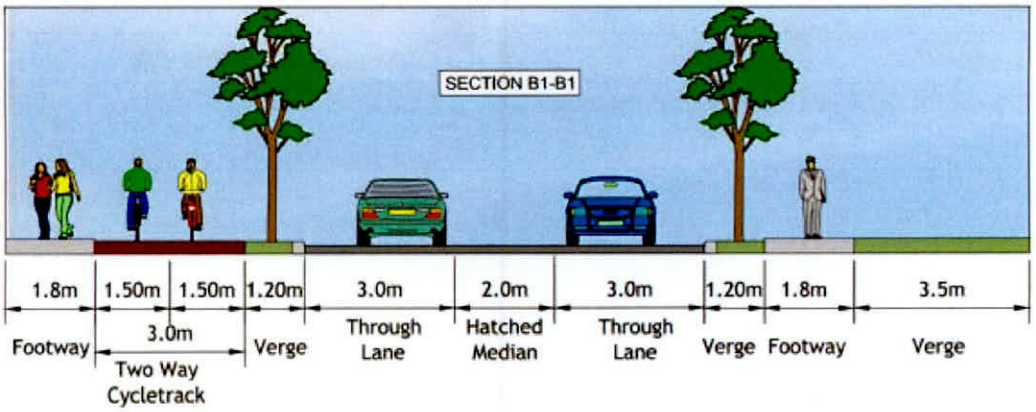


Figure 6 – Street Geometry : Warehouse / Logistics East-West Aligned Access Road

Office Parks East-West Aligned Internal Access Road

The principal geometric characteristics of the proposed developments internal east-west access road to/from the office element of the site are detailed in Figure 7 below and can be summarised as follows;

- Footpaths – 1.8m wide,
- Two-Way Cycle Track – 3.0m wide
- Landscaped Verges – vary
- Road carriageway – 6m (incorporating two no. 3m lanes).
- Kerb Radius as internal junctions to / from car parking areas – 4.5m

- Kerb Radius as external junction with Ballymount Avenue – 6m

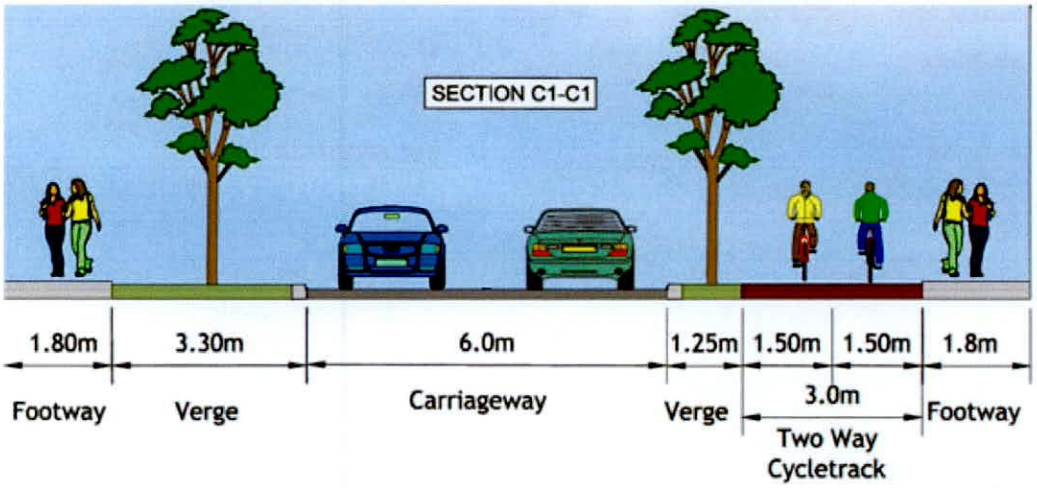


Figure 7 – Street Geometry : Office Park's East-West Aligned Access Road

Ballymount Avenue Corridor (At site access)

The principal geometric characteristics of Ballymount Avenue corridor in the immediate area of the proposed developments site access junction is detailed in Figure 8 below and can be summarised as follows;

- Existing Footpaths – 1.8m wide,
- Existing One-Way Cycle Tracks – 1.4m
- Existing Landscaped Verges (to rear of path) – varies
- Road carriageway – 10m (incorporating two no. through lanes and 3m right turning lane / central ghost island.
- Kerb Radius as site access junctions to / from Office car parking areas – 6m

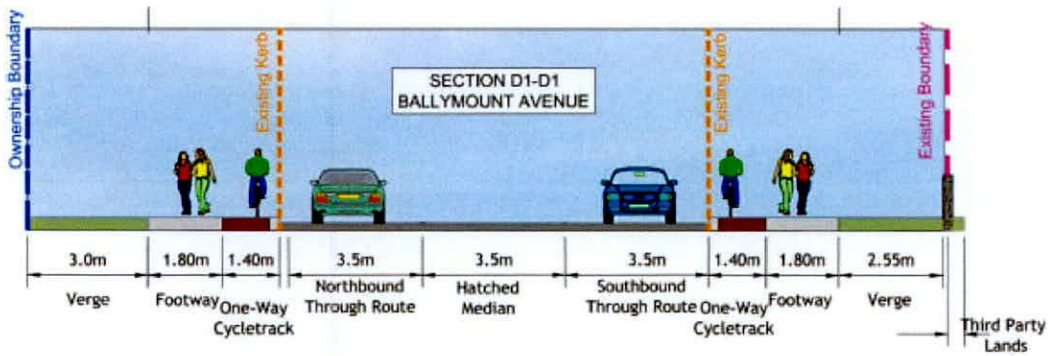


Figure 8– Street Geometry : Ballymount Avenue

Calmount Road Corridor (At site access)

The principal geometric characteristics of Calmount Road (location between the proposed site access junction and Ballymount Avenue corridor are detailed in Figure 9 below and can be summarised as follows;

- Footpaths – Varies, 2.0m wide new facility along the northern side of the corridor and 2.1m (existing retained) on the southern side of the corridor
- Two-Way Cycle Track – 2.5m wide set back from the carriageway by a 1.3m verge.
- Landscaped Verges (varies) – 1.3m to 3.4m
- Road carriageway – existing 9m retained incorporating two no. 4.5m through lanes.
- Kerb Radius at proposed development site access junction (Warehouse / Logistics access road) – 9m with compound curve to accommodate HGV swept paths.

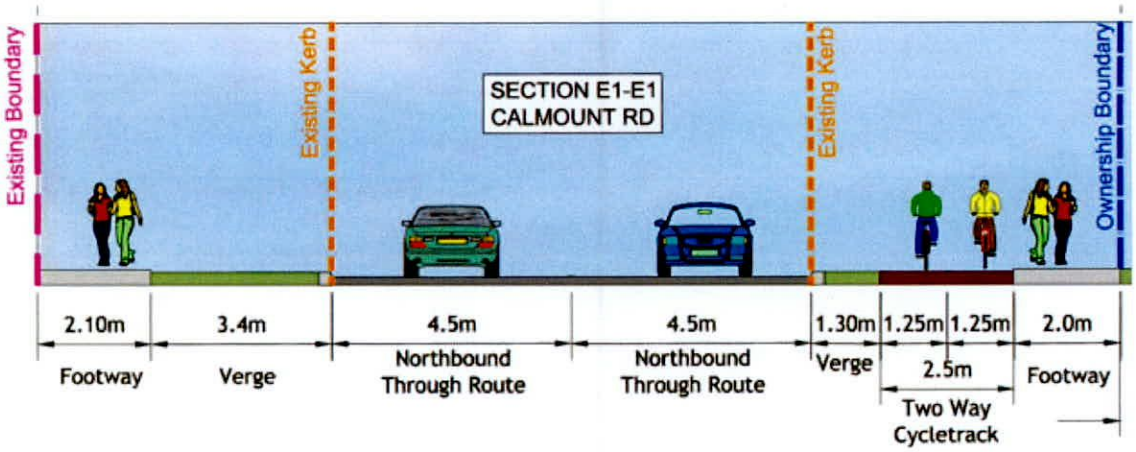


Figure 9 – Street Geometry : Calmount Road

3 FURTHER INFIRMATION REQUEST ITEM 2

3.1 SDCC FI Query No. 2

To minimise the potential to prejudice the completion of the County Development road's objective through the application site in terms of realising a connection with Ballymount Road Lower, demonstration of how the proposed development would accommodate optional alignments/connections with reference to the potential to link with Ballymount Road Lower via the existing turning circle and industrial estate road directly on the north-west boundary of the application site. This option could be kept open by way of relocating the HGV loading for Unit 2 out of the path of a potential route towards the existing turning circle and by removing any proposed gateway controls. The applicant shall also provide details setting out how they have re-considered the design / orientation of this unit and whether it would be more appropriate for this unit to face north, with parking etc to the front. A strong frontage should also be provided along the north / south access road, with glazing detail turning the corner to the south west elevation. The above information should be consistent with the Traffic and Transport Assessment that has been submitted with the subject application or any revised Traffic and Transport Assessment.

3.2 DBFL Response to Item 2

The alignment and position of the proposed developments internal north-south street has been influenced by several factors including the indicative alignments detailed in both the previous SDCC County Development Plan (2016-2022) and the recently adopted County Development Plan (2022-2028). As illustrated in Figure 9 below both of these versions of the County Development Plans present this long-standing road objective as extending through the subject site (and adjoining third party lands) between Calmount Rd (to the south) and Ballymount Road Lower (to the north) in the very same position. This position ties in directly with the location (and junction on Ballymount Road Lower) of the existing north-south access road (to the north) through Merrywell Business Park thereby delivering an extended north-south corridor.

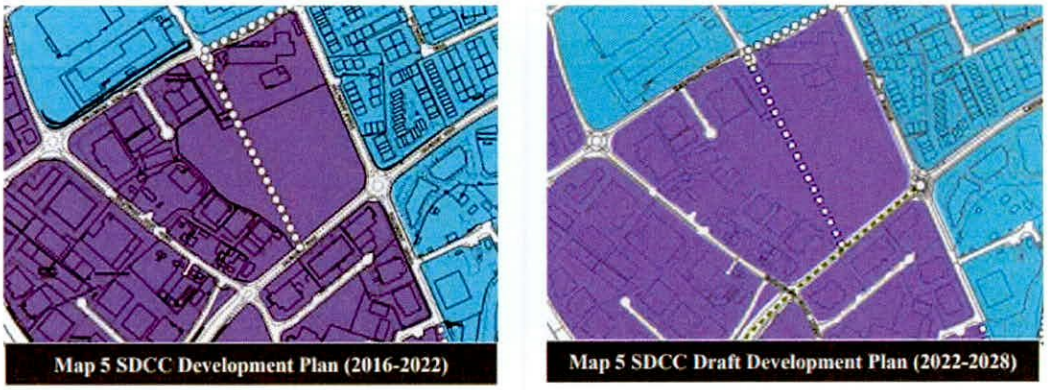


Figure 10 – SDCC Roads Objective Indicative Alignment

The general alignment is also indicatively presented within a number of the movement network focused Figures in the **City Edge Projects Strategic Framework** documentation including Figure 118 which is reproduced below in Figure 11.

Figure 11 – City Edge Movement Framework

The proposed position and alignment of the SDCC Roads Objective through the subject site as detailed in the scheme proposals offers a number of benefits in regard to the subject commercial development proposals including;

- Maximises the efficiency of the proposed Warehouse / Logistical plots as proposed along both sides of this north-south connection in regard to the plots ability to accommodate the scale of buildings (in response to Warehouse requirements and logistical practices) that business require and the associated HGV marshalling / parking / service areas.
- Provides a convenient and easily travelled route for the large number of articulated HGV's that are predicted to be calling at the proposed Warehouse / Logistical buildings in respect of the swept path requirements of this specific type of vehicle (e.g., end user).
- The alignment ties in with and extends the existing Merrywell Business Park (north-south) access road thereby minimising the number of junctions on the road network and delivering a network that is more easily understood (e.g. wayfinding) and used (driven along in regard to swept path requirements) by HGV vehicle drivers.
- The proposed elevational treatment of the units which face onto this north-south street address the point raised in terms of having a strong front.

The design team considered the alternative alignment suggested in FIR Item 2 through the subject site. Our analysis reveals the this potential alternative arrangement not only contravenes the suggested alignment in both SDCC Development Plans and the City Edge Strategic Framework documentation but would result in a more circuitous meandering route through the subject site which presents a number of inefficiencies including;

- Adverse impact upon a number of the individual internal plots in terms of the ability to efficiently accommodate the proposed scale of Warehouse / Logistical and associated HGV marshalling / parking / service / loading areas.
- Whilst the meandering nature of the alternative alignment suggested in the FI request may be appropriate (and desirable) in a residential development context (e.g. traffic calming benefits) it is considered undesirable in the proposed commercial context considering the number and size of articulated HGV vehicles predicted to be traveling to / from the proposed Warehouse / Logistical units onsite.
- Would not align with the existing Merrywell Business Park access road on Ballymount Road Lower thereby negatively impacting upon one of the key benefits of the SDCC Roads Objective.

Notwithstanding the above operational issues the ability to deliver the final connection at its northern end onto Ballymount Road Lower (via the "existing turning circle and industrial estate road on the north-west boundary of the application site") is severely compromised due to potential difficulties is safeguarding the appropriate level of visibility splays at each of the private third party entrances currently accommodated by and located adjoining this "existing turning circle and industrial estate road" assuming that all third party land owners were happy to accommodate the suggested alternative alignment.

Accordingly, the proposed alignment of the development's internal north-south road connection, which mirrors the alignment illustrated in the SDCC Development Plans and City Edge Strategic Framework, is retained at it offers the optimum alignment through the subject development site in the context of the local receiving environment and operational requirements of the proposed Warehouse / Logistical units.

We note that under SDCC Reg. Ref.: SD21A/0347 that permission was granted for an extension of a workshop building on the Galco site to the immediate north. In assessing that application, the applicant was requested to show how the north-south link road objective could be routed through their site as part of the FI response (see fig 9 extract below from the FI response) and this gave the Planning Authority sufficient comfort to grant permission, acknowledging the longer-term nature of the objective to deliver the through road.

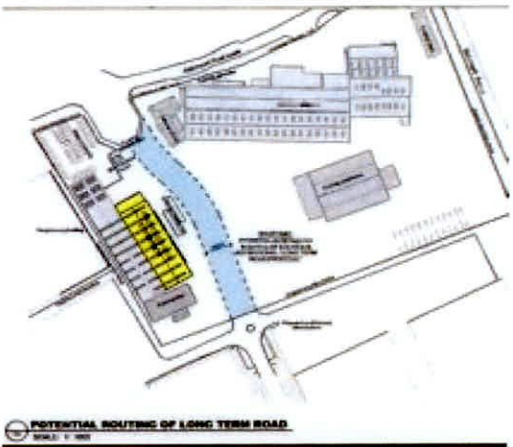


Figure 12 : Potential Re-Routing of the Council's Aspirational 'Long-Term Road Proposals

Having regard to the above, we respectfully submit that the current road alignment and layout is appropriate for the subject site and its classification as a LOCAL street, satisfies the requirements of the Development Plan, provides enhanced permeability for all modes of travel, and mirrors the emerging movement strategy presented in the **City Edge Projects Strategic Framework** documentation. Accordingly, further consideration of an alternative more circuitous routing through the subject lands is considered not warranted.

4 FURTHER INFIRMATION REQUEST ITEM 3

4.1 SDCC FI Query No. 3

Further landscaping and road layout details that demonstrate how the proposed development would tie in with and accommodate the NTA's Greenhills to City Centre Core Bus Corridor Preferred Route (November 2020) and demonstrate how the following would interact:

i. the shared surface/tactile paved area, landscaped entrance plaza and section of two-way cycle track that is proposed by the applicant at the south-east corner of the application site; and

ii. the conversion of the existing roundabout junction between Calmount Road and Ballymount Avenue to a fully signalised junction with pedestrian and cycle facilities including the upgrade of the western arm junction with filter lanes as indicated by the NTA. To accommodate the NTA's Emerging Preferred Route and the applicant's proposed pedestrian, plaza entrance and cycle facilities, this may necessitate inclusion of a section(s) of footpath and cycle lanes within the application site. To ensure that the further information is communicated clearly, it is recommended that the following information be presented, as appropriate:

- *The width of streets, footways, verges etc.*
- *The location, type and configuration of crossings and junctions.*
- *Kerb lines (including heights)*
- *Surface Materials and Planting.*
- *Lighting*
- *Areas to be taken in charge and in public ownership*

4.2 DBFL Response to Item 3(i)

Please see accompanying DBFL drawing 210175-DBFL-TR-SP-DR-C-1019 which details how the proposed development has been updated in response to SDCC FIR. The amended layout now includes an encroachment into the south-east corner of the subject site which accommodates the inclusion of a new section of footpath and the realignment of cycle track within the application site the extent of which is to be offered to be adopted by the

local roads authority. This amendment enables (i) the proposed external off-site cycle track to be continued uninterrupted around the southeast corner of the site (between Calmount Rd and Ballymount Avenue in the short-term scenario that the existing off-site Calmount Rd / Ballymount Avenue roundabout is retained in-situ), and (ii) ensures the successful integration of the proposed development and associated offsite active travel infrastructure enhancements with the emerging NTA's Bus Connects Core Bus Corridor (CBC) signal-controlled junction arrangement at this off-site junction (which will replace the existing roundabout arrangement in the future).

As expanded upon below the most up to date scheme details of the NTA's CBC proposals in Ballymount Area that are currently in the public domain remain the third round of Bus Connects consultation material dated November 2020 (for the Route No 9 Greenhills to City Centre CBC scheme) as referenced in the SDCC FIR.

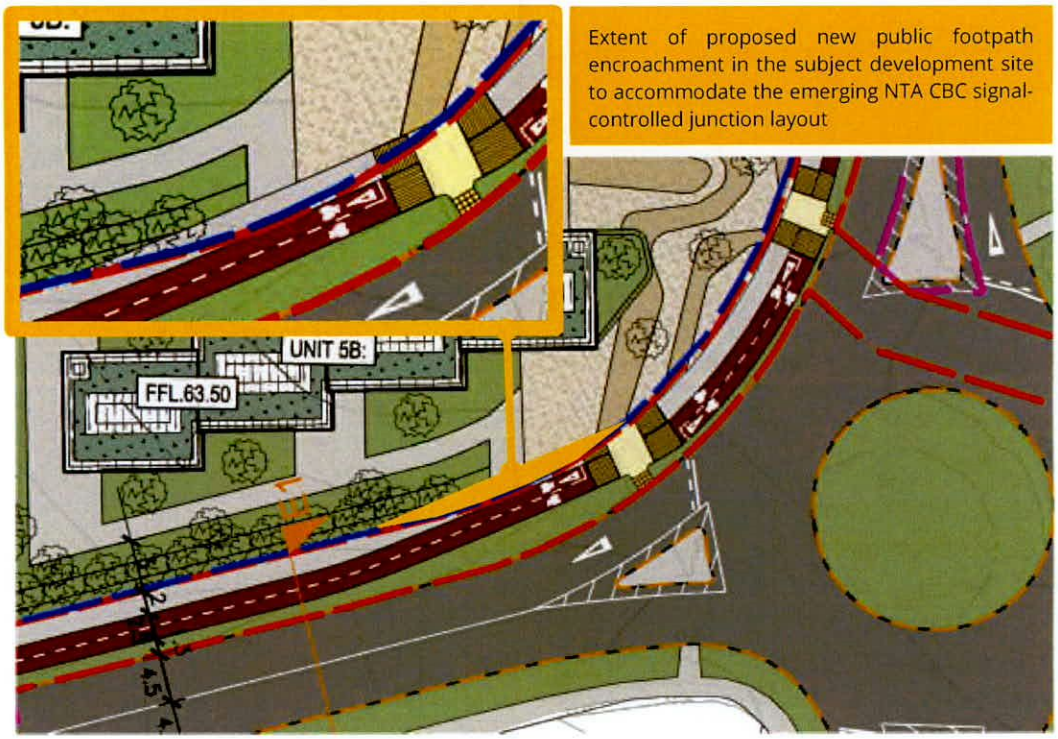


Figure 13– Realigned Footpath and Cycle Track in the South-East corner of the Development Site

Further to DBFL drawing 210175-DBFL-TR-SP-DR-C-1019 (as reproduced in Figure 12 above) the successful integration of the proposed development with the Calmount Road / Ballymount Avenue junction is graphically presented in the CGI's compiled for the RFI and reproduced in Figures 14 to 16 below.

Figure 14– Areal CGI of Proposed Development South-East Conor

Figure 15 – CGI of Proposed Developments South-East Corner with Calmount Rd

Figure 16 – CGI of Proposed Developments South-East Corner with Ballymount Avenue

The proposed design provides for an open unhindered pedestrian interface between the proposed developments plaza area (to the south-east of the proposed Office blocks) and the external street environment at its boundary with the Calmount Rd / Ballymount Avenue junction. This arrangement is proposed in both the (i) short term scenario for when the existing offsite roundabout is retained (prior to NTA works being undertaken/completed), and (ii) in the medium-term scenario for when the existing roundabout is replaced by the NTA's CBC signal-controlled junction layout. This proposed arrangement maximises pedestrian and cyclists' permeability to/from the site and offers convenient access routes to both the existing and proposed pedestrian / cycle crossing facilities at the adjoining Calmount Rd / Ballymount Avenue junction. The design team believe that this is an appropriate design response to the interaction of the subject site with this off-site junction in the context that it is identified as a public transport interchange hub in the City Edge Strategic Framework documentation.

4.3 DBFL Response to Item 3(ii)

The NTA's Bus Connects proposals originally incorporated a total of 16 separate CBC corridors however during the various consultation exercises and subsequent design process a number of corridors have been amalgamated. This has resulted in the identification of 12 CBC scheme proposals as of 2022.

Whilst the CBC proposals works in the immediate area of the subject Calmount Rd development site initially formed part of CBC Corridor No 9 (Greenhills to City Centre) it has now been merged with the Clondalkin CBC to form part of **Tallaght / Clondalkin to City Centre Core Bus Corridor Scheme**.

As of the first week in September 2022 the NTA have given notice of their applications under Section 51(2) of the Roads Act 1993 (as amended) to An Bord Pleanála for approval in relation to the initial four (of 12 in total) proposed CBC schemes consisting of;

- the Blanchardstown to City Centre Core Bus Corridor Scheme,
- the Belfield/Blackrock to City Centre Core Bus Corridor Scheme and
- the Clongriffin to City Centre Core Bus Corridor Scheme.
- The Liffey Valley to City Centre CBC Scheme;

It is the NTA's intention to submit the remaining CBC schemes on a phased basis with the next two (2) schemes likely to be submitted in the order shown below:

- Ballymun/Finglas to City Centre CBC Scheme;
- Ringsend to City Centre CBC Scheme.

Based upon the above NTA planning schedule it will likely be 2023 at the earliest before the Greenhills to City Centre CBC Scheme is submitted to An Bord Pleanála for planning.

The most up to date scheme details of the NTA's CBC proposals in the Ballymount Area (Route No 9 Greenhills to City Centre CBC scheme) that are currently in the public domain (ref **Error! Hyperlink reference not valid.** as accessed on 6th September 2022) remain that of the third round of Bus Connects consultation material dated November 2020 as referenced in the SDCC FIR. These CBC proposals, which include upgrading the Calmount Rd / Ballymount Ave junction to a traffic signal-controlled junction arrangement are illustrated in Figure 17 below.

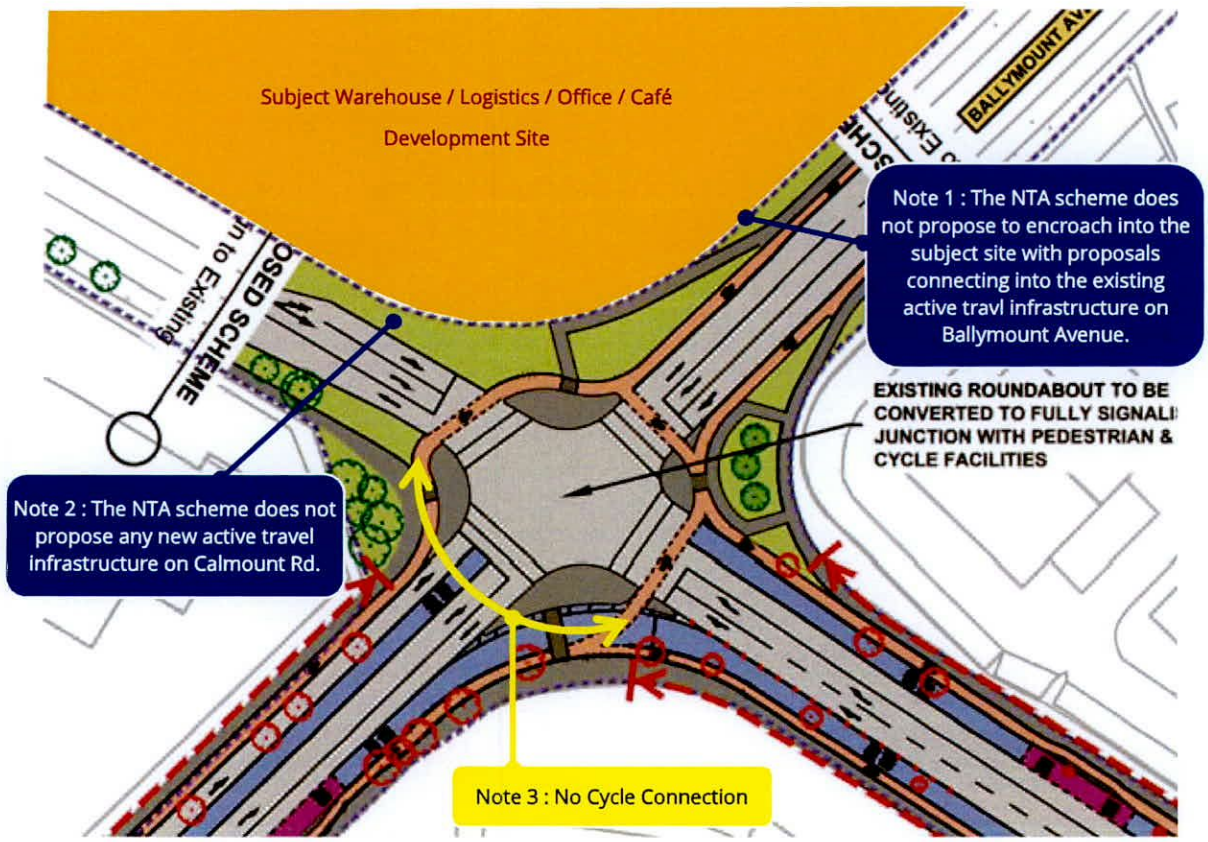


Figure 17 – NTA's Greenhills to City Centre Scheme details for Calmount Rd / Ballymount Avenue Junction

DBFL noted that the NTA CBC proposals (dated November 2020) did not include for a dedicated cycle connection (as per YELLOW arrow in Figure 15) from the junction's eastern arm to either its western arm (Calmount Rd) or its northern arm (Ballymount Avenue). It is likely that this oversight has subsequently been addressed during the interim as part of the schemes preliminary design stage (for the purpose of planning) which have not yet been made public. DBFL drawing 210175-DBFL-TR-SP-DR-C-1020 presents the proposed NTA CBC junction arrangement (dated November 2020) and its seamless integration with the updated development proposals.

As part of the process of transposing the NTA CBC scheme layout onto this drawing in parallel with the proposed Warehouse / Logistics / Office / Café development, DBFL have sought to demonstrate how the cycle connectivity issues introduced above (Yellow arrow in Figure 17) can be readily addressed through the introduction of a new dedicated cycle connection on the junction's southern arm thereby maximising cycle accessibility to/from the subject commercial development.

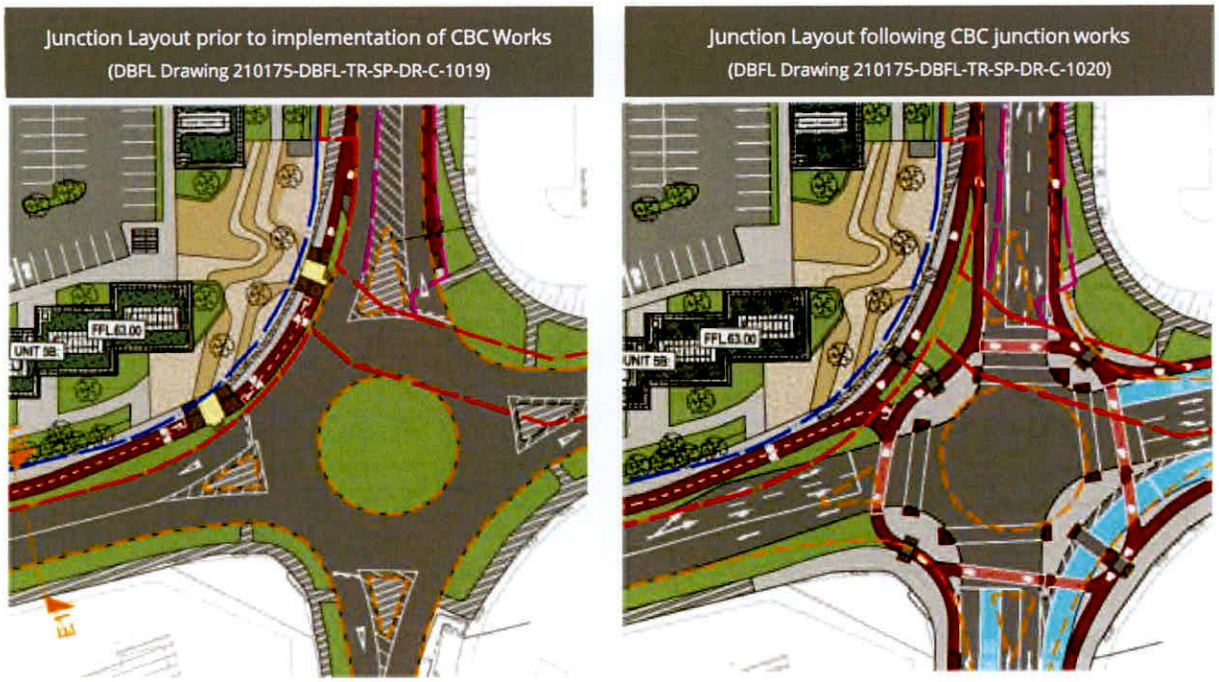


Figure 18 – Comparison of Calmount Rd / Ballymount Avenue Junction Layouts

As illustrated in Figure 16 above (and DBFL drawings 210175-DBFL-TR-SP-DR-C-1019 and 210175-DBFL-TR-SP-DR-C-1020 which accompany this report) the amended Warehouse / Logistics / Office / Café development proposals successfully integrate with both (i) the

existing roundabout layout of the Calmount Road / Ballymount Avenue junction and (ii) the emerging proposals for the upgraded signal controlled layout as being advanced by the NTA as part of its BusConnects CBC proposals. The amended commercial development layout compiled in response to SDCC FIR is found to actively safeguard the delivery of the NTA scheme proposals. Furthermore, due to the detail / alignment of the off-site works being proposed by the application as part of the proposed commercial development, minimal infrastructure tie-in works will be required to implement the NTA signal controlled junction.

It is likely that the design of the NTA CBC proposals through the Calmount Road / Ballymount Avenue junction have been advanced and updated slightly since the release of the last CBC scheme details to the public in November 2020. Accordingly, with the objective of demonstrating now the proposed commercial development continues to integrate with the latest NTA CBC scheme proposals the applicant invites an appropriate worded planning condition that requires, prior to the commence of development how the subject Warehouse / Logistics / Office / Café development continues to successfully integrate with the latest NTA scheme proposals. This would be a relatively standard approach, particularly where the applicant has demonstrated that the schemes are complementary to each other, the application does not prejudice the delivery of the separate infrastructure project and the outstanding matters relate to detailed design items

In regard to details requested within the SDCC FIR item 3(ii) DBFL can confirm the following;

- **Width of streets** – the proposed Warehouse / Logistics / Office / Café development does not result in the narrowing of the existing Calmount Rd and Ballymount Avenue corridors. In fact, as previously discussed in regard to Figure 12, the extend of the public controlled streets will increase slightly due to the alignment of new footpath / cycle tracks slightly into the southeast corner of the subject development and being offered for adoption by the local road's authority.
- **Width of Footpaths** – the width of new off-site public footpaths implemented as part of the development proposals will be 2.0m wide.
- **Width of Cycle Tracks** – the width of new off-site public fcycle tracks varies between 1.75m for a one-way tracks and 2.5m for a two-way cycle track.

- **Width of Verges** – the width of verges located off-site varies but in general incorporate (i) a 1.3m grass verge between the road edge and the new two-way cycle track along the northern side of Calmount Rd, and (ii) the retention of the existing 3.0m wide grass along the western side of Ballymount Avenue between the back of the existing footpath and the subject sites boundary (position of which remains the same but treatment is upgraded as part of the subject development proposals).

- **The location, type and configuration of crossings and junctions** – Influenced in part by both the SDCC FIR and the Quality Audit undertaken during the course of compiling this FIR response the following treatments can be confirmed;

  - Site Access Junction on Calmount Road – the amended proposals now provide for the implementation of a ghost island priority junction layout incorporating a dedicated right turning lane into the subject site as illustrated in DBFL drawing 210175-DBFL-TR-SP-DR-C-1019.

  - Road Crossing Facilities on Calmount Road – the proposals include for a new signal controlled TOUCAN crossing facility on Calmount Road at a location immediately to the west of the proposed site access junction.

  - Site Access Junction on Ballymount Avenue – the amended proposals now provide for the implementation of a ghost island priority junction layout incorporating a dedicated right turning lane into the subject site as illustrated in DBFL drawing 210175-DBFL-TR-SP-DR-C-1019.

  - Road Crossing Facilities on Ballymount Avenue – the proposals include for a new signal-controlled TOUCAN crossing facility on Ballymount Avenue at a location immediately to the south of the proposed site access junction.

  - Road Crossing Facilities at Site Access Junction on Calmount Rd and Ballymount Avenue – Influenced by the recommendations contained within the independent Quality Audit (which included a Stage 1 Road Safety Audit) the pedestrian / cycle crossing on the minor arms of both site access junctions are not controlled but a raised flat top ramp is provided to enhance the conspicuous of the crossing location.

- **Surface Materials and Planting** – DBFL can confirm that all off-site works and areas to be taken in charge (by the local authority) are to be constructed to SDCC adoption

standards which include the implementation of concrete formed footpaths and asphalt / macadam cycle tracks. Further details in regard to the planting strategy are provided in the landscaped architects FIR response documentation.

- **Lighting** – A revised lighting strategy by PEMP Consulting forms part of the applicants FIR response documentation.
- **Areas to be taken in charge** – An updated taken in charge drawing has been compiled by TOT architects and forms part of the applicants FIR response documentation.

5 FURTHER INFIRMATION REQUEST ITEM 7

5.1 SDCC FI Query No. 7(i)

(i) The applicant is requested to submit

a) a revised layout of the proposed vehicle access locations showing the layouts for right turning into the development.

b) a revised layout of the Calmount Road access as a junction type to provide for the future link road.

c) a drawing showing AutoTRAK manoeuvres for large vehicles accessing and egressing, including articulated lorries, emergency vehicles, bin lorries.

d) a revised layout showing how cycle track and footpaths will link into the road network and the individual units.

e) details of a 2.0m wide footpath west along Calmount Road to link with the existing footpath at the roundabout with Ballymount Avenue Upper.

f) a stage 1 road safety audit for the development.

g) details re the expected staff and patron numbers of the proposed café.

We note that in responding to the FI items raised by SDCC that some works are proposed on lands outside the applicant's control / the original red line, however, all these works are proposed on the public roads / verges and therefore can be required to be implemented as a condition of planning (as provided for under Section 34(4)(B) of the P&D Act 2000, as amended)'.

5.2 DBFL Response to Item 7(i)(a)

DBFL confirm that the amended proposals now provide for the implementation of a 'ghost island' priority controlled junction layout incorporating a dedicated right turning lane into the subject site at both site access junctions as located on Calmount Rd (reference Figure 19 and DBFL drawing 210175-DBFL-TR-SP-DR-C-1019 and 210175-DBFL-TR-SP-DR-C-1022) and Ballymount Avenue corridors (reference Figure 20 and DBFL drawing 210175-DBFL-TR-SP-DR-C-1019 and 210175-DBFL-TR-SP-DR-C-1023).

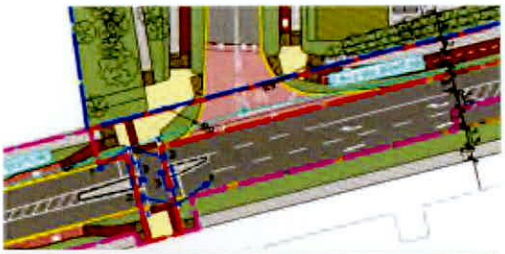


Figure 19 –Calmount Rd Site Access

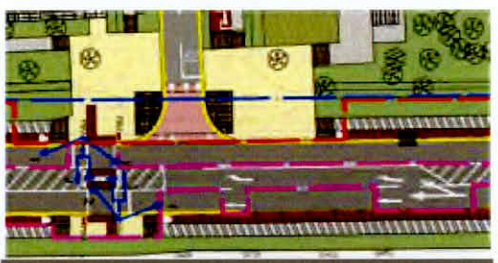


Figure 20 – Ballymount Avenue Site Access

5.3 DBFL Response to Item 7(i)(b)

The FIR stated a "*revised layout of the Calmount Road access as a junction type to provide for the future link road.*" The proposed 'ghost island' priority-controlled junction arrangement now being proposed for the Calmount Rd site access as part of the applicant's response to the FIR has the flexibility to also accommodate any potential increase in traffic movements that this junction may experience once the SDCC objective for the "*future link road*" to Ballymount Road Lower is delivered in the future.

Nevertheless, whilst the FIR statement for a "*junction type*" is unclear DBFL have compiled a preliminary design of a fully signal controlled junction arrangement for this junction to demonstrate how the proposed 'ghost island' priority-controlled junction arrangement being implemented by the applicant can readily be upgraded in the future to a signal controlled layout with minimum civil works required. This potential future signal controlled junction arrangement is presented in Figure 21 below and in DBFL drawing 210175-DBFL-TR-SP-DR-C-1022.

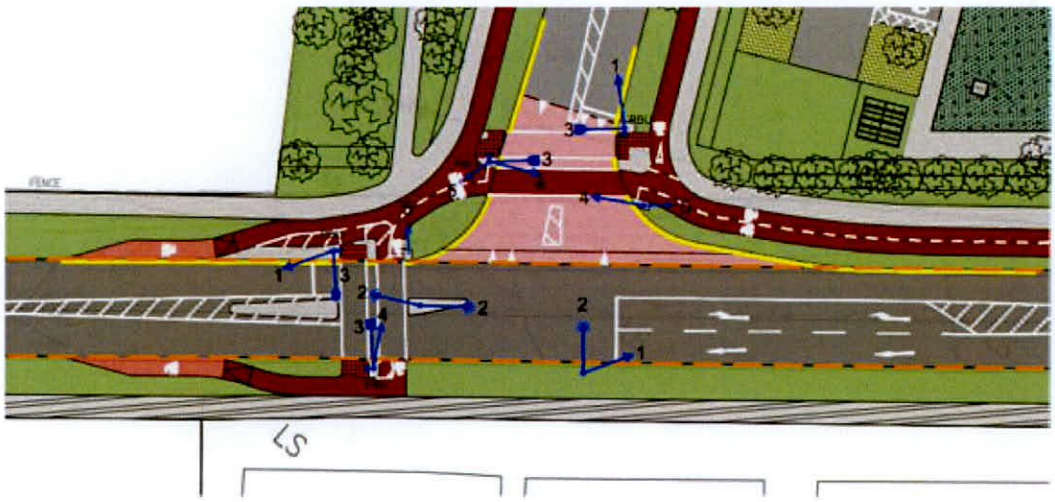


Figure 21 – Potential Signal Controlled Arrangement at the Calmount Rd Site Access Junction

5.4 DBFL Response to Item 7(i)(c)

The requested AutoTRAK analysis is detailed in the following two DBFL drawings which demonstrate how both a 16.5m articulated vehicle and a 7.7m long fire tender can safely manoeuvre into, through and out from the updated layout of the proposed Warehouse / Logistics / Office / Café development;

- 210175-DBFL-TR-SP-DR-C-1024 entitled ***Swept Path Analysis – 16.5m Articulated Vehicle***
- 210175-DBFL-TR-SP-DR-C-1025 entitled ***Swept Path Analysis – 7.7m Fire Tender***

5.5 DBFL Response to Item 7(i)(d)

The proposed developments footpaths and cycle tracks, including the off-site works have been design to provide a convenient continuous and safe connection to the existing off-site active travel networks. These key seamless connections include;

- **Ballymount Ave Site Access** – This new site access arrangement has been designed to enable both pedestrians and cyclists to easily connect to the existing off-site infrastructure that is already present (and being retained) along both sides of this corridor. A TOUCAN crossing is provided on Ballymount Ave to facilitate the safe passage across the carriageway whilst a raised flat top ramp in accordance with the National Cycle Manual is provided on the minor arm. Further to Figure 22 additional details are provided in drawing 210175-DBFL-TR-SP-DR-C-1023.

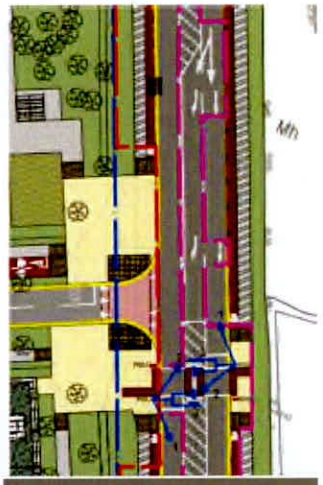


Figure 22

- **Calmount Rd / Ballymount Ave Junction** – The scheme proposals provide for a new off-site continuous footpath and cycle connection to enable pedestrians and cyclists travel from Calmount Rd into Ballymount Ave as illustrated in Figure 23 and DBFL drawing 210175-DBFL-TR-SP-DR-C-1019.

Figure 23

The proposals also include for an extension of the existing southbound cycle track (eastern side) on Ballymount Ave southwards as far as the crossing facility on the northern arm of the existing Calmount Rd / Ballymount Ave Roundabout Junction.

Pedestrian and cycle connections at this junction will be further enhanced as part of the NTA CBC proposals for which DBFL drawing 210175-DBFL-TR-SP-DR-C-1020 and

1021 demonstrate how active travel linkages through this junction are integrated with the subject development proposals and associated off-site infrastructure works.

- **Calmount Rd Site Access** – In response to both the SDCC FIR and recommendations raised with the commissioned Quality Audit the design of the site access junction on Calmount Road has been revisited. A TOUCAN crossing is provided on Calmount Rd to facilitate the safe passage across the carriageway whilst a raised flat top ramp in accordance with the National Cycle Manual is provided on the minor arm to accommodate pedestrian and cycle connectivity along the northern side of the Calmount Rd corridor and through the new site access junction. As there is no cycle infrastructure provided to the southwest of the site access junction on Calmount appropriate transition facilities have been incorporated into the design to enable cyclists travel between the road carriageway (to/from the southwest) and the off-site cycle tracks (to the east of the site access junction). Further to Figure 24 additional details are provided in drawing 210175-DBFL-TR-SP-DR-C-1019.

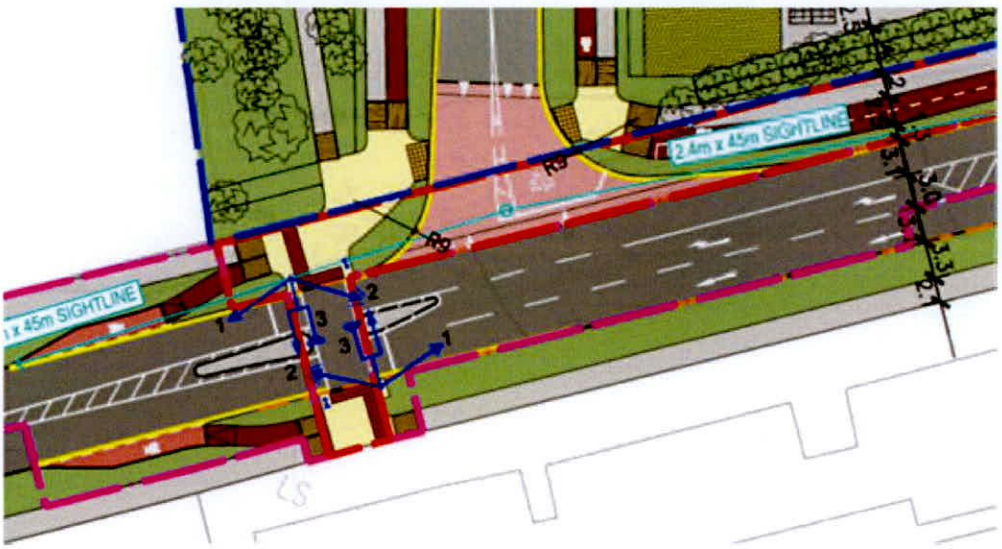


Figure 24 – Calmount Rd Site Access Junction Pedestrian and Cycle Connections

- **Internal Access Road** – In response to the SDCC FIR a number of new active travel crossing facilities have been incorporated into the updated scheme proposals. Considering the number of access points to/from the different internal development plots a balance has been sought to be achieved were the new crossing facilities would accommodate access to and from a number of adjoining plots. Further details

of these new internal active travel crossing facilities are presented in Figure 25 additional details are provided in drawing 210175-DBFL-TR-SP-DR-C-1019.

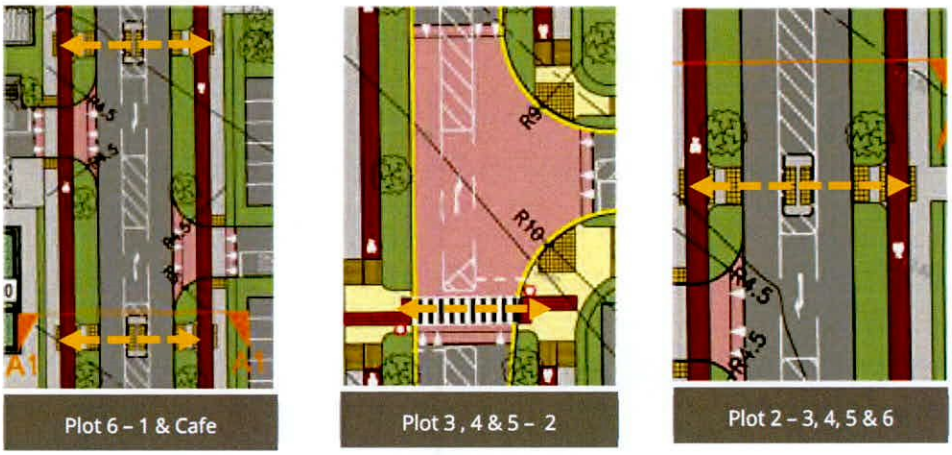


Figure 25 – Internal Active Travel Road Crossing Facilities (North-South Access Road)

- **Internal North-South Access Road** – The interim (until the SDCC Roads Objective to Ballymount Rd Lower is delivered through the adjoining Galco site in the future) termination of the north-south access road through the Warehouse / Logistics area of the development site incorporates a mini-roundabout. This termination treatment seeks to provide flexibility where by in additoin to providing access to the rear HGV service areas of Plot 2 and Plot 3 it enables any vehicles who may have by mistake entered the subject Warehouse / Logistics development to safely undertake a U-turn manoeuvre and exit the subject site. This mini roundabout arrangement is considered a temporary layout can be readily removed, if required, once the SDDC Roads Objective to/from Ballymount Rd Lower (to the north) is implemented and a continuous through link is delivered in the future.

- As cyclists, including staff and visitors traveling to / from Warehouse / Logistics plots No. 2 and No. 3, generated by the scheme proposals will not in the short term need to travel to (or via) this northern termination point, the design of the cycle track has facilitated the cyclists to safely transfer to and from the road carriageway as illustrated in Figure 26 and drawing 210175-DBFL-TR-SP-DR-C-1019.

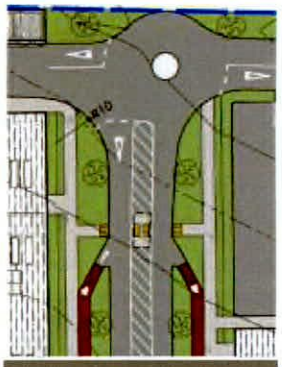


Figure 26

This provides the flexibility to the designers of the future SDCC road extension to accommodate a number of different options to continue the segregated cycle tracks northwards in a similar manner to that provided along the developments north-south access road.

5.6 DBFL Response to Item 7(i)(e)

As per the SDCC request the scheme proposals have been updated to include the provision of a new 2.0m wide concrete footpath along the northern side of Calmount Rd corridor between the proposed site access junction and the existing Calmount Rd / Ballymount Rd Lower tear-drop roundabout junction.

Whilst the details / alignment of this new pedestrian connection can be amended / conditioned in response to SDCC specific requirements, the presented alignment seeks to position this new footpath in close proximity to the existing northern boundary treatment with the objective of retaining a grass verge (criteria 5.0m) wide between the new footpath and the existing road carriageway with the objective of retaining the maximum level of flexibility to accommodate any future enhancement works that SDCC may seek to implement along this corridor in the long term. The extent of this new footpath is graphically presented in Figure 27 below and DBFL drawing 210175-DBFL-TR-SP-DR-C-1019.

Figure 27 – New 2.0m wide Footpath between the Calmount Rd Site Access and Ballymount Rd Upper

5.7 DBFL Response to Item 7(i)(f)

As per the requirements of the FIR, an independent Stage 1 Quality Audit, incorporating a Stage 1 Road Safety Audit, a walking audit, a cycle audit and an access audit; has been commissioned and undertaken by Burton Consulting Engineers. The auditors identified a total of 13 issues that they recommended actions were required to address and / or minimise the occurance of the safety / access concern. Accordingly, in additon to specific items raised within the SDCC FIR the design of the scheme propsals have been revisited to incorporate the recommendations of the auditors.

As detailed in the Quality Audit reports feedback form, as appended to this report, the updated design measures have been noted as addressing in full the auditors concerns.

6 CIVIL INFRASTRUCTURE CHANGES REQUIRED

6.1 Introduction

The Further Information (FI) request does not specifically address any of the civil infrastructure proposals previously submitted, however given that there have been a number of changes to the overall layout between the original planning submission and the revised submission for the FI request, a number of changes have been required to the civil infrastructure design. Civil Infrastructure revisions to accommodate the new layout and proposals included within the Green Infrastructure Report and Coordinated Design Response Document have been developed in conjunction with *TOT Architects*, and landscape architects - *Mitchell + Associates*, and incorporate elements of the recently adopted *South Dublin County Development Plan 2022 - 2028*.

The approach to the civil infrastructure provision is in line with previous proposals for the site, with the majority of changes focussed on accommodating changes to unit 6 at the southern side of the site.

Minor variations to the layout of SuDS features (swales and tree pits) along the public road have also been made to accommodate additional crossing points but do not change the overall strategy, all runoff from these roads will continue to be routed through SuDS features in line with the previously submitted approach.

Foul Sewers and Watermain supply for unit 6 have also been revised and to accommodate minor changes in the proposed site layout while repositioning of hydrants has been required to ensure complete site coverage due to a change in position of a proposed ESB substation. All revisions required are reflected in the latest issue of the drawings submitted as part of the Further Information response.

Revised drawings are included as part of the DBFL drawing pack submitted as part of the FI response, with the latest proposals for the civil infrastructure reflected for the site:

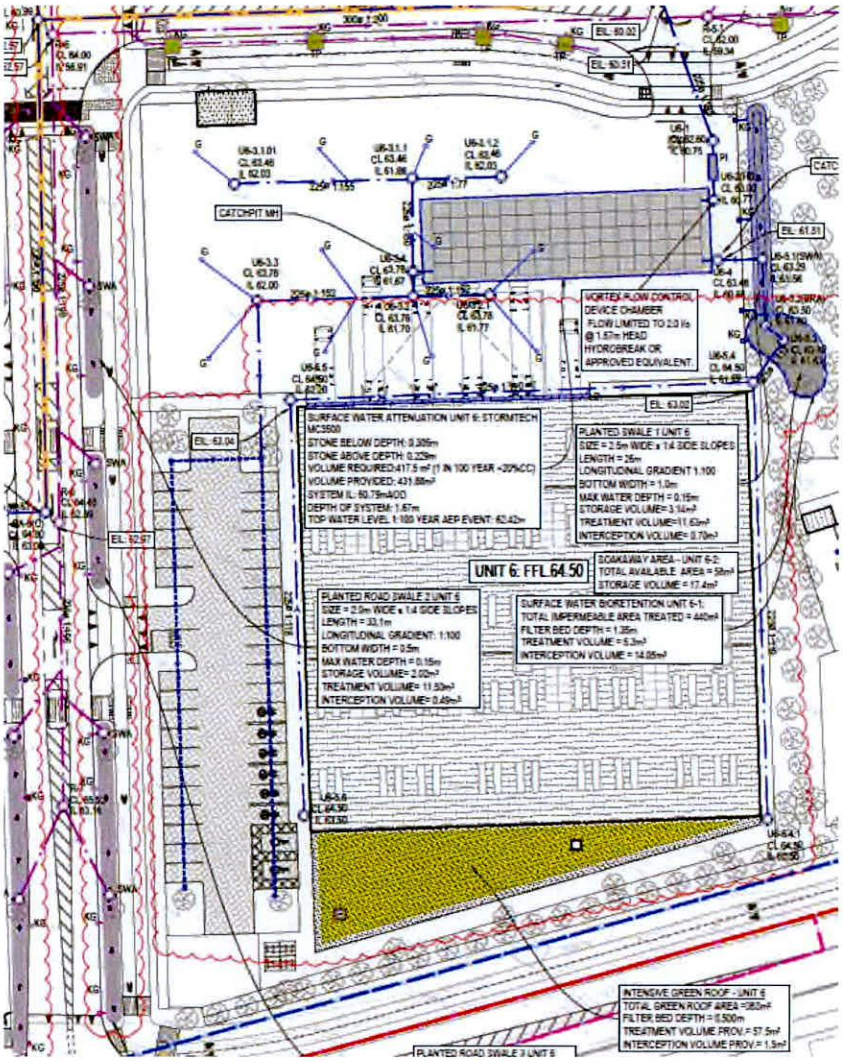
- **Surface Water Layout Plan** – 210175-DBFL-SW-SP-DR-C-1300
- **Foul Sewer Layout Plan** – 210175-DBFL-FW-SP-DR-C-1302
- **Watermain Layout Plan** – 210175-DBFL-WM-SP-DR-C-1001
- **Roads Layout Plan** – 210175-DBFL-RD-SP-DR-C-1101
- **Typical Road Cross Section** - 210175-DBFL-RD-SP-DR-C-5018 –

6.2 Unit 6 - Surface Water Network Revisions

Referring to Figure 28 below, the most evident change is the rotation of the unit through 90 degrees and an increased provision of green roof for the office building. With regards to the collection of runoff, the overall approach as outlined in the previously submitted Engineering Service Report is adhered to. Roof runoff is collected via 225mm diameter pipes which convey runoff to the soakaway/bioretention area at the northeast corner of the unit, in turn discharging to the proposed attenuation system which remains unchanged from the previous submission.

Intensive green roof of a depth of 0.5m is provided above the office unit and will provide a treatment and interception volume of 57.5m^3 and 1.5m^3 respectively. An intensive green roof also improves biodiversity for the site, while permeable pavement is proposed for the parking area to the front of the unit to provide interception and treatment for an area of 963m^2. Revised SuDS calculations for changes required across the site are appended and a revised microdrainage model has been created for unit 6 which shows no flooding is expected in the unit 6 network for a 1:100 year + 20% climate change event (results also appended)

The SuDS features proposed for the site have been designed alongside *Mitchells + Associates* to ensure that compliance is achieved with the SDCC Development Plan in terms of Green Infrastructure Policy Objectives (please refer to Green Infrastructure report for further details). In a civil engineering context the proposals for the development have been developed to achieve SDCC *Policy IE3 : Surface Water and Ground Water*, particularly *Objectives 2 and 8.*



[Figure 28 – Excerpt of unit 6 from drawing: 210175-DBFL-SW-SP-DR-C-1300]

6.3 Unit 6 – Foul Sewer Revisions

Due to the change in orientation of unit 6 an additional section of foul sewer has been required to service this connection. Minor downstream changes to the network have been required to facilitate this additional section of pipe and have been reflected on the revised drawings and microdrainage calculations appended to this report (foul loading for the network remains unchanged). Self-cleansing velocities are maintained across the network and the layout maintains complicity with Irish Water's standard details and Code of Practice. These revisions, and the overall scheme, are in line with SDCC *Policy IE2: Water Supply and Wastewater* and specifically *IE2 Objectives 1, 3, 5, 8, 9 and 10.*

6.4 Internal Roads – Surface Water Network Revisions

As a result of the roads safety audit a number of additional crossings have been provided for the internal roads for the development, this has necessitated revisions to the swale layout for these roads. While the position and layout of the swales has changed to accommodate these changes, the overarching approach of draining these roads entirely to SuDS features is maintained.

An additional area of permeable paving is proposed at the entrance to Unit 5. This has been made possible due to the removal of HGV traffic from this entrance to the site, and as such the expected traffic loading is appropriate for a permeable pavement in this location. This additional area of permeable paving further increases the volumes of interception and treatment for the site.

No changes to the piped surface water sewer network to be taken in charge by the local authority have been made and, excluding the revisions to unit 6 noted above, individual unit networks remain unaltered also. All individual unit network discharge rates, and the whole development network discharge rate proposed in the earlier planning submission are maintained while incorporating these required changes.

The overall SuDS provision for the site has increased slightly as a result of these proposed changes. The SuDS summary sheet appended to this document totals the interception and treatment volumes for the site at 362.8m^3 and 1437.9m^3 respectively. This is an increase of 18.1m^3 interception and 34.8m^3 treatment when compared to the previously submitted proposal for the site.

As per the revisions for unit 6 elaborated on in section 6.2, the revised SuDS proposals are aligned with the SDCC *County Development Plan 2022-2028, Policy IE3* and Green Infrastructure Objectives referenced in the *Green Infrastructure Report* and the *Coordinated Design Response Document*.

6.5 Watermain Network Revisions

Minor amendments have been made to facilitate the revisions to the site layout, namely the revised position of hydrants to provide full coverage for units 3 and 4. There has also been an extension of the feed for unit 6 to accommodate the revised orientation of this unit (water demand calculations remain unchanged). The watermain network design maintains complicity with Irish Water's Standard Details and Codes of Practice as per

previous planning drawings. Similar to the foul sewer revisions, all watermain revisions have been made in line with the SDCC policies noted in section 6.3.

Appendix A : Quality Audit Report

Title: **QUALITY AUDIT**

INCLUDING

Road Safety Audit, Access Audit, Cycle Audit and Walking Audit.

For;

WAREHOUSING / LOGISTICS & OFFICES AT CALMOUNT ROAD, BALLYMOUNT, Co Dublin.

Client: **DBFL Consulting Engineers**

Date: **August 2022**

Report reference: **1584R01**

VERSION: **FINAL (6-9-2022)**

Prepared By:

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BRUTON CONSULTING ENGINEERS

CONTENTS SHEET

Contents

1.0 Introduction

This report was prepared in response to a request from Mr. Thomas Jennings, DBFL Consulting Engineers for a Quality Audit for a proposed warehousing/logistics & offices at Calmount Road, Ballymount, Co Dublin.

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 portion of the Quality Audit is a design stage audit and includes a Stage 1 Road Safety Audit (in accordance with TII Publication GE-DTY-01024, dated December 2017), an access audit, a walking audit and a cycling audit. (i.e. aspects of a Quality Audit carried out independent of the Design Team and generally included as appendices to the overall Audit)

The Road Safety and Quality Audit Team comprised of;

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

TII Road safety Auditor approval number: NB 168446

Team Member: **Daniel Pentony**, CEng MIEI PGDipPM

TII Auditor Approval number: DP3383505

This portion of the Quality Audit involved the examination of drawings and other material and a site visit by the Audit Team, on the 18th of August 2022. The weather at the time of the site visit was dry and the road surface was also 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**.

2.0 Background

It is proposed to construct 5 warehouse / logistics units (Units 1, 2 3, 4 and 6), Including ancillary office use and entrance / reception areas over two levels. Each warehouse / logistics unit includes car parking to the front, and service yards, including HGV loading bays, to the rear of each unit. A total of 200 car parking spaces and 110 cycle spaces are provided for the warehouse/logistics units. A total of 77 car parking spaces, 50 cycle parking spaces and a bin storage area are provided for the proposed office buildings. The development is to be accessed off Ballymount Avenue and Calmount Road and includes for alterations and upgrades to the public footpaths and road.

Calmount Road and Ballymount Avenue are single carriageway roads with a speed limit of 50km/hr. Calmount Road has an existing footpath on the south side (opposite of the development). Ballymount Avenue has an existing offroad segregated footpath and cycleway on both sides.

The scheme has been designed to achieve the objectives set out in DMURS.

The site location map is shown below.

Site Location Map (image courtesy of openstreetmap.org

No data was available from the Road Safety Authority's website on collisions due to an ongoing review of the policy on making such information available.

3.0 Issues Identified in the Stage 1 Quality Audit

Summary Table of Problem Categories

Problem Reference	Access Audit	Walking Audit	Cycling Audit	Road Safety Audit	Quality Audit
3.1		✓	✓	✓	✓
3.2		✓		✓	✓
3.3			✓	✓	✓
3.4			✓	✓	✓
3.5			✓	✓	✓
3.6		✓		✓	✓
3.7				✓	✓
3.8		✓	✓	✓	✓
3.9		✓	✓	✓	✓
3.10		✓		✓	✓
3.11		✓		✓	✓
3.12		✓	✓	✓	✓
3.13			✓	✓	✓

3.1 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019, Calmount Road

ISSUE

The drawing shows a zebra crossing at the junction on Calmount Road. Given the volume of HGV traffic, such vehicles will be overhanging the Calmount Carriageway when allowing pedestrians and cyclists to cross. This could result in rear-end collisions.

RECOMMENDATION

It is recommended that an uncontrolled crossing be provided whereby drivers can continue to turn when pedestrians and cyclists are clear of their path.

3.2 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019, Calmount Road, uncontrolled pedestrian crossing.

ISSUE

The drawing shows an uncontrolled pedestrian crossing of Calmount Road however road marking tram lines suggest a controlled crossing. This may lead to confusion over priority between drivers and pedestrians resulting in collisions.

RECOMMENDATION

It is recommended that the crossing be upgraded to a controlled crossing.

3.3 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019, Calmount Road, uncontrolled pedestrian crossing.

ISSUE

The drawing shows an uncontrolled pedestrian crossing of Calmount Road. There will be a desire for cyclists to cross at this location given the termination of the two-way cycle track on the opposite side of Calmount Road and the cycle tracks from within the development.

RECOMMENDATION

It is recommended that the crossing be upgraded to a toucan crossing of suitable width and with appropriate road markings.

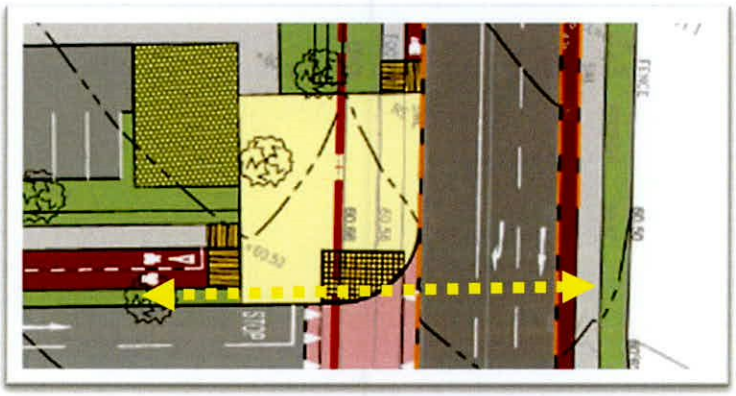
3.4 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019, Ballymount Avenue.

ISSUE

There is a discontinuity in cycle facilities between the south bound cycle lane on Ballymount Avenue and the two-way facility within the development. Cyclists may travel cross at the right turning lane for vehicular traffic could lead to collisions with turning HGVs.



RECOMMENDATION

It is recommended that a toucan crossing be provided on Ballymount Avenue.

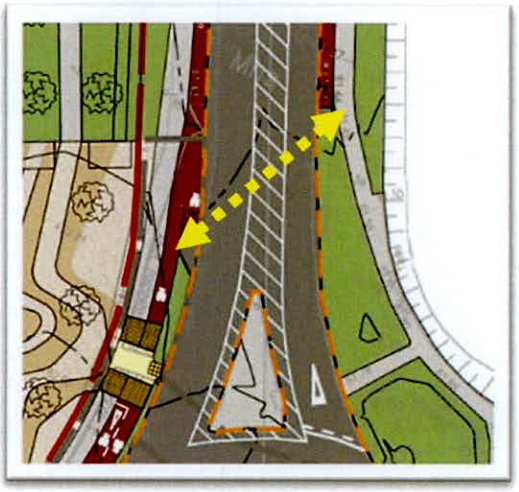
3.5 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019, Ballymount Avenue.

ISSUE

There is a discontinuity in cycle facilities between the south bound cycle lane on Ballymount Avenue and the two -way facility on the development side. Cyclists mat travel diagonally across the carriageway or opt to stay on-road at the roundabout which could lead to collisions with turning HGVs.



RECOMMENDATION

It is recommended that a toucan crossing be provided on Ballymount Avenue.

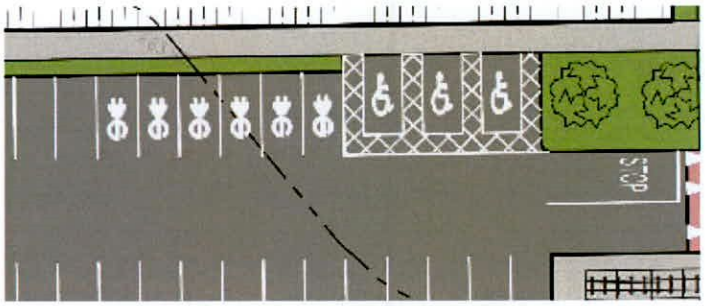
3.6 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

The dimensions of the electric vehicle charging points are not clear, or the location of the charging unit. Cables from this unit may be left lying on a footpath which could be a slip hazard for vulnerable road users resulting in slip/fall type injuries.



RECOMMENDATION

It is recommended that adequate space be available for the charging spaces and charging units so that the charging cables are not a hazard for pedestrians.

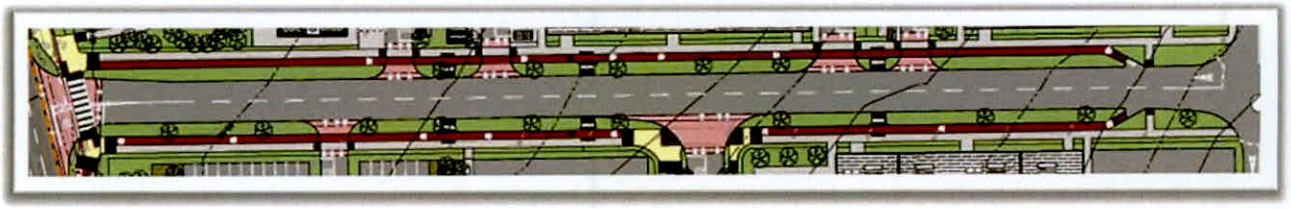
3.7 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

The main internal north -south road widths are not dimensioned, including footpaths, cycleways etc. The audit team are concerned that this long straight road could result in higher speeds which could put vulnerable users using the crossing points at risk of collision resulting in injury.



RECOMMENDATION

The design team should ensure that appropriate speed control measures are incorporated within the scheme to reduce vehicular speeds.

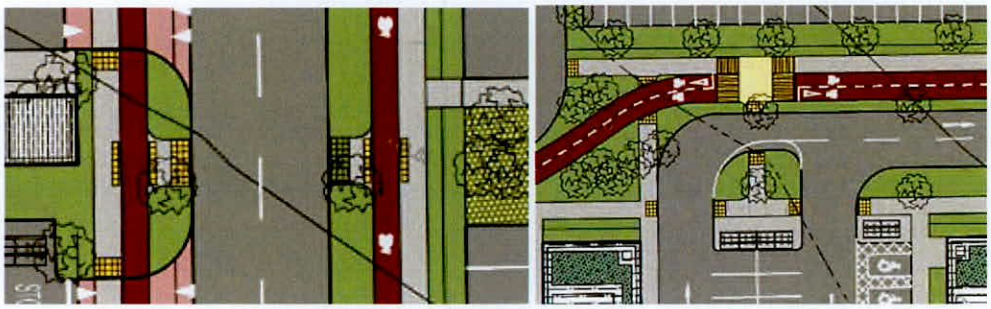
3.8 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

There are proposed trees located at uncontrolled crossing locations throughout the proposed development. Their presence at crossing points may hinder intervisibility between vehicles and vulnerable road users.



RECOMMENDATION

It is recommended that tree planting locations are specified carefully to be outside the visibility splays or that the tree girths, canopy heights etc. are chosen so that the trees are only momentary obstacles to visibility.

3.9 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

The width of the footpath and two-way cycle way along the Calmount road are unknown. An inappropriate width may lead to cyclist/pedestrian collisions.

RECOMMENDATION

An appropriate width should be provided.

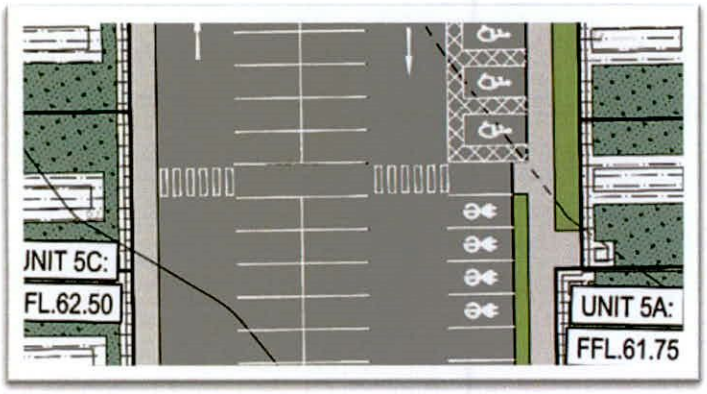
3.10 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

The crossing point between Unit 5A and 5C does not have tactile paving detailed. The lack of appropriate detailing can increase the likelihood of pedestrians crossing at unsafe locations resulting in vehicular/pedestrian collisions.



RECOMMENDATION

It is recommended that tactile paving and dropped kerbing be included at the crossing location.

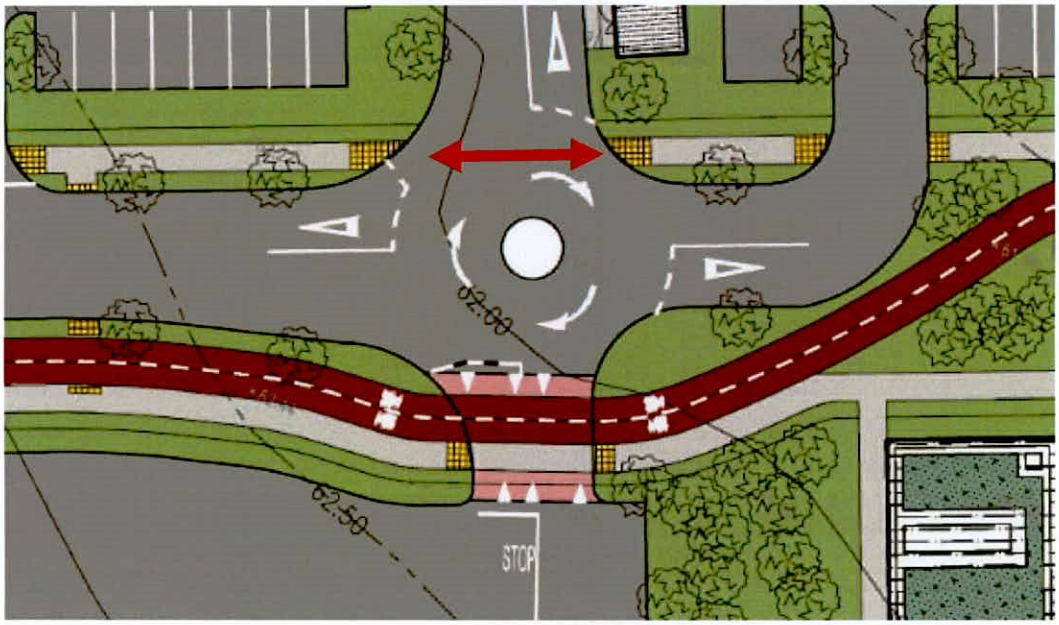
3.11 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

The crossing point to the north side of the roundabout is located within the circulating carriageway of the roundabout. Crossings at inappropriate locations increase the risk of pedestrian/vehicular collision leading to injury.



RECOMMENDATION

It is recommended that the crossing location be relocated to a safe crossing location with a reduced crossing width.

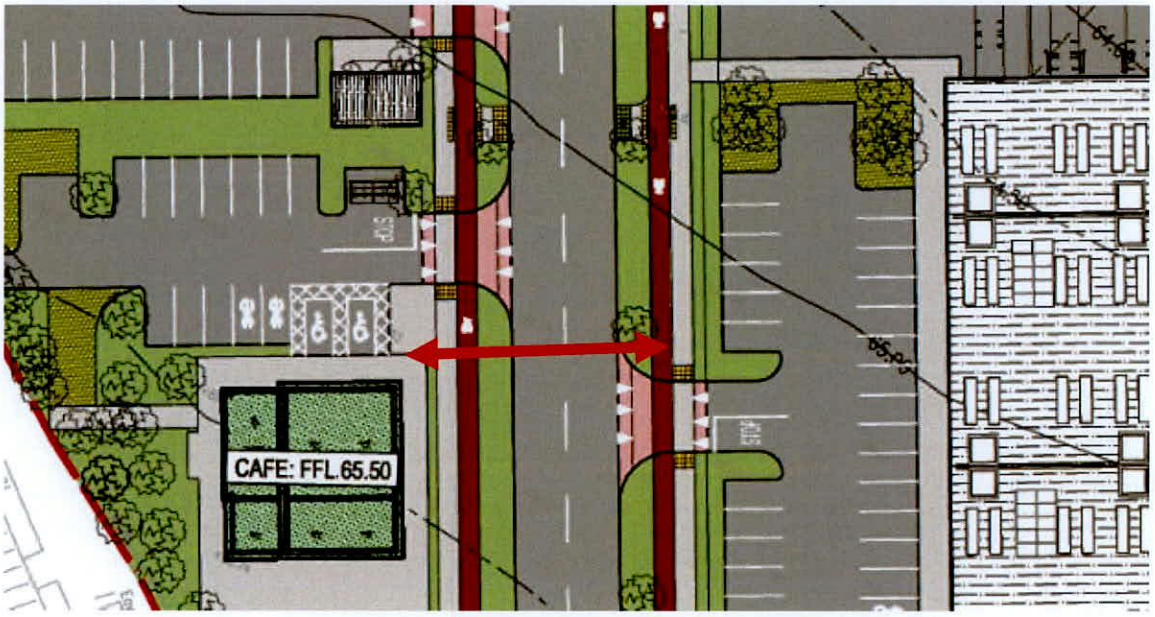
3.12 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

A pedestrian desire line exists from Unit 6 to the café. No crossing point has been provided on this desire line leading to an increased risk of vehicle/pedestrian collisions due to likelihood of pedestrians crossing at unsafe locations.



RECOMMENDATION

It is recommended that an appropriate crossing point be provided.

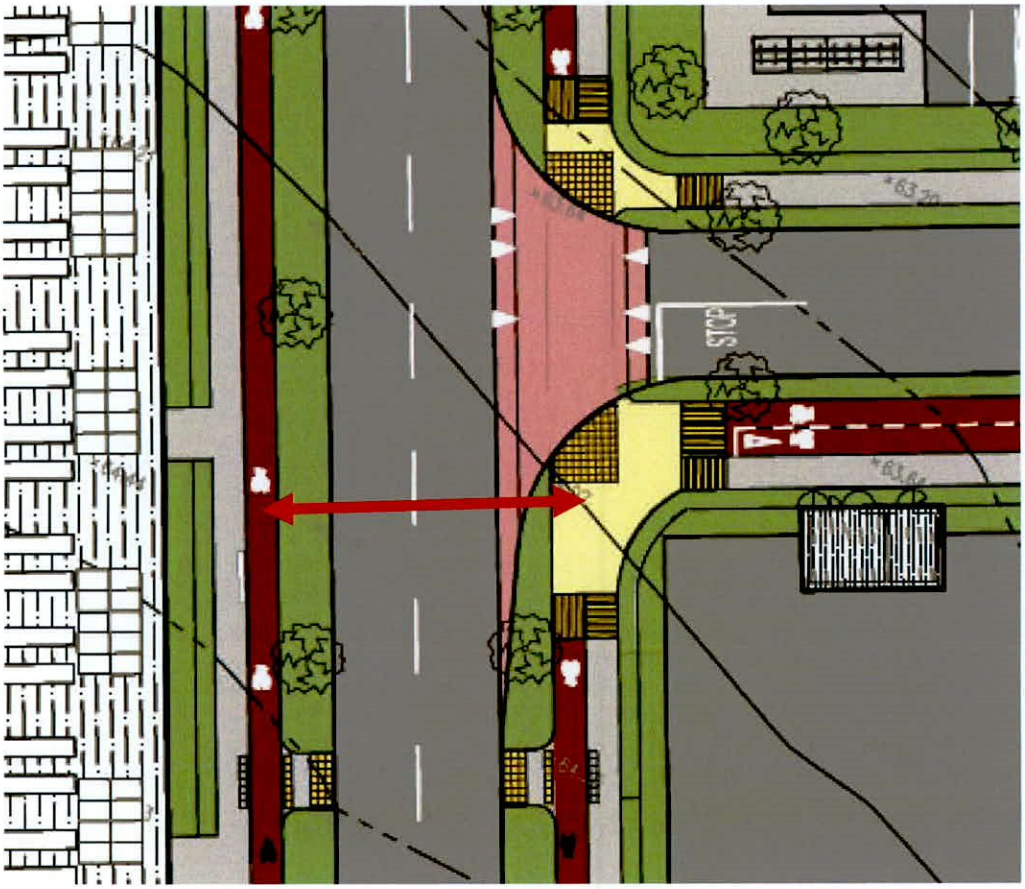
3.13 Problem

LOCATION

Drawing 210175-DBFL-TR-SP-DR-C-1019

ISSUE

There will be a desire for cyclists to cross at this location given the termination of the two-way cycle track to the east of the junction. This cyclist discontinuity increases the risk of a collision between vehicles and cyclists who cross at undesignated locations.



RECOMMENDATION

It is recommended that a crossing facility be provided.

4 Observations

4.1 Observation

Design drawings for Drainage, Kerbing, Signage, Public Lighting have not been provided to the audit team

4.2 Observation

There is an existing embankment along the site boundary at Calmount Road. It is assumed that the proposed footpaths and cycle tracks will have suitable crossfalls.

5 Quality Audit Statement

This portion of the 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:** Norman Bruton

(Quality Audit Team Leader) **Dated: 6-9-2022**

Daniel Pentony **Signed:** David

(Quality Audit Team Member) **Dated: 6-9-2022**

Appendix A

List of Material Supplied for this Quality Audit;

- Drawing 210175-DBFL-TR-SP-DR-C-1019
- Drawing 210175-DBFL-TR-SP-DR-C-1024
- Drawing 210175-DBFL-TR-SP-DR-C-1025

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Appendix B

Feedback Form

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QUALITY AUDIT FORM – FEEDBACK ON QUALITY AUDIT REPORT

Scheme: Warehousing/Logistics & offices at Calmount road, Ballymount, Dublin.
Quality Audit- Stage 1
Date Audit (site visit) Completed 21-08-2022

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		
3.2	Yes	Yes		
3.3	Yes	Yes		
3.4	Yes	Yes		
3.5	Yes	No	The identified potential cyclists desire line will be accommodated in the medium term by the NTA's Core Bus Corridor works which will see the existing roundabout upgraded to a signal-controlled crossroad arrangement with dedicated 'protected' cycle lanes / tracks circumventing the junction as per NTA guidance. In the short term, prior to the implementation of the proposed NTA scheme; it is proposed that the existing southbound cycle track on Ballymount Ave is extended southwards (and retained elevated / segregated from the carriageway by a criteria 125mm upstand / kerb) some 27m from its existing termination point to the roundabouts existing crossing facility on the roundabout northern arm.	Yes
3.6	Yes	Yes		
3.7	Yes	Yes	A centrally located 'ghost island' by way of road markings is to be introduced along the carriageway which will narrow the traffic lanes (both 'through' lanes and right turn pockets) to 3.0m in width. In addition, at all uncontrolled crossing points, refuge islands are to be introduced as an additional traffic calming measure.	Yes
3.8	Yes	Yes		
3.9	Yes	Yes	Footpath width of 2.0m with parallel segregated (50mm upstand as per NTA guidance) 2.5m wide two-way cycle track as per National Cycle Manual recommendations. The two-way cycle track is to be set back some 1.3m (grass verge) from the road	Yes

			edge thereby providing flexibility for it to be enhanced in the future should the need arise.	
3.10	Yes	Yes		
3.11	Yes	Yes		
3.12	Yes	Yes		
3.13	Yes	Yes		

Signed..... **Date:** 2nd September 2022
Design Team Leader

Signed..... **Date**: ...6-9-2022.....
Audit Team Leader

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Appendix C

Problem Location Plan.


3.6
3.11
example
3.4
3.7
3.13
3.8
example
3.9
3.10
3.5
3.12
3.1
3.3
3.2

Appendix B : Revised Civil Infrastructure Calculations

Appendix B : 1 – Unit 6 Revised Surface Water Microdrainage

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for UNIT 6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	69
M5-60 (mm)	17.500	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.750
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for UNIT 6

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	56.973	0.480	118.7	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	54.262	0.460	118.0	0.124	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	60.944	0.510	119.5	0.048	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	6.688	0.060	111.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	3.124	0.030	104.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	8.688	0.040	217.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	5.938	0.050	118.8	0.091	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	4.556	0.020	227.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	7.464	0.040	186.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	20.691	0.160	129.3	0.149	4.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	10.648	0.070	152.1	0.029	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	3.898	0.030	129.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	53.53	4.79	63.500	0.089	0.0	0.0	0.0	1.20	47.7	12.9
S2.000	53.69	4.75	63.500	0.124	0.0	0.0	0.0	1.20	47.8	18.0
S2.001	50.49	5.60	62.200	0.171	0.0	0.0	0.0	1.19	47.5	23.4
S1.001	50.18	5.69	61.690	0.260	0.0	0.0	0.0	1.24	49.2	35.4
S1.002	50.04	5.73	61.630	0.260	0.0	0.0	0.0	1.28	50.9	35.4
S1.003	49.58	5.87	61.600	0.260	0.0	0.0	0.0	1.06	75.1	35.4
S1.004	49.36	5.94	61.560	0.351	0.0	0.0	0.0	1.44	101.9	46.9
S1.005	49.12	6.01	60.850	0.351	0.0	0.0	0.0	1.04	73.3	46.9
S1.006	48.77	6.12	60.830	0.351	0.0	0.0	0.0	1.15	81.1	46.9
S3.000	55.61	4.30	62.030	0.149	0.0	0.0	0.0	1.15	45.7	22.4
S4.000	56.21	4.17	61.770	0.029	0.0	0.0	0.0	1.06	42.1	4.4
S3.001	55.36	4.36	61.700	0.178	0.0	0.0	0.0	1.15	45.5	26.7

Network Design Table for UNIT 6

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.000	23.173	0.150	154.5	0.048	4.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	12.127	0.080	151.6	0.021	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	11.174	0.074	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	3.242	0.020	162.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	33.601	0.170	197.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	4.234	0.020	211.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.008	7.984	0.020	399.2	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.009	19.454	0.100	194.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.000	54.83	4.48	62.030	0.048	0.0	0.0	0.0	0.81	14.2	7.1
S6.000	56.11	4.19	62.030	0.021	0.0	0.0	0.0	1.06	42.1	3.3
S5.001	54.10	4.65	61.880	0.069	0.0	0.0	0.0	1.07	42.4	10.1
S3.002	53.88	4.71	61.670	0.247	0.0	0.0	0.0	1.02	40.7	36.0
S3.003	51.53	5.31	61.650	0.247	0.0	0.0	0.0	0.93	36.8	36.0
S1.007	48.59	6.18	60.790	0.598	0.0	0.0	0.0	1.24	137.1	78.7
S1.008	48.12	6.32	60.770	0.598	0.0	0.0	0.0	0.90	99.5	78.7
S1.009	55.41	4.35	60.750	0.000	2.0	0.0	0.0	0.93	37.1	2.0

Manhole Schedules for UNIT 6

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
U6 - 5.4.1	64.500	1.000	Open Manhole	1200	S1.000	63.500	225				
U6 - 5.6	64.500	1.000	Open Manhole	1200	S2.000	63.500	225				
U6 - 5.5	64.500	2.300	Open Manhole	1200	S2.001	62.200	225	S2.000	63.040	225	840
U6 - 5.4	64.500	2.810	Open Manhole	1200	S1.001	61.690	225	S1.000	63.020	225	1330
								S2.001	61.690	225	
U6 - 5.3	63.500	1.870	Open Manhole	1200	S1.002	61.630	225	S1.001	61.630	225	
U6 - 5.2	63.500	1.900	Open Manhole	1200	S1.003	61.600	300	S1.002	61.600	225	
U6 - 5.1(SWA)	63.290	1.730	Open Manhole	1200	S1.004	61.560	300	S1.003	61.560	300	
U6 - 4	63.460	2.610	Open Manhole	1200	S1.005	60.850	300	S1.004	61.510	300	660
U6 - ATNN	63.200	2.370	Open Manhole	1200	S1.006	60.830	300	S1.005	60.830	300	
U6 - 3.3	63.460	1.430	Open Manhole	1200	S3.000	62.030	225				
U6 - 3.2.1	63.200	1.430	Open Manhole	1200	S4.000	61.770	225				
U6 - 3.2	63.200	1.500	Open Manhole	1200	S3.001	61.700	225	S3.000	61.870	225	170
								S4.000	61.700	225	
U6 - 3.1.01	63.460	1.430	Open Manhole	1200	S5.000	62.030	150				
U6 - 3.1.2	63.460	1.430	Open Manhole	1200	S6.000	62.030	225				
U6 - 3.1.1	63.460	1.580	Open Manhole	1200	S5.001	61.880	225	S5.000	61.880	150	
								S6.000	61.950	225	70
U6 - 3.1	63.460	1.790	Open Manhole	1200	S3.002	61.670	225	S3.001	61.670	225	
								S5.001	61.806	225	136
U6 - ATTN	63.460	1.810	Open Manhole	1200	S3.003	61.650	225	S3.002	61.650	225	
U6 - 3(ATTN)	63.460	2.670	Open Manhole	1350	S1.007	60.790	375	S1.006	60.790	300	
								S3.003	61.480	225	540
U6 - 2(HB)	63.000	2.230	Open Manhole	1350	S1.008	60.770	375	S1.007	60.770	375	
U6 - 1	62.600	1.850	Open Manhole	1350	S1.009	60.750	225	S1.008	60.750	375	
U6 -	61.900	1.250	Open Manhole	0		OUTFALL		S1.009	60.650	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U6 - 5.4.1	709929.285	730322.233	709929.285	730322.233	Required	
U6 - 5.6	709873.531	730297.685	709873.531	730297.685	Required	
U6 - 5.5	709849.667	730346.418	709849.667	730346.418	Required	
U6 - 5.4	709904.296	730373.433	709904.296	730373.433	Required	
U6 - 5.3	709905.744	730379.963	709905.744	730379.963	Required	

Manhole Schedules for UNIT 6

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U6 - 5.2	709902.729	730380.781	709902.729	730380.781	Required	
U6 - 5.1(SWA)	709898.830	730388.546	709898.830	730388.546	Required	
U6 - 4	709893.537	730385.854	709893.537	730385.854	Required	
U6 - ATNN	709889.318	730384.135	709889.318	730384.135	Required	
U6 - 3.3	709840.424	730356.360	709840.424	730356.360	Required	
U6 - 3.2.1	709868.945	730369.327	709868.945	730369.327	Required	
U6 - 3.2	709859.116	730365.232	709859.116	730365.232	Required	
U6 - 3.1.01	709831.368	730369.793	709831.368	730369.793	Required	
U6 - 3.1.2	709863.310	730384.715	709863.310	730384.715	Required	
U6 - 3.1.1	709852.704	730378.835	709852.704	730378.835	Required	
U6 - 3.1	709857.068	730368.548	709857.068	730368.548	Required	
U6 - ATTN	709860.092	730369.718	709860.092	730369.718	Required	
U6 - 3(ATTN)	709886.172	730390.904	709886.172	730390.904	Required	
U6 - 2(HB)	709889.968	730392.782	709889.968	730392.782	Required	
U6 - 1	709886.417	730399.933	709886.417	730399.933	Required	
U6 -	709873.019	730414.038			No Entry	

PIPELINE SCHEDULES for UNIT 6

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	U6 - 5.4.1	64.500	63.500	0.775	Open Manhole	1200
S2.000	o	225	U6 - 5.6	64.500	63.500	0.775	Open Manhole	1200
S2.001	o	225	U6 - 5.5	64.500	62.200	2.075	Open Manhole	1200
S1.001	o	225	U6 - 5.4	64.500	61.690	2.585	Open Manhole	1200
S1.002	o	225	U6 - 5.3	63.500	61.630	1.645	Open Manhole	1200
S1.003	o	300	U6 - 5.2	63.500	61.600	1.600	Open Manhole	1200
S1.004	o	300	U6 - 5.1(SWA)	63.290	61.560	1.430	Open Manhole	1200
S1.005	o	300	U6 - 4	63.460	60.850	2.310	Open Manhole	1200
S1.006	o	300	U6 - ATNN	63.200	60.830	2.070	Open Manhole	1200
S3.000	o	225	U6 - 3.3	63.460	62.030	1.205	Open Manhole	1200
S4.000	o	225	U6 - 3.2.1	63.200	61.770	1.205	Open Manhole	1200
S3.001	o	225	U6 - 3.2	63.200	61.700	1.275	Open Manhole	1200
S5.000	o	150	U6 - 3.1.01	63.460	62.030	1.280	Open Manhole	1200
S6.000	o	225	U6 - 3.1.2	63.460	62.030	1.205	Open Manhole	1200
S5.001	o	225	U6 - 3.1.1	63.460	61.880	1.355	Open Manhole	1200
S3.002	o	225	U6 - 3.1	63.460	61.670	1.565	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	56.973	118.7	U6 - 5.4	64.500	63.020	1.255	Open Manhole	1200
S2.000	54.262	118.0	U6 - 5.5	64.500	63.040	1.235	Open Manhole	1200
S2.001	60.944	119.5	U6 - 5.4	64.500	61.690	2.585	Open Manhole	1200
S1.001	6.688	111.5	U6 - 5.3	63.500	61.630	1.645	Open Manhole	1200
S1.002	3.124	104.1	U6 - 5.2	63.500	61.600	1.675	Open Manhole	1200
S1.003	8.688	217.2	U6 - 5.1(SWA)	63.290	61.560	1.430	Open Manhole	1200
S1.004	5.938	118.8	U6 - 4	63.460	61.510	1.650	Open Manhole	1200
S1.005	4.556	227.8	U6 - ATNN	63.200	60.830	2.070	Open Manhole	1200
S1.006	7.464	186.6	U6 - 3(ATTN)	63.460	60.790	2.370	Open Manhole	1350
S3.000	20.691	129.3	U6 - 3.2	63.200	61.870	1.105	Open Manhole	1200
S4.000	10.648	152.1	U6 - 3.2	63.200	61.700	1.275	Open Manhole	1200
S3.001	3.898	129.9	U6 - 3.1	63.460	61.670	1.565	Open Manhole	1200
S5.000	23.173	154.5	U6 - 3.1.1	63.460	61.880	1.430	Open Manhole	1200
S6.000	12.127	151.6	U6 - 3.1.1	63.460	61.950	1.285	Open Manhole	1200
S5.001	11.174	150.0	U6 - 3.1	63.460	61.806	1.429	Open Manhole	1200
S3.002	3.242	162.1	U6 - ATTN	63.460	61.650	1.585	Open Manhole	1200

PIPELINE SCHEDULES for UNIT 6

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.003	o	225	U6 - ATTN	63.460	61.650	1.585	Open Manhole	1200
S1.007	o	375	U6 - 3(ATTN)	63.460	60.790	2.295	Open Manhole	1350
S1.008	o	375	U6 - 2(HB)	63.000	60.770	1.855	Open Manhole	1350
S1.009	o	225	U6 - 1	62.600	60.750	1.625	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.003	33.601	197.7	U6 - 3(ATTN)	63.460	61.480	1.755	Open Manhole	1350
S1.007	4.234	211.7	U6 - 2(HB)	63.000	60.770	1.855	Open Manhole	1350
S1.008	7.984	399.2	U6 - 1	62.600	60.750	1.475	Open Manhole	1350
S1.009	19.454	194.5	U6 -	61.900	60.650	1.025	Open Manhole	0

Free Flowing Outfall Details for UNIT 6

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.009	U6 -	61.900	60.650	0.000	0	0

Simulation Criteria for UNIT 6

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

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

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Summer
Return Period (years)		2	Cv (Summer) 0.750
Region	Scotland and Ireland		Cv (Winter) 0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for UNIT 6

Hydro-Brake® Optimum Manhole: U6 - 3(ATTN), DS/PN: S1.007, Volume (m³): 5.5

Unit Reference	MD-SHE-0059-2000-1670-2000
Design Head (m)	1.670
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	60.790
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.670	2.0	Kick-Flo®	0.531	1.2
Flush-Flo™	0.264	1.5	Mean Flow over Head Range	-	1.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	0.800	1.4	2.000	2.2	4.000	3.0	7.000	3.9
0.200	1.4	1.000	1.6	2.200	2.3	4.500	3.2	7.500	4.0
0.300	1.5	1.200	1.7	2.400	2.4	5.000	3.3	8.000	4.1
0.400	1.4	1.400	1.8	2.600	2.4	5.500	3.5	8.500	4.2
0.500	1.3	1.600	2.0	3.000	2.6	6.000	3.6	9.000	4.4
0.600	1.3	1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5

Storage Structures for UNIT 6

Tank or Pond Manhole: U6 - 3(ATTN), DS/PN: S1.007

Invert Level (m) 60.790

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	1.670	250.0	1.671	0.0

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 6

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.500 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.276 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	U6 - 5.4.1	15 Winter	100	+20%					63.661
S2.000	U6 - 5.6	15 Winter	100	+20%	100/15 Summer				63.924
S2.001	U6 - 5.5	15 Winter	100	+20%	100/15 Summer				63.573
S1.001	U6 - 5.4	15 Winter	100	+20%	100/15 Summer				62.901
S1.002	U6 - 5.3	15 Winter	100	+20%	100/15 Summer				62.525
S1.003	U6 - 5.2	2160 Winter	100	+20%	100/15 Summer				62.425
S1.004	U6 - 5.1(SWA)	2160 Winter	100	+20%	100/15 Summer				62.424
S1.005	U6 - 4	2160 Winter	100	+20%	100/15 Summer				62.424
S1.006	U6 - ATNN	2160 Winter	100	+20%	100/15 Summer				62.423
S3.000	U6 - 3.3	15 Winter	100	+20%	100/15 Summer				63.032
S4.000	U6 - 3.2.1	15 Winter	100	+20%	100/15 Summer				62.820
S3.001	U6 - 3.2	15 Winter	100	+20%	100/15 Summer				62.807
S5.000	U6 - 3.1.01	15 Winter	100	+20%	100/15 Summer				62.851
S6.000	U6 - 3.1.2	15 Winter	100	+20%	100/15 Summer				62.734
S5.001	U6 - 3.1.1	15 Winter	100	+20%	100/15 Summer				62.723
S3.002	U6 - 3.1	15 Winter	100	+20%	100/15 Summer				62.670
S3.003	U6 - ATTN	2160 Winter	100	+20%	100/15 Summer				62.425
S1.007	U6 - 3(ATTN)	2160 Winter	100	+20%	100/15 Summer				62.423
S1.008	U6 - 2(HB)	2160 Winter	100	+20%					60.814
S1.009	U6 - 1	2160 Winter	100	+20%					60.785

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	U6 - 5.4.1	-0.064	0.000	0.85			39.2	OK	
S2.000	U6 - 5.6	0.199	0.000	1.05			48.4	SURCHARGED	
S2.001	U6 - 5.5	1.148	0.000	1.22			56.0	SURCHARGED	
S1.001	U6 - 5.4	0.986	0.000	2.49			85.9	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 6

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.002	U6 - 5.3	0.670	0.000	2.91			86.8	SURCHARGED	
S1.003	U6 - 5.2	0.525	0.000	0.09			5.1	SURCHARGED	
S1.004	U6 - 5.1(SWA)	0.564	0.000	0.11			6.8	SURCHARGED	
S1.005	U6 - 4	1.274	0.000	0.14			6.8	SURCHARGED	
S1.006	U6 - ATNN	1.293	0.000	0.11			6.7	SURCHARGED	
S3.000	U6 - 3.3	0.777	0.000	1.23			51.1	SURCHARGED	
S4.000	U6 - 3.2.1	0.825	0.000	0.24			8.5	SURCHARGED	
S3.001	U6 - 3.2	0.882	0.000	1.87			55.9	SURCHARGED	
S5.000	U6 - 3.1.01	0.671	0.000	1.05			14.2	SURCHARGED	
S6.000	U6 - 3.1.2	0.479	0.000	0.19			6.9	SURCHARGED	
S5.001	U6 - 3.1.1	0.618	0.000	0.54			19.5	SURCHARGED	
S3.002	U6 - 3.1	0.775	0.000	2.70			71.6	SURCHARGED	
S3.003	U6 - ATTN	0.550	0.000	0.14			4.9	SURCHARGED	
S1.007	U6 - 3(ATTN)	1.258	0.000	0.02			2.0	SURCHARGED	
S1.008	U6 - 2(HB)	-0.331	0.000	0.03			2.0	OK	
S1.009	U6 - 1	-0.190	0.000	0.06			2.0	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for UNIT 6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	69
M5-60 (mm)	17.500	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.750
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for UNIT 6

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	56.973	0.480	118.7	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	54.262	0.460	118.0	0.124	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	60.944	0.510	119.5	0.048	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	6.688	0.060	111.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	3.124	0.030	104.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	8.688	0.040	217.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	5.938	0.050	118.8	0.091	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	4.556	0.020	227.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	7.464	0.040	186.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	20.691	0.160	129.3	0.149	4.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	10.648	0.070	152.1	0.029	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	3.898	0.030	129.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	53.53	4.79	63.500	0.089	0.0	0.0	0.0	1.20	47.7	12.9
S2.000	53.69	4.75	63.500	0.124	0.0	0.0	0.0	1.20	47.8	18.0
S2.001	50.49	5.60	62.200	0.171	0.0	0.0	0.0	1.19	47.5	23.4
S1.001	50.18	5.69	61.690	0.260	0.0	0.0	0.0	1.24	49.2	35.4
S1.002	50.04	5.73	61.630	0.260	0.0	0.0	0.0	1.28	50.9	35.4
S1.003	49.58	5.87	61.600	0.260	0.0	0.0	0.0	1.06	75.1	35.4
S1.004	49.36	5.94	61.560	0.351	0.0	0.0	0.0	1.44	101.9	46.9
S1.005	49.12	6.01	60.850	0.351	0.0	0.0	0.0	1.04	73.3	46.9
S1.006	48.77	6.12	60.830	0.351	0.0	0.0	0.0	1.15	81.1	46.9
S3.000	55.61	4.30	62.030	0.149	0.0	0.0	0.0	1.15	45.7	22.4
S4.000	56.21	4.17	61.770	0.029	0.0	0.0	0.0	1.06	42.1	4.4
S3.001	55.36	4.36	61.700	0.178	0.0	0.0	0.0	1.15	45.5	26.7

Network Design Table for UNIT 6

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.000	23.173	0.150	154.5	0.048	4.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	12.127	0.080	151.6	0.021	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	11.174	0.074	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	3.242	0.020	162.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	33.601	0.170	197.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	4.234	0.020	211.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.008	7.984	0.020	399.2	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.009	19.454	0.100	194.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.000	54.83	4.48	62.030	0.048	0.0	0.0	0.0	0.81	14.2	7.1
S6.000	56.11	4.19	62.030	0.021	0.0	0.0	0.0	1.06	42.1	3.3
S5.001	54.10	4.65	61.880	0.069	0.0	0.0	0.0	1.07	42.4	10.1
S3.002	53.88	4.71	61.670	0.247	0.0	0.0	0.0	1.02	40.7	36.0
S3.003	51.53	5.31	61.650	0.247	0.0	0.0	0.0	0.93	36.8	36.0
S1.007	48.59	6.18	60.790	0.598	0.0	0.0	0.0	1.24	137.1	78.7
S1.008	48.12	6.32	60.770	0.598	0.0	0.0	0.0	0.90	99.5	78.7
S1.009	55.41	4.35	60.750	0.000	2.0	0.0	0.0	0.93	37.1	2.0

Manhole Schedules for UNIT 6

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
U6 - 5.4.1	64.500	1.000	Open Manhole	1200	S1.000	63.500	225				
U6 - 5.6	64.500	1.000	Open Manhole	1200	S2.000	63.500	225				
U6 - 5.5	64.500	2.300	Open Manhole	1200	S2.001	62.200	225	S2.000	63.040	225	840
U6 - 5.4	64.500	2.810	Open Manhole	1200	S1.001	61.690	225	S1.000	63.020	225	1330
								S2.001	61.690	225	
U6 - 5.3	63.500	1.870	Open Manhole	1200	S1.002	61.630	225	S1.001	61.630	225	
U6 - 5.2	63.500	1.900	Open Manhole	1200	S1.003	61.600	300	S1.002	61.600	225	
U6 - 5.1(SWA)	63.290	1.730	Open Manhole	1200	S1.004	61.560	300	S1.003	61.560	300	
U6 - 4	63.460	2.610	Open Manhole	1200	S1.005	60.850	300	S1.004	61.510	300	660
U6 - ATNN	63.200	2.370	Open Manhole	1200	S1.006	60.830	300	S1.005	60.830	300	
U6 - 3.3	63.460	1.430	Open Manhole	1200	S3.000	62.030	225				
U6 - 3.2.1	63.200	1.430	Open Manhole	1200	S4.000	61.770	225				
U6 - 3.2	63.200	1.500	Open Manhole	1200	S3.001	61.700	225	S3.000	61.870	225	170
								S4.000	61.700	225	
U6 - 3.1.01	63.460	1.430	Open Manhole	1200	S5.000	62.030	150				
U6 - 3.1.2	63.460	1.430	Open Manhole	1200	S6.000	62.030	225				
U6 - 3.1.1	63.460	1.580	Open Manhole	1200	S5.001	61.880	225	S5.000	61.880	150	
								S6.000	61.950	225	70
U6 - 3.1	63.460	1.790	Open Manhole	1200	S3.002	61.670	225	S3.001	61.670	225	
								S5.001	61.806	225	136
U6 - ATTN	63.460	1.810	Open Manhole	1200	S3.003	61.650	225	S3.002	61.650	225	
U6 - 3(ATTN)	63.460	2.670	Open Manhole	1350	S1.007	60.790	375	S1.006	60.790	300	
								S3.003	61.480	225	540
U6 - 2(HB)	63.000	2.230	Open Manhole	1350	S1.008	60.770	375	S1.007	60.770	375	
U6 - 1	62.600	1.850	Open Manhole	1350	S1.009	60.750	225	S1.008	60.750	375	
U6 -	61.900	1.250	Open Manhole	0		OUTFALL		S1.009	60.650	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U6 - 5.4.1	709929.285	730322.233	709929.285	730322.233	Required	
U6 - 5.6	709873.531	730297.685	709873.531	730297.685	Required	
U6 - 5.5	709849.667	730346.418	709849.667	730346.418	Required	
U6 - 5.4	709904.296	730373.433	709904.296	730373.433	Required	
U6 - 5.3	709905.744	730379.963	709905.744	730379.963	Required	

Manhole Schedules for UNIT 6

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U6 - 5.2	709902.729	730380.781	709902.729	730380.781	Required	
U6 - 5.1(SWA)	709898.830	730388.546	709898.830	730388.546	Required	
U6 - 4	709893.537	730385.854	709893.537	730385.854	Required	
U6 - ATNN	709889.318	730384.135	709889.318	730384.135	Required	
U6 - 3.3	709840.424	730356.360	709840.424	730356.360	Required	
U6 - 3.2.1	709868.945	730369.327	709868.945	730369.327	Required	
U6 - 3.2	709859.116	730365.232	709859.116	730365.232	Required	
U6 - 3.1.01	709831.368	730369.793	709831.368	730369.793	Required	
U6 - 3.1.2	709863.310	730384.715	709863.310	730384.715	Required	
U6 - 3.1.1	709852.704	730378.835	709852.704	730378.835	Required	
U6 - 3.1	709857.068	730368.548	709857.068	730368.548	Required	
U6 - ATTN	709860.092	730369.718	709860.092	730369.718	Required	
U6 - 3(ATTN)	709886.172	730390.904	709886.172	730390.904	Required	
U6 - 2(HB)	709889.968	730392.782	709889.968	730392.782	Required	
U6 - 1	709886.417	730399.933	709886.417	730399.933	Required	
U6 -	709873.019	730414.038			No Entry	

PIPELINE SCHEDULES for UNIT 6

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	U6 - 5.4.1	64.500	63.500	0.775	Open Manhole	1200
S2.000	o	225	U6 - 5.6	64.500	63.500	0.775	Open Manhole	1200
S2.001	o	225	U6 - 5.5	64.500	62.200	2.075	Open Manhole	1200
S1.001	o	225	U6 - 5.4	64.500	61.690	2.585	Open Manhole	1200
S1.002	o	225	U6 - 5.3	63.500	61.630	1.645	Open Manhole	1200
S1.003	o	300	U6 - 5.2	63.500	61.600	1.600	Open Manhole	1200
S1.004	o	300	U6 - 5.1(SWA)	63.290	61.560	1.430	Open Manhole	1200
S1.005	o	300	U6 - 4	63.460	60.850	2.310	Open Manhole	1200
S1.006	o	300	U6 - ATNN	63.200	60.830	2.070	Open Manhole	1200
S3.000	o	225	U6 - 3.3	63.460	62.030	1.205	Open Manhole	1200
S4.000	o	225	U6 - 3.2.1	63.200	61.770	1.205	Open Manhole	1200
S3.001	o	225	U6 - 3.2	63.200	61.700	1.275	Open Manhole	1200
S5.000	o	150	U6 - 3.1.01	63.460	62.030	1.280	Open Manhole	1200
S6.000	o	225	U6 - 3.1.2	63.460	62.030	1.205	Open Manhole	1200
S5.001	o	225	U6 - 3.1.1	63.460	61.880	1.355	Open Manhole	1200
S3.002	o	225	U6 - 3.1	63.460	61.670	1.565	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	56.973	118.7	U6 - 5.4	64.500	63.020	1.255	Open Manhole	1200
S2.000	54.262	118.0	U6 - 5.5	64.500	63.040	1.235	Open Manhole	1200
S2.001	60.944	119.5	U6 - 5.4	64.500	61.690	2.585	Open Manhole	1200
S1.001	6.688	111.5	U6 - 5.3	63.500	61.630	1.645	Open Manhole	1200
S1.002	3.124	104.1	U6 - 5.2	63.500	61.600	1.675	Open Manhole	1200
S1.003	8.688	217.2	U6 - 5.1(SWA)	63.290	61.560	1.430	Open Manhole	1200
S1.004	5.938	118.8	U6 - 4	63.460	61.510	1.650	Open Manhole	1200
S1.005	4.556	227.8	U6 - ATNN	63.200	60.830	2.070	Open Manhole	1200
S1.006	7.464	186.6	U6 - 3(ATTN)	63.460	60.790	2.370	Open Manhole	1350
S3.000	20.691	129.3	U6 - 3.2	63.200	61.870	1.105	Open Manhole	1200
S4.000	10.648	152.1	U6 - 3.2	63.200	61.700	1.275	Open Manhole	1200
S3.001	3.898	129.9	U6 - 3.1	63.460	61.670	1.565	Open Manhole	1200
S5.000	23.173	154.5	U6 - 3.1.1	63.460	61.880	1.430	Open Manhole	1200
S6.000	12.127	151.6	U6 - 3.1.1	63.460	61.950	1.285	Open Manhole	1200
S5.001	11.174	150.0	U6 - 3.1	63.460	61.806	1.429	Open Manhole	1200
S3.002	3.242	162.1	U6 - ATTN	63.460	61.650	1.585	Open Manhole	1200

PIPELINE SCHEDULES for UNIT 6

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.003	o	225	U6 - ATTN	63.460	61.650	1.585	Open Manhole	1200
S1.007	o	375	U6 - 3(ATTN)	63.460	60.790	2.295	Open Manhole	1350
S1.008	o	375	U6 - 2(HB)	63.000	60.770	1.855	Open Manhole	1350
S1.009	o	225	U6 - 1	62.600	60.750	1.625	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.003	33.601	197.7	U6 - 3(ATTN)	63.460	61.480	1.755	Open Manhole	1350
S1.007	4.234	211.7	U6 - 2(HB)	63.000	60.770	1.855	Open Manhole	1350
S1.008	7.984	399.2	U6 - 1	62.600	60.750	1.475	Open Manhole	1350
S1.009	19.454	194.5	U6 -	61.900	60.650	1.025	Open Manhole	0

Free Flowing Outfall Details for UNIT 6

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.009	U6 -	61.900	60.650	0.000	0	0

Simulation Criteria for UNIT 6

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for UNIT 6

Hydro-Brake® Optimum Manhole: U6 - 3(ATTN), DS/PN: S1.007, Volume (m³): 5.5

Unit Reference	MD-SHE-0059-2000-1670-2000
Design Head (m)	1.670
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	60.790
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.670	2.0	Kick-Flo®	0.531	1.2
Flush-Flo™	0.264	1.5	Mean Flow over Head Range	-	1.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	0.800	1.4	2.000	2.2	4.000	3.0	7.000	3.9
0.200	1.4	1.000	1.6	2.200	2.3	4.500	3.2	7.500	4.0
0.300	1.5	1.200	1.7	2.400	2.4	5.000	3.3	8.000	4.1
0.400	1.4	1.400	1.8	2.600	2.4	5.500	3.5	8.500	4.2
0.500	1.3	1.600	2.0	3.000	2.6	6.000	3.6	9.000	4.4
0.600	1.3	1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5

Storage Structures for UNIT 6

Tank or Pond Manhole: U6 - 3(ATTN), DS/PN: S1.007

Invert Level (m) 60.790

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	1.670	250.0	1.671	0.0

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 6

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.500 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.276 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	U6 - 5.4.1	15 Winter	100	+20%					63.661
S2.000	U6 - 5.6	15 Winter	100	+20%	100/15 Summer				63.924
S2.001	U6 - 5.5	15 Winter	100	+20%	100/15 Summer				63.573
S1.001	U6 - 5.4	15 Winter	100	+20%	100/15 Summer				62.901
S1.002	U6 - 5.3	15 Winter	100	+20%	100/15 Summer				62.525
S1.003	U6 - 5.2	2160 Winter	100	+20%	100/15 Summer				62.425
S1.004	U6 - 5.1(SWA)	2160 Winter	100	+20%	100/15 Summer				62.424
S1.005	U6 - 4	2160 Winter	100	+20%	100/15 Summer				62.424
S1.006	U6 - ATNN	2160 Winter	100	+20%	100/15 Summer				62.423
S3.000	U6 - 3.3	15 Winter	100	+20%	100/15 Summer				63.032
S4.000	U6 - 3.2.1	15 Winter	100	+20%	100/15 Summer				62.820
S3.001	U6 - 3.2	15 Winter	100	+20%	100/15 Summer				62.807
S5.000	U6 - 3.1.01	15 Winter	100	+20%	100/15 Summer				62.851
S6.000	U6 - 3.1.2	15 Winter	100	+20%	100/15 Summer				62.734
S5.001	U6 - 3.1.1	15 Winter	100	+20%	100/15 Summer				62.723
S3.002	U6 - 3.1	15 Winter	100	+20%	100/15 Summer				62.670
S3.003	U6 - ATTN	2160 Winter	100	+20%	100/15 Summer				62.425
S1.007	U6 - 3(ATTN)	2160 Winter	100	+20%	100/15 Summer				62.423
S1.008	U6 - 2(HB)	2160 Winter	100	+20%					60.814
S1.009	U6 - 1	2160 Winter	100	+20%					60.785

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	U6 - 5.4.1	-0.064	0.000	0.85			39.2	OK	
S2.000	U6 - 5.6	0.199	0.000	1.05			48.4	SURCHARGED	
S2.001	U6 - 5.5	1.148	0.000	1.22			56.0	SURCHARGED	
S1.001	U6 - 5.4	0.986	0.000	2.49			85.9	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 6

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.002	U6 - 5.3	0.670	0.000	2.91			86.8	SURCHARGED	
S1.003	U6 - 5.2	0.525	0.000	0.09			5.1	SURCHARGED	
S1.004	U6 - 5.1(SWA)	0.564	0.000	0.11			6.8	SURCHARGED	
S1.005	U6 - 4	1.274	0.000	0.14			6.8	SURCHARGED	
S1.006	U6 - ATNN	1.293	0.000	0.11			6.7	SURCHARGED	
S3.000	U6 - 3.3	0.777	0.000	1.23			51.1	SURCHARGED	
S4.000	U6 - 3.2.1	0.825	0.000	0.24			8.5	SURCHARGED	
S3.001	U6 - 3.2	0.882	0.000	1.87			55.9	SURCHARGED	
S5.000	U6 - 3.1.01	0.671	0.000	1.05			14.2	SURCHARGED	
S6.000	U6 - 3.1.2	0.479	0.000	0.19			6.9	SURCHARGED	
S5.001	U6 - 3.1.1	0.618	0.000	0.54			19.5	SURCHARGED	
S3.002	U6 - 3.1	0.775	0.000	2.70			71.6	SURCHARGED	
S3.003	U6 - ATTN	0.550	0.000	0.14			4.9	SURCHARGED	
S1.007	U6 - 3(ATTN)	1.258	0.000	0.02			2.0	SURCHARGED	
S1.008	U6 - 2(HB)	-0.331	0.000	0.03			2.0	OK	
S1.009	U6 - 1	-0.190	0.000	0.06			2.0	OK	

Appendix B : 2 – Revised Foul Sewer Microdrainage

FOUL SEWERAGE DESIGN

Design Criteria for FOUL

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	10
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Calculation Method	EN 752	Maximum Backdrop Height (m)	0.000
Frequency Factor	0.50	Min Design Depth for Optimisation (m)	0.750
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for FOUL

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	69.543	0.980	71.0	0.000	25.4	0.0	0.600	o	225	Pipe/Conduit	
F1.001	44.341	0.520	85.3	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F2.000	27.249	0.450	60.6	0.000	10.6	0.0	0.600	o	150	Pipe/Conduit	
F3.000	14.635	0.250	58.5	0.000	0.0	0.0	0.600	o	100	Pipe/Conduit	
F3.001	18.334	0.210	87.3	0.000	25.4	0.0	0.600	o	150	Pipe/Conduit	
F2.001	31.341	0.290	108.1	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F4.000	25.561	0.300	85.2	0.000	25.4	0.0	0.600	o	150	Pipe/Conduit	
F2.002	41.564	0.310	134.1	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F1.002	49.141	0.350	140.4	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F5.000	30.532	0.350	87.2	0.000	25.4	0.0	0.600	o	150	Pipe/Conduit	
F5.001	17.037	0.160	106.5	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	61.550	0.000	0.0	25.4	0.3	32	0.79	1.55	61.8	2.8
F1.001	60.570	0.000	0.0	25.4	0.3	34	0.74	1.42	56.3	2.8
F2.000	64.200	0.000	0.0	10.6	0.2	28	0.77	1.29	22.9	1.8
F3.000	63.450	0.000	0.0	0.0	0.0	0	0.00	1.01	7.9	0.0
F3.001	63.200	0.000	0.0	25.4	0.3	39	0.77	1.08	19.0	2.8
F2.001	62.990	0.000	0.0	36.0	0.3	45	0.75	0.97	17.1	3.3
F4.000	63.450	0.000	0.0	25.4	0.3	38	0.78	1.09	19.3	2.8
F2.002	62.700	0.000	0.0	61.4	0.4	54	0.75	0.87	15.3	4.3
F1.002	60.050	0.000	0.0	86.8	0.5	52	0.74	1.10	43.8	5.1
F5.000	60.130	0.000	0.0	25.4	0.3	39	0.77	1.08	19.0	2.8
F5.001	59.780	0.000	0.0	25.4	0.3	41	0.72	0.97	17.2	2.8

Network Design Table for FOUL

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.003	81.729	0.500	163.5	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F6.000	45.981	0.360	127.7	0.000	68.8	0.0	0.600	o	100	Pipe/Conduit	
F6.001	11.559	0.090	128.4	0.000	0.0	0.0	0.600	o	100	Pipe/Conduit	
F1.004	37.268	0.200	186.3	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F7.000	28.462	0.330	86.2	0.000	25.4	0.0	0.600	o	150	Pipe/Conduit	
F1.005	76.253	0.350	217.9	0.000	68.8	0.0	0.600	o	225	Pipe/Conduit	
F8.000	34.756	0.270	128.7	0.000	68.8	0.0	0.600	o	150	Pipe/Conduit	
F8.001	25.789	0.190	135.7	0.000	0.0	0.0	0.600	o	150	Pipe/Conduit	
F1.006	17.539	0.070	250.6	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.007	30.182	0.120	251.5	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.008	52.863	0.220	240.3	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.009	24.563	0.100	245.6	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.003	59.620	0.000	0.0	112.2	0.5	57	0.73	1.02	40.6	5.8
F6.000	61.400	0.000	0.0	68.8	0.4	71	0.76	0.68	5.3	4.6
F6.001	61.040	0.000	0.0	68.8	0.4	71	0.76	0.68	5.3	4.6
F1.004	59.120	0.000	0.0	181.0	0.7	67	0.74	0.95	38.0	7.4
F7.000	60.000	0.000	0.0	25.4	0.3	39	0.77	1.08	19.1	2.8
F1.005	58.920	0.000	0.0	275.2	0.8	78	0.74	0.88	35.1	9.1
F8.000	62.000	0.000	0.0	68.8	0.4	56	0.77	0.88	15.6	4.6
F8.001	61.730	0.000	0.0	68.8	0.4	56	0.75	0.86	15.2	4.6
F1.006	58.570	0.000	0.0	344.0	0.9	86	0.73	0.82	32.7	10.2
F1.007	58.500	0.000	0.0	344.0	0.9	86	0.73	0.82	32.6	10.2
F1.008	58.380	0.000	0.0	344.0	0.9	85	0.74	0.84	33.4	10.2
F1.009	58.160	0.000	0.0	344.0	0.9	86	0.73	0.83	33.0	10.2

Manhole Schedules for FOUL

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F1	62.450	0.900	Open Manhole	1200	F1.000	61.550	225				
F2	63.000	2.430	Open Manhole	1200	F1.001	60.570	225	F1.000	60.570	225	
F3.3	65.180	0.980	Open Manhole	1200	F2.000	64.200	150				
F3.2.2	64.350	0.900	Open Manhole	1200	F3.000	63.450	100				
F3.2.1	64.350	1.150	Open Manhole	1200	F3.001	63.200	150	F3.000	63.200	100	
F3.2	64.750	1.760	Open Manhole	1200	F2.001	62.990	150	F2.000	63.750	150	760
								F3.001	62.990	150	
F3.1.1	64.350	0.900	Open Manhole	1200	F4.000	63.450	150				
F3.1	64.250	1.550	Open Manhole	1200	F2.002	62.700	150	F2.001	62.700	150	
								F4.000	63.150	150	450
F3	64.000	3.950	Open Manhole	1200	F1.002	60.050	225	F1.001	60.050	225	
								F2.002	62.390	150	2265
F4.2	61.030	0.900	Open Manhole	1200	F5.000	60.130	150				
F4.1	61.200	1.420	Open Manhole	1200	F5.001	59.780	150	F5.000	59.780	150	
F4	61.900	2.280	Open Manhole	1200	F1.003	59.620	225	F1.002	59.700	225	80
								F5.001	59.620	150	
F5.2	62.300	0.900	Open Manhole	1200	F6.000	61.400	100				
F5.1	62.280	1.240	Open Manhole	1200	F6.001	61.040	100	F6.000	61.040	100	
F5	62.000	2.880	Open Manhole	1200	F1.004	59.120	225	F1.003	59.120	225	
								F6.001	60.950	100	1705
F6.1	60.950	0.950	Open Manhole	1200	F7.000	60.000	150				
F6	60.900	1.980	Open Manhole	1200	F1.005	58.920	225	F1.004	58.920	225	
								F7.000	59.670	150	675
F7.2	62.950	0.950	Open Manhole	1200	F8.000	62.000	150				
F7.1	62.600	0.870	Open Manhole	1200	F8.001	61.730	150	F8.000	61.730	150	
F7	62.500	3.930	Open Manhole	1200	F1.006	58.570	225	F1.005	58.570	225	
								F8.001	61.540	150	2895
F8	62.100	3.600	Open Manhole	1200	F1.007	58.500	225	F1.006	58.500	225	
F9	61.500	3.120	Open Manhole	1200	F1.008	58.380	225	F1.007	58.380	225	
F10	60.500	2.340	Open Manhole	1200	F1.009	58.160	225	F1.008	58.160	225	
F	0.000		Open Manhole	0		OUTFALL		F1.009	58.060	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F1	709714.938	730388.506	709714.938	730388.506	Required	
F2	709777.487	730418.902	709777.487	730418.902	Required	
F3.3	709803.128	730301.478	709803.128	730301.478	Required	

Manhole Schedules for FOUL

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F3.2.2	709858.172	730312.295	709858.172	730312.295	Required	
F3.2.1	709844.850	730306.236	709844.850	730306.236	Required	
F3.2	709827.815	730313.014	709827.815	730313.014	Required	
F3.1.1	709791.607	730330.582	709791.607	730330.582	Required	
F3.1	709814.724	730341.490	709814.724	730341.490	Required	
F3	709796.972	730379.072	709796.972	730379.072	Required	
F4.2	709805.993	730402.849	709805.993	730402.849	Required	
F4.1	709833.540	730416.016	709833.540	730416.016	Required	
F4	709841.079	730400.738	709841.079	730400.738	Required	
F5.2	709933.736	730382.494	709933.736	730382.494	Required	
F5.1	709913.582	730423.823	709913.582	730423.823	Required	
F5	709915.152	730435.275	709915.152	730435.275	Required	
F6.1	709921.575	730460.940	709921.575	730460.940	Required	
F6	709948.540	730451.832	709948.540	730451.832	Required	
F7.2	709932.117	730351.111	709932.117	730351.111	Required	
F7.1	709957.882	730374.438	709957.882	730374.438	Required	
F7	709982.081	730383.352	709982.081	730383.352	Required	
F8	709998.878	730378.303	709998.878	730378.303	Required	

Manhole Schedules for FOUL

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F9	710028.770	730382.477	710028.770	730382.477	Required	
F10	710072.017	730412.878	710072.017	730412.878	Required	
F	710096.580	730412.878			No Entry	

PIPELINE SCHEDULES for FOUL

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	F1	62.450	61.550	0.675	Open Manhole	1200
F1.001	o	225	F2	63.000	60.570	2.205	Open Manhole	1200
F2.000	o	150	F3.3	65.180	64.200	0.830	Open Manhole	1200
F3.000	o	100	F3.2.2	64.350	63.450	0.800	Open Manhole	1200
F3.001	o	150	F3.2.1	64.350	63.200	1.000	Open Manhole	1200
F2.001	o	150	F3.2	64.750	62.990	1.610	Open Manhole	1200
F4.000	o	150	F3.1.1	64.350	63.450	0.750	Open Manhole	1200
F2.002	o	150	F3.1	64.250	62.700	1.400	Open Manhole	1200
F1.002	o	225	F3	64.000	60.050	3.725	Open Manhole	1200
F5.000	o	150	F4.2	61.030	60.130	0.750	Open Manhole	1200
F5.001	o	150	F4.1	61.200	59.780	1.270	Open Manhole	1200
F1.003	o	225	F4	61.900	59.620	2.055	Open Manhole	1200
F6.000	o	100	F5.2	62.300	61.400	0.800	Open Manhole	1200
F6.001	o	100	F5.1	62.280	61.040	1.140	Open Manhole	1200
F1.004	o	225	F5	62.000	59.120	2.655	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	69.543	71.0	F2	63.000	60.570	2.205	Open Manhole	1200
F1.001	44.341	85.3	F3	64.000	60.050	3.725	Open Manhole	1200
F2.000	27.249	60.6	F3.2	64.750	63.750	0.850	Open Manhole	1200
F3.000	14.635	58.5	F3.2.1	64.350	63.200	1.050	Open Manhole	1200
F3.001	18.334	87.3	F3.2	64.750	62.990	1.610	Open Manhole	1200
F2.001	31.341	108.1	F3.1	64.250	62.700	1.400	Open Manhole	1200
F4.000	25.561	85.2	F3.1	64.250	63.150	0.950	Open Manhole	1200
F2.002	41.564	134.1	F3	64.000	62.390	1.460	Open Manhole	1200
F1.002	49.141	140.4	F4	61.900	59.700	1.975	Open Manhole	1200
F5.000	30.532	87.2	F4.1	61.200	59.780	1.270	Open Manhole	1200
F5.001	17.037	106.5	F4	61.900	59.620	2.130	Open Manhole	1200
F1.003	81.729	163.5	F5	62.000	59.120	2.655	Open Manhole	1200
F6.000	45.981	127.7	F5.1	62.280	61.040	1.140	Open Manhole	1200
F6.001	11.559	128.4	F5	62.000	60.950	0.950	Open Manhole	1200
F1.004	37.268	186.3	F6	60.900	58.920	1.755	Open Manhole	1200

PIPELINE SCHEDULES for FOUL

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F7.000	o	150	F6.1	60.950	60.000	0.800	Open Manhole	1200
F1.005	o	225	F6	60.900	58.920	1.755	Open Manhole	1200
F8.000	o	150	F7.2	62.950	62.000	0.800	Open Manhole	1200
F8.001	o	150	F7.1	62.600	61.730	0.720	Open Manhole	1200
F1.006	o	225	F7	62.500	58.570	3.705	Open Manhole	1200
F1.007	o	225	F8	62.100	58.500	3.375	Open Manhole	1200
F1.008	o	225	F9	61.500	58.380	2.895	Open Manhole	1200
F1.009	o	225	F10	60.500	58.160	2.115	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F7.000	28.462	86.2	F6	60.900	59.670	1.080	Open Manhole	1200
F1.005	76.253	217.9	F7	62.500	58.570	3.705	Open Manhole	1200
F8.000	34.756	128.7	F7.1	62.600	61.730	0.720	Open Manhole	1200
F8.001	25.789	135.7	F7	62.500	61.540	0.810	Open Manhole	1200
F1.006	17.539	250.6	F8	62.100	58.500	3.375	Open Manhole	1200
F1.007	30.182	251.5	F9	61.500	58.380	2.895	Open Manhole	1200
F1.008	52.863	240.3	F10	60.500	58.160	2.115	Open Manhole	1200
F1.009	24.563	245.6	F	0.000	58.060		Open Manhole	0

Free Flowing Outfall Details for FOUL

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.009	F	0.000	58.060	0.000	0	0

Simulation Criteria for FOUL

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

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

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 2

Synthetic Rainfall Details

Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	17.500	Cv (Winter)	0.840
Ratio R	0.276	Storm Duration (mins)	30
Profile Type	Summer		

Appendix B : 3 – Revised SuDS Calculations (Swales, Permeable Paving, Bioretention Areas & Green Roof)

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road		210175	
SUBJECT		Calc. Sheet No.	
Swale 1 Channel Café		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	40.4	m
Slope (S)	60	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.0014	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	70.2	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	14.034	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.0	m
Swale Storage Volume per 9m Length	**0.60**	m^3
Swale Storage Volume (V)	**2.42**	m^3

INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.285	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**147.8**	l/s
Maximum Swale Velocity at Outlet	**0.90**	m/s
[3]Typical Swale Retention Time	**0.013**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE Warehousing and Logistics Development at Calmount Road		Job Reference 210175	
SUBJECT **Swale Channel 1 Unit 1**		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by SSJ	Checked by RTM	Date 02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	30.7	m
Slope (S)	46	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	53.3	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	10.665	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	6.9	m
Swale Storage Volume per 7m Length	**0.46**	m^3
Swale Storage Volume (V)	**1.85**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.216	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**168.8**	l/s
Maximum Swale Velocity at Outlet	**1.02**	m/s
[3]Typical Swale Retention Time	**0.008**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 1 Unit 2		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	12.9	m
Slope (S)	66	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	22.4	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	4.481	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.9	m	
Swale Storage Volume per 10m Length	**0.67**	m^3	
Swale Storage Volume (V)	**0.67**	m^3	

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.317	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**140.9**	l/s	
Maximum Swale Velocity at Outlet	**0.85**	m/s	
[3]Typical Swale Retention Time	**0.004**	hr	

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE	Job Reference
Warehousing and Logistics Development at Calmount Road	210175
SUBJECT	**Calc. Sheet No.**
Swale 2 Channel Café	1

DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	15.3	m
Slope (S)	60	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.0014	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	26.5	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	5.306	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.0	m
Swale Storage Volume per 9m Length	**0.60**	m^3
Swale Storage Volume (V)	**1.21**	m^3

INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.285	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**147.8**	l/s
Maximum Swale Velocity at Outlet	**0.90**	m/s
[3]Typical Swale Retention Time	**0.005**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE	Job Reference
Warehousing and Logistics Development at Calmount Road	210175
SUBJECT	**Calc. Sheet No.**
Swale Channel 2 Unit 1	1

DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	20.7	m
Slope (S)	48	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	36.0	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	7.207	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	7.2	m
Swale Storage Volume per 7m Length	**0.49**	m^3
Swale Storage Volume (V)	**1.46**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.238	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**165.3**	l/s
Maximum Swale Velocity at Outlet	**1.00**	m/s
[3]Typical Swale Retention Time	**0.006**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 2 Unit 2		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	29.03.2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	27.1	m
Slope (S)	66	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	47.1	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	9.414	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.9	m
Swale Storage Volume per 10m Length	**0.67**	m^3
Swale Storage Volume (V)	**2.00**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.317	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**140.9**	l/s
Maximum Swale Velocity at Outlet	**0.85**	m/s
[3]Typical Swale Retention Time	**0.009**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		**Job Reference**	
Warehousing and Logistics Development at Calmount Road		210175	
SUBJECT		**Calc. Sheet No.**	
Swale Channel 2 Unit 3		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	12.6	m
Slope (S)	66	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	21.9	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	4.377	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.9	m
Swale Storage Volume per 10m Length	**0.67**	m^3
Swale Storage Volume (V)	**0.67**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.317	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**140.9**	l/s
Maximum Swale Velocity at Outlet	**0.85**	m/s
[3]Typical Swale Retention Time	**0.004**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE	Job Reference	
Warehousing and Logistics Development at Calmount Road	210175	
SUBJECT	**Calc. Sheet No.**	
Swale Channel 2 Unit 6	1	

DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	33.1	m
Slope (S)	100	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (*f*)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	57.5	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	11.498	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	15.0	m
Swale Storage Volume per 15m Length	**1.01**	m^3
Swale Storage Volume (V)	**2.02**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.02	l/s	
[3]Total Swale Infiltration Volume	0.487	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**114.5**	l/s
Maximum Swale Velocity at Outlet	**0.69**	m/s
[3]Typical Swale Retention Time	**0.013**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE	Job Reference
Warehousing and Logistics Development at Calmount Road	210175
SUBJECT	**Calc. Sheet No.**
Swale Channel 3 Unit 3	1

DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	27.1	m
Slope (S)	66	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	47.1	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	9.414	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.9	m
Swale Storage Volume per 10m Length	**0.67**	m^3
Swale Storage Volume (V)	**2.00**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.317	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**140.9**	l/s
Maximum Swale Velocity at Outlet	**0.85**	m/s
[3]Typical Swale Retention Time	**0.009**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr	
Source: Microdrainage	

TITLE Warehousing and Logistics Development at Calmount Road		Job Reference 210175	
SUBJECT **Swale Channel 3 Unit 6**		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by SSJ	Checked by RTM	Date 02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	15.3	m
Slope (S)	57	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	26.6	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	5.315	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	8.6	m
Swale Storage Volume per 9m Length	**0.58**	m^3
Swale Storage Volume (V)	**1.15**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.278	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**151.7**	l/s
Maximum Swale Velocity at Outlet	**0.92**	m/s
[3]Typical Swale Retention Time	**0.005**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE	Job Reference	
Warehousing and Logistics Development at Calmount Road	210175	
SUBJECT	**Calc. Sheet No.**	
Swale Channel 4 Unit 3	1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	41.5	m
Slope (S)	48	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	72.1	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	14.417	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	7.2	m
Swale Storage Volume per 7m Length	**0.49**	m^3
Swale Storage Volume (V)	**2.93**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.01**	l/s	
[3]Total Swale Infiltration Volume	0.238	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**165.3**	l/s
Maximum Swale Velocity at Outlet	**1.00**	m/s
[3]Typical Swale Retention Time	**0.012**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 4 Unit 6		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	36.9	m
Slope (S)	80	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	64.1	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	12.819	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	12.0	m
Swale Storage Volume per 12m Length	**0.81**	m^3
Swale Storage Volume (V)	**2.42**	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	**0.02**	l/s	
[3]Total Swale Infiltration Volume	0.386	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	**128.0**	l/s
Maximum Swale Velocity at Outlet	**0.78**	m/s
[3]Typical Swale Retention Time	**0.013**	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE Warehousing and Logistics Development at Calmount Road		Job Reference 210175	
SUBJECT Permeable Paving Design - Unit 6		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by SSJ	Checked by RTM	Date 22/08/2022

FLAT SITES

INPUT DATA

Pavement Area (A)	963.0	m^2
Pavement Perimeter (P)	188.0	m
Sub-base Depth (d)	0.400	m
[1]Sub-base Voids Ratio (η)	0.30	
Sub-base Infiltration Rate per hour	1000	mm/hr
Sub-base Infiltration Rate (k)	0.278	mm/s
Subgrade Infiltration Rate per hour	5.0	mm/hr
Subgrade Infiltration Rate (f)	0.001	mm/s

VOLUME (STORAGE AND TREATMENT)

Permeable Paving Storage Volume per m^2	0.120	m^3/m^2
Total Permeable Paving Storage Volume	115.6	m^3

INFILTRATION / INTERCEPTION VOLUME

			5mm SURFACE INTERCEPTION
Approx. Permeable Paving Infiltration per m^2	0.001	$l/s/m^2$	4.82 m^3
[2]**Total Permeable Paving Infiltration Rate**	1.442	l/s	
[3]**Total Permeable Paving Infiltration Volume**	31.1	m^3	

FLOW

Average Distance between Outlet Drains	6.0	m	Assumed one outlet per building
Flow Velocity through Permeable Paving	0.000038	m/s	
Trench Retention Time	44.2	hr	

TITLE		Job Reference		
Warehousing and Logistics Development at Calmount Road		210175		
SUBJECT		Calc. Sheet No.		
Permeable Paving Design - Unit 6		1		
DRAWING NUMBER	Calculations by	Checked by	Date	
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	22/08/2022	

Notes:

1 Sub-base material has a void ratio of approximately 30%, source 'BRE Digest 365'.

2 Wetted perimeter assuming 50% of trench depth, source 'BRE Digest 365'.

3 Volume calculated using 6 hour storm event.

4 For Paving on slopes includes infiltration, provide 500mmx500mm trenches at 10m centres along slope with 1000mmx500mm at base of slope. source 'Formpave - Aquaflow Permeable Paving System'.

Table: 1

Material	void Ratio, η
Clean stone	0.40 - 0.50
Uniform gravel	0.30 - 0.40
Graded sand or gravel	0.20 - 0.30
Source: The SUDS manual, Published by CIRIA.	

Table: 2

Pavement Type	Effective Depth (m)
Car-Parking	0.40
Footpath	0.20
Effective Depths are provided from source 'Formpave - Aquaflow Permeable Paving System' and may subject to change as per site requirement.	

Total Permeable Paving Outflow:

$= A \cdot k \cdot i$

where:

A = Cross Sectional Area of Subbase
k = Subbase Infiltration Rate
i = Hydraulic Gradient

Hydraulic gradient has been assumed as the pavement gradient with an additional 250mm fall per 100m length.

Table: 3

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

Total Trench Infiltration:

$= 1/2 \cdot D \cdot L \cdot f$

where:

L = Length
D = Depth to Invert
f = Subgrade infiltration rate

TITLE Warehousing and Logistics Development at Calmount Road		Job Reference 210175	
SUBJECT Permeable Paving Design - Unit 5(additional)		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by SSJ	Checked by RTM	Date 02/09/2022

FLAT SITES

INPUT DATA

Pavement Area (A)	361.0	m^2	
Pavement Perimeter (P)	134.0	m	
Sub-base Depth (d)	0.400	m	
[1]Sub-base Voids Ratio (η)	0.30		
Sub-base Infiltration Rate per hour	1000	mm/hr	
Sub-base Infiltration Rate (k)	0.278	mm/s	
Subgrade Infiltration Rate per hour	5.0	mm/hr	
Subgrade Infiltration Rate (*f*)	0.001	mm/s	

VOLUME (STORAGE AND TREATMENT)

Permeable Paving Storage Volume per m^2	0.120	m^3/m^2	
Total Permeable Paving Storage Volume	43.3	m^3	

INFILTRATION / INTERCEPTION VOLUME

			5mm SURFACE INTERCEPTION
Approx. Permeable Paving Infiltration per m^2	0.002	$l/s/m^2$	5.03 m^3
[2]Total Permeable Paving Infiltration Rate	0.576	l/s	
[3]Total Permeable Paving Infiltration Volume	12.4	m^3	

FLOW

Average Distance between Outlet Drains	6.0	m	Assumed one outlet per building
Flow Velocity through Permeable Paving	0.000038	m/s	
Trench Retention Time	44.2	hr	

TITLE	Job Reference		
Warehousing and Logistics Development at Calmount Road	210175		
SUBJECT	Calc. Sheet No.		
Permeable Paving Design - Unit 5(additional)	1		
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	02/09/2022

Notes:

1 Sub-base material has a void ratio of approximately 30%, source 'BRE Digest 365'.

2 Wetted perimeter assuming 50% of trench depth, source 'BRE Digest 365'.

3 Volume calculated using 6 hour storm event.

4 For Paving on slopes includes infiltration, provide 500mmx500mm trenches at 10m centres along slope with 1000mmx500mm at base of slope. source 'Formpave - Aquaflow Permeable Paving System'.

Table: 1

Material	void Ratio, η
Clean stone	0.40 - 0.50
Uniform gravel	0.30 - 0.40
Graded sand or gravel	0.20 - 0.30
Source: The SUDS manual, Published by CIRIA.	

Table: 2

Pavement Type	Effective Depth (m)
Car-Parking	0.40
Footpath	0.20
Effective Depths are provided from source 'Formpave - Aquaflow Permeable Paving System' and may subject to change as per site requirement.	

Total Permeable Paving Outflow:

$= A \cdot k \cdot i$

where:

A = Cross Sectional Area of Subbase
k = Subbase Infiltration Rate
i = Hydraulic Gradient

Hydraulic gradient has been assumed as the pavement gradient with an additional 250mm fall per 100m length.

Table: 3

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

Total Trench Infiltration:

$= 1/2 \cdot D \cdot L \cdot f$

where:

L = Length
D = Depth to Invert
f = Subgrade infiltration rate

TITLE		Job Reference	
Logistics and Warehousing Development at Calmount road		210175	
SUBJECT		Calc. Sheet No.	
Bioretention Area 1 (Unit 6)		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	05/09/2022

INPUT DATA

Effective Impermeable Area for Treatment (A)	440.0	m^2
[1]Filter Bed Depth (L)	1.350	m
Coefficient of Permeability of Filter Medium (k)	0.000002	m/s
[2]Average Height of Water above Filter Bed (h)	0.010	m
Time Required for Percolation (t)	48.0	hr

BIORETENTION AREA

Minimum Surface Area of Bioretention Area (A_f)	**15.2**	m^2

TREATMENT VOLUME

[3]Treatment Volume (V_T)	5.3	m^3	Provided Treatment Volume

INFILTRATION / INTERCEPTION VOLUME

Subgrade Infiltration Rate per hour	5.0	mm/hr	
Subgrade Infiltration Rate (f)	0.001	mm/s	
[4]Subgrade Infiltration Volume	6.764	m^3	Provided Interception Volume

Notes:

1 Filter Bed depth typically between 1.2 and 1.5m

2 h = Half maximum height, where hmax <=2m

3 Treatment Volume Vt (m^3) = Impermeable Area (ha) x 15mm x 10 x 80% (GDSDS Section 6.3.1.2.1).

4 Volume calculated using 6 hour storm event.

Area of Bioretention Filter Bed = $\frac{V_T \cdot L}{k(h+L)t}$

Table: 1

Material	Infiltration Rate (m/s)
Source: SUDS Manual Section 25-1	
Silty Loam	0.000002
Sand	0.000000028 - 0.000028
Loamy sand	0.0000000028 - 0.00000028
Sandy loam	0.000000014 - 0.00000014
Loam	0.00000000028 - 0.000000028
Silty Loam	0.00000000014 - 0.0000000014

TITLE		**Job Reference**	
Logistics and Warehousing Development at Calmount Road		210175	
SUBJECT		**Calc. Sheet No.**	
GREEN ROOF DESIGN UNIT 6		1	
DRAWING NUMBER	**Calculations by**	**Checked by**	**Date**
210175-DBFL-SW-SP-DR-C-1300	SSJ	RTM	22/08/2022

INPUT DATA

Green Roof Area (A)	383.00	m^2
[1]Filter Layer Depth (d)	0.500	m
[1]Filter Layer Voids Ratio (η)	30.0	%

TREATMENT VOLUME

[2]Treatment Volume (V_T)	57.5	m^3	Provided Treatment Volume

EVAPOTRANSPIRATION / INTERCEPTION VOLUME

[3]Evapotranspiration Rate per Day	4.00	mm/day	
Evapotranspiration Volume	1.5	m^3	Provided Interception Volume

Notes:

1 Filter Bed depth typically between 0.15 and 0.35m. This consists of the substrate and drainage layer.

2 Treatment Volume Vt (m^3) = Green Roof Area (m^2) **x d x η**

3 Assumed 2mm evaporation and 3mm transpiration.

TITLE	Job Reference		
Development at Ballymount Ave	210175		
SUBJECT	Calc. Sheet No.		
Interception/Treatment Volume Summary	1		
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	05/09/2022

INPUT DATA

Interception Volume Required	217.4	m^3
Treatment Volume Required	652.3	m^3

Catchment	Interception Volumes		Treatment Volumes	
Swales	6.9	m^3	287.8	m^3
Bio-Retention	107.6	m^3	21.5	m^3
Permeable Paving	239.2	m^3	892.1	m^3
Rain Gardens	3.0	m^3	12.0	m^3
Green Roofs	6.1	m^3	224.5	m^3
Tree Pits		m^3		m^3
Stormtech Isolator Row		m^3		m^3
Total Volumes Provided	362.8	m^3	1437.9	m^3
Check Provided Volumes are greater than Required Volumes	PASS		PASS	

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