

DEVELOPMENT OF LAND AT MONKSTOWN ROAD, DUBLIN, DALGUISE HOUSE

Drainage Impact Assessment Report

GEDV Monkstown Owner Limited

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Client: GEDV Monkstown Owner Limited

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Disclaimer: Please note that this report is based on specific information, instructions and information from our Client and should not be relied upon by third parties.

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1 Introduction

1.1 General

Byrne Looby Partners have been commissioned by GEDV Monkstown Owner Limited to prepare a Drainage Impact Assessment Report (DIA) for the proposed development of land at Dalguise House, Monkstown, Co. Dublin as part of the pre-planning application to Dun Laoghaire Rathdown County Council.

The report details the existing site condition, existing drainage infrastructure within the site and surrounding area and provides an overview of the proposed foul and storm drainage infrastructure for the development.

1.2 Objectives and Scope

The objectives of this DIA are to:

- Outline the strategy for the discharge of foul water from the development
- Outline the surface water drainage strategy for the development
- Identify any drainage issues which may arise from the development

In order to achieve these objectives this DIA provides the following information:

- The existing drainage infrastructure on the site
- Outline the relevant policy, standards and guidance for the design of the site drainage
- The proposed strategy for surface and foul water drainage

2 Site Location

2.1 Site Location

The site is located some 11km Southeast of Dublin City Centre and approx. 2 km from Dun

Laoghaire. The Dalguise House proposed residential development consists of an overall site area of c.3.58 hectares within a mature landscape setting adjoining, with Monkstown Valley to the West, Richmond Park to the East, Brock Court to the South with Monkstown Road to the Northern boundary of the site.

The site comprises of Dalguise House, 2 gate lodges and a dwelling house, walled garden and associated buildings and garden lands. There is significant tree coverage and vegetative screening from the surrounding area, which is predominantly residential.

Pedestrian & vehicle access is proposed through the existing Dalguise access and Purbeck Road off Monkstown Road. Current access to the site is provided via the current existing entrance opposite Albany Avenue, off the Monkstown Road. The access via a bridge from Purbeck Road is to be developed as part of the site development. See Figure 1 below.



Figure 1 Site Location (Extracted from Google Maps)

3 Proposed Development Site

3.1 Development Description

GEDV Monkstown Owner Limited intends to apply for permission for development on a site of c. 3.58 hectares at Dalguise House (Protected Structure RPS No. 870), Monkstown Road, Monkstown, County Dublin, A94 D7D1 (the lands include the following structures identified as Garage (A94 N3A1); Gate Lodge (aka Brick Lodge) (A94 R9T1); Dalguise Lodge (aka Entrance Lodge) (No. 71 Monkstown Rd, A94 TP46); White Lodge (A94 V6V9)); and on-street car parking in front of Nos. 6 and 7 Purbeck (A94 C586 and A94 HT99, respectively), with the provision of vehicular and pedestrian access and egress at two points on Monkstown Road: the existing entrance to Dalguise; and at Purbeck.

Alterations will be made at Purbeck including the relocation of 4 No. existing car parking spaces to facilitate the construction of a new vehicular and pedestrian bridge over the Stradbrook Stream.

The development, with a total gross floor area of approximately 46,940 sq m (including a basement of 5,230 sq m and undercroft parking of 1,344 sq m) (of which some 45,712 sq m is new build, and 1,228 sq m retained existing buildings), will consist of the construction of 491 No. residential units, consisting of 484 No. new build and 7 No. residential units (the latter within existing structures (repurposed from Dalguise House, Gate Lodge (Brick Lodge) and Coach House)).

The residential provision will comprise: 3 No. two storey 3-bed terraced houses (GFA 569 sq m), and 488 No. Build-to-Rent units (consisting of 2 No. studio units; 288 No. 1-beds; 32 No. 2-beds/3 persons; 153 No. 2-beds/4-persons; and 13 No. 3-beds) (with an option for the use of 4 No. of the BTR Units to cater for short-term stays of up to 14 days at any one time to cater inter alia for visitors and short-term visits to residents of the overall scheme) residential amenities and residential support facilities; a childcare facility; and restaurant/café.

The development will consist of: the demolition and partial demolition of existing structures (total demolition area 967 sq m, comprising: two residential properties (White Lodge (A94 V6V9), a 2 storey house (192 sq m); and a residential garage (A94 N3A1) and shed to the southwest of Dalguise House (285 sq m)); swimming pool extension to the southeast of Dalguise House (250 sq m); lean-to structures to the south of the walled garden (142 sq m); part-demolition of Lower Ground Floor at Dalguise House (9 sq m); single storey extension to the south of the Coach House (29 sq m) and three ancillary single-storey structures (8 sq m, 8 sq m, and 31 sq m) within the yard; potting shed (13 sq m); removal of 2 No. glasshouses; and alterations to, including the creation of 3 No. opes and the removal of a 12.4 m section of the walled garden wall to the east); the construction of: 11 No. residential blocks (identified as: Block A (total GFA 2,015 sq m) 7 storey, comprising 19 No. apartment units (15 No. 1-beds, 4 No. 2-beds) and a childcare facility (540 sq m over Ground and First Floor Levels); Block B (total GFA 3,695 sq m) 7 storey over undercroft car parking, comprising 48 No. apartment units (33 No. 1-beds, 6 No. 2-beds/3 persons, 9 No. 2-beds/4-persons); Block C (total GFA 3,695 sq m) 7 storey over undercroft car parking, comprising 48 No. apartment units (33 No. 1-beds, 6 No. 2-beds/3 persons, 9 No. 2-beds/4-persons); Block D (total GFA 4,150 sq m) 7 storey over basement level car park, comprising 50 No. apartment units (24 No. 1-beds, 26 No. 2-beds); Block E (total GFA 5,904 sq m) 9 storey over basement level car park, comprising 66 No. apartment units (40 No. 1-beds, 26 No. 2-beds), with residents' support facilities (75 sq m) and residents' amenities (gym, yoga studio, residents' lounge/co-working space; lobby 494 sq m) at Ground Floor Level, and residents' amenities (residents' lounge; games room; screen room; private lounge; kitchen 333 sq m) with

roof terrace (106 sq m) at Eighth Floor Level; Block F (total GFA 5,469 sq m) 7 storey over basement level car park, comprising 76 No. apartment units (46 No. 1-beds, 5 No. 2-beds/3 persons, 23 No. 2-beds/4-persons, 2 No. 3-beds); Block G (total GFA 5,469 sq m) 7 storey over basement level car park, comprising 76 No. apartment units (46 No. 1-beds, 5 No. 2-beds/3 persons, 23 No. 2-beds/4-persons, 2 No. 3-beds); Block H (total GFA 4,252 sq m) 5 storey over Lower Ground Floor, comprising 54 No. apartment units (30 No. 1-beds, 5 No. 2-beds/3 persons, 17 No. 2-beds/4-persons, 2 No. 3-beds); Block I1 (total GFA 1,038 sq m) 3 storey, comprising 12 No. apartment units (3 No. 1-beds, 2 No. 2-beds/3 persons, 7 No. 2-beds/4-persons); Block I2 (total GFA 1,038 sq m) 3 storey, comprising 12 No. apartment units (3 No. 1-beds, 2 No. 2-beds/3 persons, 7 No. 2-beds/4-persons); and Block J (total GFA 1,844 sq m) 4 storey, comprising 20 No. apartment units (13 No. 1-beds and 7 No. 3-beds)); the refurbishment, adaptation and reuse of: two storey Dalguise Lodge (Entrance Lodge) (GFA 55 sq m) comprising residential support facilities; a single storey Gate Lodge (GFA 55 sq m) comprising 1 No. 1-bed unit; and two storey Coach House and single storey Stableman's House (GFA 319 sq m) to provide 3 No. apartment units (1 No. 1-bed, 2 No. 2-bed/4 persons); the refurbishment, adaptation and change of use of Dalguise House (GFA 799 sq m) from a single residential dwelling to provide: 3 No. apartment units (2 No. studios and 1 No. 2-bed/3 person) at First Floor Level; a restaurant/cafe at Lower Ground Floor Level (GFA 273 sq m); and residents' amenities at Ground Floor Level (library, residents' lounge, events space, bar/bookable room, 157 sq m); works to the existing structures include: removal of existing internal partitions and doors, alterations to internal layout including provision of new partitions and doors to Dalguise Lodge (Entrance Lodge); the removal of the western chimney and chimney breast, removal of existing internal partitions and doors, and alterations to internal layout including provision of new partitions and doors to Gate Lodge (Brick Lodge); replacement of existing roof, windows and doors, non-original mezzanine floor and stairs of Coach House, creation of new internal and external opes, reconstruction of chimney, construction of new stairs, provision of new internal partitions and doors, replacement of the demolished single storey structure to south of Coach House with a 42 sq m single storey extension, including construction of a link between Coach House and Stableman's House; replacement of existing roofs, windows, doors, creation of new external opes and provision of new internal partitions and doors to Stableman's House; restoration of Coach House yard walls; removal of security bars from windows, internal partitions, doors, two secondary staircases, non-original fireplaces; and the reconfiguration of internal layout including introduction of new partitions, doors and fireplaces, in-fill of former secondary staircases; removal of an existing window at rear facade of Lower Ground Level, alterations to ope and replacement with a new external door; reinstatement of external wall fabric in place of demolished lean-to at the rear facade; and removal of external door to swimming pool on eastern facade and closure of ope at Dalguise House).

The development will also consist of: the construction of a garden pavilion; the provision of balconies and terraces, communal open space including roof gardens, public open spaces, hard and soft landscaping, landscaping works including the removal of trees, alterations to boundaries; the provision of: 224 No. car parking spaces (148 No. at basement level; 20 No. at undercroft; and 56 No. at surface level); motorbike spaces; level changes; ESB Substations (at Block D and Block H); plant areas; waste storage areas; provision of cycle parking (including cargo bike spaces) at basement and surface level; and all ancillary site development works above and below ground.

Provision is made in the landscaping proposals for potential future pedestrian and cycle connections that would facilitate permeability through the site boundaries with the residential estates of Arundel and Richmond Park, respectively, and the former Cheshire Home site, subject to agreement with those parties and/or Dún Laoghaire-Rathdown County Council, as appropriate.



Figure 2 – Proposed development site

3.2 Site Topography

The general topography of the site falls from south to north towards the Stradbroke stream. Levels vary in the region of 29.15m – 15.0m. The highest area in the site is the area surrounding Dalguse House and the lowest point on site is at the northern boundary adjacent to Stradbroke stream.

A small area of land north of the Stradbroke Stream at Purbeck is included in the Planning Application boundary (with the consent of a third party) to allow for the relocation of 4 no. existing car parking spaces and in order to facilitate the construction of the new bridge. The levels and surface water system on the north side of the new bridge at Purbeck will tie into the existing network and therefore no stormwater runoff to surrounding lands.

3.3 Flood Risk

A site specific Flood Risk Assessment was prepared by McCloy Consulting for the development (Report No. M02121-01_DG01 March 2020). The report identifies the Stradbroke stream as the potential main source of fluvial flooding within the site. Lands to the north of the site, along the Stradbroke Stream have been demonstrated to be affected by fluvial flooding for the 1% AEP (Flood Zone A) and 0.1% AEP (Flood Zone B).

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Location	1% AEP Water Level (m OD)	0.1% AEP Water Level (m OD)
Upstream extent of Site	15.84	15.85
Middle of Site	15.57	15.61
Downstream extent of Site	15.38	15.46

Table 1 Flood Level Summary

The main findings of the report relating to site drainage infrastructure are as follows:

- The report recommends a minimum Finished Floor Level/Finished Ground Level of 16.15m.
- The outfall for the surface water drainage system shall be above the 1% AEP + Climate Change (CC) level. The relevant 1% AEP + CC level at the downstream end of the site is 15.40m

4 Foul Infrastructure

4.1 Existing Foul Sewer Infrastructure

The background information identifies that a main combined sewer exists running under/on the line of the Stradbrook/Monkstown Stream. The sewer is a 450mm dia. vitrified clay (VC) line flowing towards Carrickbrennan Road.

A further 450mm dia. Irish Water/ DLRC Vitrified Clay (VC) combined line, exists, which runs from the Monkstown Valley development onto the application site, current entrance/exit roadway, and onto Monkstown Road, down Albany Avenue before connecting onto a main combined line on Seapoint Avenue was noted.

4.2 Existing Site-Specific Foul Sewer Infrastructure

Dalguise House is served by a separate septic tank and percolation area located in the lands outside to the Walled Garden on the western boundary. (See figure 3 below).

A detailed Remediation Plan will be developed to cater for the de-commissioning of the septic tank and removal of contaminated soils. This proposal is to be utilised and forms part of the current LRD application.

The White Lodge, (3 No existing residential units) along with Gate Lodge 1 & 2, drain into the existing 450mm dia. V.C sewer draining thru the existing estate entrance roadway, onto Albany Avenue and to the sewer running along Seapoint Avenue (information from GSDS F011- West Pier West Report April 2006).



Figure 3 Existing Foul Infrastructure

4.3 Proposed Foul Infrastructure

4.3.1 Overview

The Foul Drainage System for the site will be separated from the surface water network thru-out the development. The proposed foul system consists of two networks.

The first network begins adjacent to the Block I and follows the proposed access road before collecting flows from the second Block I, Block J, Block G, Dalguise House, Block H, Block F, Block E and Block D before connecting to the existing 450mm sewer in the northwest corner of the site.

The second network collects flow from Blocks A, B & C and connects to the existing 450mm sewer adjacent to Purbeck Access Road.

All basement drainage shall be collected in a separate collection chamber prior to passing through a suitable petrol interceptor. This collection chamber will pump to the foul sewer system via duty and standby pumps.



Figure 3 Foul Network Overview

The connection points to the existing sewer are indicated in Figure 3 above and have been approved by Irish Water on 8th March 2022 following a pre-connection enquiry application submitted on 15 December 2021 (see Appendix A of ESR Report for response letter). Irish water has requested that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works.

Specific details on the above are contained within Appendix B of the ESR report and on ByrneLooby Partners Ltd Drg. No. W3683-DR-1007, included with this submission.

4.3.2 Proposed Discharge

The proposed development is to consist of 491 units total, inclusive of childcare facility and cafe/restaurant. Based on Irish Water guidelines, the foul effluent generated will be based on Irish Water guidelines and is described in detail below.

The following criteria has been adopted for calculation of foul demands:

- 150 litres/head/day domestic loading
- 2.7 head/apartment
- 60 litres/head/day non-domestic loading
- Domestic Peaking Factor = 3
- Non-domestic Peaking Factor = 4.5

A detailed breakdown of the foul drainage demand calculations is provided in Appendix B of the ESR report.

5 Storm Water Infrastructure

5.1 Existing Storm Drainage Infrastructure

Examination of the drainage infrastructure maps supplied by Irish Water/ Dun Laoghaire Rathdown County Council Drainage Division for the surrounding areas of Dalguise House site, indicate that there is no specific separate surface water main in proximity to the development.

In general, existing developed sites adjacent to the subject site have discharged surface water to the Stradbrook Stream located on the Northern boundary, using agreed controlled flows, set by the Local Authority, equivalent to, or less than undeveloped greenfield discharge Q_{bar} as defined in the section 6.3.1.2.2 "River Regime Protection" of the Greater Dublin Strategic Drainage Study Volume 2 – New development and within Report 124 " Flood estimation for small catchments", 1994 produced by the Institute of Hydrology.

The existing development site is generally greenfield but there are some small areas of brownfield located within the overall site area of 3.58-hectare section of site (excluding roadway section in Purbeck lodge, 77 Monkstown Road of Area = 0.156 ha), at Dalguise House, the White Lodge (3 No existing houses subject to demolition and re-development), Gate Lodges (2 No) and the Coach House located on the South-West boundary.

The current site surface water from the above existing areas is combined with foul discharges and connected to an existing site septic tank or onto the existing 450 dia. vitrified clay Irish Water combined main from Monkstown Valley flowing down the existing site entrance roadway onto Albany Avenue -see Irish Water Web map.

As referred to in Section 4.2 of this report, a site-specific Remediation Plan will be prepared for the removal of the septic tank and associated percolation area pipework and contaminated soils.

Any retained structures as part the new site development will be provided with new separate foul, surface water and mains water connections

5.2 Proposed Infrastructure

In accordance with Dun Laoghaire Rathdown County Council requirements, storm water shall be managed in two phases. The first is to restrict storm water run-off from the proposed development to greenfield run-off rates. The second aspect to be included in new applications is to incorporate sustainable urban drainage systems ('SuDs') proposals into the scheme. The 'SuDs' concept requires that storm water quality is improved before disposal and, where applicable, storm water is discharged into the ground on site. The proposed surface water system within the site will be separated from the foul system as required.

The development will be served by a simple gravity drainage system (as far as reasonably possible) including Suds features (swales, permeable paving, tree pits etc) and will follow the natural topography of the site, falling towards the Stradbrook Stream on the Northern end of the site.

The proposed basement car park, located under Blocks D, E, F G and the Central Plaza, will have a series of gullies and drainage channels cast into the floor slab which will cater for limited amounts of run-off that enters the proposed car park through ramps, service ventilation opes etc. and vehicles entry point.

The proposed channels and gullies will be connected to a buried gravity pipe network that will fall to the attenuation tanks shown in Drg. No. W3683-DR-1014. The outflow from the tank, will flow to the outfall points via a gravity system and through oil interceptors prior to discharge into Stradbrook Stream.

The site has been split into two catchment areas, the upper catchment area (south of the site) and the lower catchment area (north of the site). The upper catchment includes runoff from Block I (No. 1 & 2), Block H, Block J, Block E, Block F, Block C, Block B and existing buildings to the north and south of Block J and associated hardstanding areas/roads. The lower catchment includes runoff from Block D, Block A and from associated road and hardstanding areas. Refer to Drawing W3683-DR-C-1032 for Storm Catchment Map.

5.2.1 SuDs Methodology

The development will be designed in accordance with the principles of Sustainable Urban Drainage Systems (SuDs) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GSDSDS) and Chapter 10 to the DLR CoCo Development plan 2022-2028.

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment of run-off within ‘SuDs’ features e.g., landscaping and green roof areas.
- Criterion 2: River Regime Protection - satisfied by attenuating run-off from the site in accordance with greenfield runoff rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the site being outside the 1000 year coastal and fluvial flood levels. Pluvial flood risk addressed by development designed to accommodate a 100-year extreme storm as noted in ‘GSDSDS’. Planned flood routing for storms greater than 100-year level considered in design and development run-off contained on site.
- Criterion 4: River Flood Protection – attenuation and/or long-term storage provided within the ‘SuDs’ features. In accordance with the requirements of DCC all new developments are to incorporate the principles of ‘SuDs’. The ‘SuDs’ principles require a two-fold approach to address storm water management on new developments.

5.2.2 Description of SUDS Measures

As per Criterion 4, in accordance with the requirements of DCC all new developments are to incorporate the principles of ‘SuDs’. The aim of ‘SuDs’, inclusion across the development is to provide an effective system separate from the foul network to mitigate the adverse effects of storm water run-off on the environment, through enhanced quality systems and on local infrastructure to aid in preventing downstream flooding. The features proposed shall reduce runoff volumes, pollution concentrations and enhance groundwater recharge and biodiversity.

The proposed development ‘SuDs’ features shall consist of:

- a) Green/Blue-roof – The proposed system is a ACO Roofbloxx Blue roof system, this allows the roof areas of the proposed apartments to use a filter layer to direct rainfall events into a storage layer below. An 85mm space will be provided for rainfall to be retained in the storage layer. As more intense rain falls on the blue roof can overflow from the roof through down pipes and into the schemes main drainage runs. The storage area will be covered with a sedum topsoil to increase the water retention on each roof.

b) Permeable Paving – this system allows rainwater to be directed into carparking bays whereby the rainwater can filter through gaps in the paving blocks and percolate into the subsoil or to swales. The area which can be drained is subject to the infiltration characteristics of the subsoil, which is established following ground investigation testing on site.

c) Tree Pits – Tree pits will be located along the existing avenue to capture runoff for the existing hard standing area. It is proposed that the tree pits will be connected and act like an attenuation basin where the water can then be released slowly into the storm network.

d) Swales and pond – it’s proposed to allow storm water to be directed locally into swales when the permeable paving is overflowing to delay storm water from entering the main drainage network. As the swales overall can only accommodate relatively small surface areas across this site, the proposal cannot be used to drain the site as a whole, but will be installed to contribute to the overall ‘SuDs’ strategy.

e) Filter Strip – An area of the existing road will have a filter strip located to the North to capture runoff for small rain fall events. This allows runoff from localised hardstanding areas to be filtered and trap silt prior to entering the storm network.

f) Attenuation Tanks – As noted above, for extreme storm events, a dedicated system to contain the storm water flows generated during a 1-in-100-year storm, increased by 20% for climate change are required by DLR. It is proposed to use underground storage tanks in three locations for this purpose see Drg. No. W3683-DR-1018.

g) Low Water Usage Appliances – It is also worth highlighting that low water usage appliances should also be utilised to aid in the reduction of water usage on the development.

With the above SUDs provisions it meant that oil separators are not required prior to final disposal of storm water from the development drainage network into the Stradbroke Stream (at two locations).

The combination of the above noted elements will allow the proposed development to adhere to the principles of sustainable drainage practices while enhancing overall storm water quality.

5.2.3 QBAR and Impervious area calculations

To ensure an accurate calculation of the required attenuation for the site Met Eireann was contacted to provide:

- a) The SAAR (Standard Annual Average Rainfall) for the area: 900mm/year.
- b) The sliding duration table for the site indicating the 1:100-year rainwater intensities to be used.
- c) Soil type value obtained from the Flood Studies Report, has been established as soil type 4.

These parameters allow the Q-Bar, greenfield run-off rate, to be calculated. The Q-Bar value for the site is 22.14 l/sec. The calculations for the attenuation on site takes account of the positively drained areas only which is identified below.

Area	Upper Catchment (m2)	Lower Catchment (m2)
Blue Roofs	6,084.12	991.91
Road/Permeable Paving	5,568.23	810.0
Existing Properties	970.0	170.0

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Podium	801.0	-
Total	13,824.74 (1.384 ha)	1,850.31 (0.185 ha)

The allowable discharge rate off site is as follows:

Upper Catchment (downstream outfall) – 8.9 l/s (flow rate of 6.48l/s/ha)

From Tank 1 – 5.2l/s

From Tank 2 – 8.9l/s

Lower Catchment (upstream outfall) – 1.2l/s (flow rate of 10.81 l/s/ha)

In accordance with the requirement of the SuDs Manual C752 Section 4.3 “Water Quality Design Standards” and Section 24.8 “Designing for interception”, interception needs to be provided for any contributing impermeable area so a check is required to confirm that adequate provision is made for all such areas throughout the site.

There is an amount of storage provided for interception across the site in accordance with Ciria 753. This is to capture and retain the first 5mm of the rainfall to result in no runoff to the stream. Interception and evaporation can account for 15-50% of yearly precipitation. Several approaches below have been taken to include interception storage across the site.

- Permeable paving
- Green/blue roofs
- Swales and pond
- Tree pits and bio – retention areas
- Filter strip

Additional approaches were looked at but were not found to be effective for this development. For example, soakaways, the existing ground conditions do not support this system.

Interception Storage Requirement = $15675 \times 0.005 = 78.38\text{m}^3$ which is the total volume of the first 5mm to be intercepted across the positively drained area site.

SUDs Element	Volume of Interception (m ³)
Permeable Paving	26.65
Green/Blue Roof Area	719.02
Swale/Pond	8.88
Tree Pits and Bio-retention Areas	639
Filter Strip	0.175
Total Volume of Interception (m³)	1392.73

The Calculations below show that the total interception storage equates to 1392.73m^3 for the site providing adequate interception is provided to meet the requirements within the SuDs Manual and GSDS.

5.2.4 Permeable Paving

In areas across the site where the development will require new hard standing for road access and car parking, permeable paving will be installed to a total area of c.2665.49m². This is proposed to prevent surface ponding without the need for an additional channel drainage system. The overflow connection from the permeable paving is connected to swales located close by where possible. Otherwise the flow will connect directly into the storm network.

Total hard standing area = 5568.23m²

Permeable Paving = 2665.49 m² x 0.005 x 2 = 26.65m³

5.2.5 Green/Blue Roofs

All of the proposed buildings on site are to have a blue roof system to comply with the requirements of Appendix 7 of DLRCC Development Plan 2022-2028 70% of a new roof areas to be constructed as Green/Blue Roofs. The blue roof has is to be installed as a first stage storage system and its volume is separate from the overall site attenuation requirement to aid storage during and exceedance event. There is a blue roof area application from Beton that is proposed to cover the podium area to provide additional interception storage, see drawing W3683-DR-1018. The proposed Green/ Blue Roof will be an Extensive type, build up comprising of durable, slow growing, low maintenance planting generally sedum type, with a substrate depth of typically 100mm of free-draining growing medium.

The retention from the roofs alone has been set to an 125mm depth which gives an overall maximum retention of 642.42m³ for all the blue roofs across the development and a maximum outflow of 0.79l/s. As the design develops across the site the depth can be increased to higher levels to give more capacity. We have engaged with a specialist Green/Blue roof supplier for identify the available capacities of the system for the site.

See Appendix F of the ESR report for the proposed blue roof arrangement and calculations summarised below.

The podium area will also contain a blue roof type storage system. The podium area utilised with this system is 680.86m². We therefore expect it to retain an approximate volume of 76.60m³.

680.86m² contribution = 76.60m³

Lower catchment green/blue roof 843.12m² contribution = 94.85m³

Upper catchment green/blue roof 4867.35m² contribution = 547.57 m³

Interception volume over the green/blue roofs = 719.02m³

Total Roof Area (proposed) = 5710.47m²

5.2.6 Tree Pits and Bio-retention Areas

To allow for the capture of surface run-off along the existing road, tree pits and bio-retention basin will be located intermittently to intercept run-off along this route. The aim is to use medium in the bio-retention and tree-pit system that meets the criteria of the Facility for Advanced Water Biofiltration

(FAWB) or similar for interception of run-off and to allow evaporation of leaves and provide biodiversity benefits. Guidance on the construction and maintenance of the tree pit should align with BS 8545.

Following the SDCC SUDs Explanatory, Design and Evaluation Guide by McCloys Consulting notes that on average the available storage in a bio-retention basin:

Total retention basin area of c.1065m²

Total basin volume = c.1065m² x 0.6 = 639m³

5.2.7 Pond and Swales

It is proposed that the swales will be lined as per Table 24.6 of the CIRIA 753 Suds Manual. Based on the recent SI carried out in 2022 confirming no appropriate soil infiltration capability and therefore the swales can only provide interception of up to 5 times the swale area. The swale is utilized as a connection from the permeable paving for overflow scenarios. The swales are proposed to be terraced and or flat with a raised outlet to create a temporary storage zone. This is proposed to be developed further at detailed design stage with the landscape architect.

There is a total swale/pond area of c.355.53m².

Swale/Pond Volume = c. 355.53m² x 0.005m x 5 = 8.88m³

5.2.8 Filter Strips

Filter strips are an open stone trench of 0.4-1m wide proposed to be located at the side of the existing road for capturing run off and removing silt before entering the storm network. The filter strip is utilised areas where existing trees are to be retained and utilisation of tree pits is not possible. The road length the filter strip is draining is 86m long, with 1m sections of filter strip every 6m along this section of road, connecting into the stormwater network at the end of the strip. Based on Table 24.6 of the CIRIA 753 Suds Manual the filter strip provides the following interception volume.

Total length of filter strip = 14m Proposed width of 500mm

Filter strip = 7m² x 0.005m x 5 = 0.175m³

5.3 Long-term Attenuation Storage and Volume

Using the microdrainage software, the volumes of the required attenuation for the site, as shown in Appendix D of the ESR document, result in the following tank volumes:

Upper Catchment tank 1 is 390m³. Modelled with a 5.2 l/s discharge @ 1.5m head.

Upper Catchment tank 2 is 600m³ modelled with 8.9 l/s discharge @ 1.2m head.

Lower catchment tank is 102m³ modelled with 1.2 l/s discharge @ 1.5m head.

These tanks have been designed for a 1:100 year storm event accommodating a 20% climate change and runoff rates for summer and winter (Cv) at a value of 1.0 to ensure accurate simulation results as per Appendix 7 the DLRC Development Plan 2022-2028 requirements for sizing the attenuation tanks.

The attenuation storage proposed is the use of concrete tanks as the site SI completed found that there is no infiltration ability of the soil. The above volume of water is critical, the change from concrete material to other suitable materials is possible ensuring the above volumes are accommodated.

5.4 Summary

The below table summarises the total volume of interception and attenuation storage provided across the site.

	Volume Required (m³)	Volume Provided (m³)
Attenuation	796.80	1092
Interception	78.38	1392.73