ENGINEERING SERVICES REPORT

RESIDENTIAL DEVELOPMENT AT

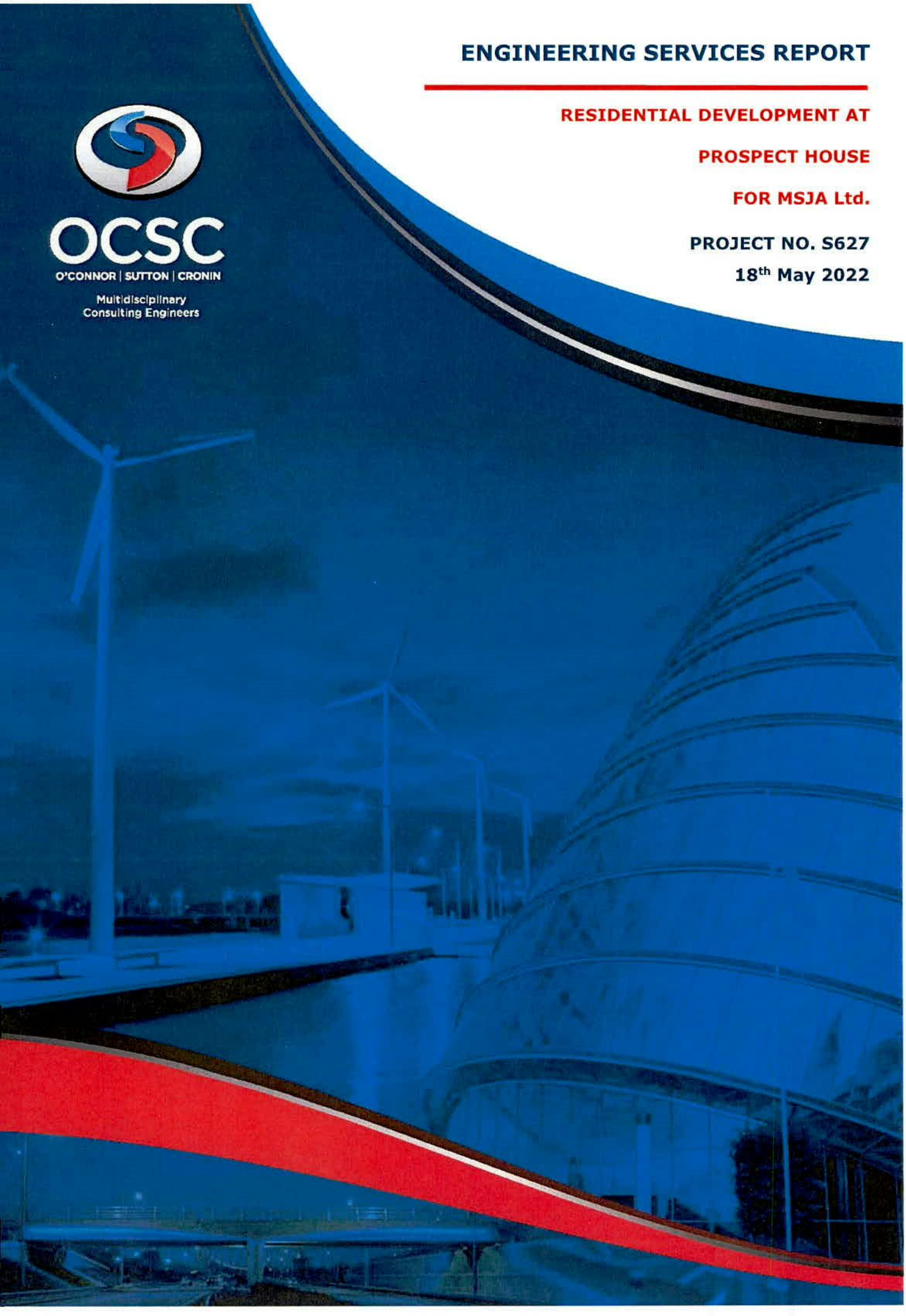
PROSPECT HOUSE

FOR MSJA Ltd.

PROJECT NO. S627

18th May 2022

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers



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1 INTRODUCTION

1.1 Appointment

O'Connor Sutton Cronin (OCSC) have been appointed by *MSJA Ltd.* to prepare an Engineering Services Report (ESR) for the proposed residential development at Prospect House, Stocking Lane, Dublin 16. The proposed development is residential and consists of the construction of 22 no. apartments, along with the renovation of the existing gatehouse and Prospect House with parking areas at the basement and communal open spaces.

1.2 Administrative Jurisdiction

The site is located within the administrative jurisdiction of South Dublin County Council and therefore the engineering services design was carried out with reference to the following:

- The South Dublin County Council Development Plan 2016 – 2022.
- Greater Dublin Strategic Drainage Strategy – GSDSD.
- The Planning System and Flood Risk Management Guidelines for Planning Authorities (Department of Environment, Heritage and Local Government and the Office of Public Works).

1.3 Site Location

The site is located at Prospect House, Stocking Lane, Dublin 16 and can be accessed via Stocking Lane by driving, walking or public transport. Refer to *Figure 1* for site location context. The site is immediately bound by:

- **North:** Greenfield that is an open area.
- **South:** Prospect View, Residential developments.
- **East:** Prospect Drive, Residential developments.
- **West:** The road Stocking Lane that gives access to the site.

2 SCOPE OF SERVICES REPORT

This report was compiled following a review of available data from the Office of Public Works (OPW), Transport Infrastructure Ireland, the Department of Housing, Planning and Local Government, Irish Water, South Dublin County Council, the client and the wider design team. The report addresses the following services with respect to the proposed development:

- Surface Water Drainage;
- Flood Risk Assessment;
- Wastewater Drainage;
- Potable Water Supply and;
- Traffic and Transportation.

Engineering proposals have been designed with reference to the following:

- South Dublin County Council Development Plan (2016 – 2022);
- Greater Dublin Strategic Drainage Study (GDSDS);
- Greater Dublin Regional Code of Practice for Drainage Works (GDRCOP);
- Irish Water Code of Practice for Wastewater, IW-CDS-5030-03;
- Irish Water Code of Practice for Water Supply, IW-CDS-5020-03;
- The Building Regulations – Technical Guidance Document Part H;
- BE EN 752 – Drainage Outside Buildings;
- BS 7533-13 – Guide for Design of Permeable Pavements;
- The Office of Public Works, the Planning System and Flood Risk Management;
- South Dublin County Council's and Irish Water's Drainage and Watermain Records;
- The SuDS Manual (CIRA C753);
- Design Manual for Urban Roads and Streets (DMURS);
- National Cycle Manual;
- Traffic Signs Manual;
- Infiltration – Manual of Good Practice (CIRIA 156) and;
- The Planning System and Flood Risk Management, Office of Public Works, December 2009.

Figure 3.2.1: Existing Site, Aerial Overview (Google Earth)

3.2.2 Existing Surface Water Drainage Infrastructure

There is an existing surface water sewer with an unknown diameter within Airpark Close at western boundary of the site. There is also a 225mm diameter surface water sewer passing at Prospect Drive at eastern boundary of the site.

Refer to *Figure 3.2.2* for an excerpt from public drainage records, which are also provided in ***Appendix A***, for indicative locations of existing infrastructure.

3.3.2 Proposed Surface Water Design Criteria

The proposed surface water network has been designed in accordance with the regulations and guidelines outlined in *Section 2,* using MicroDrainage network design software by Innovyze Inc. which simulated the performance of the integrated drainage network for varying rainfall return periods and storm durations.

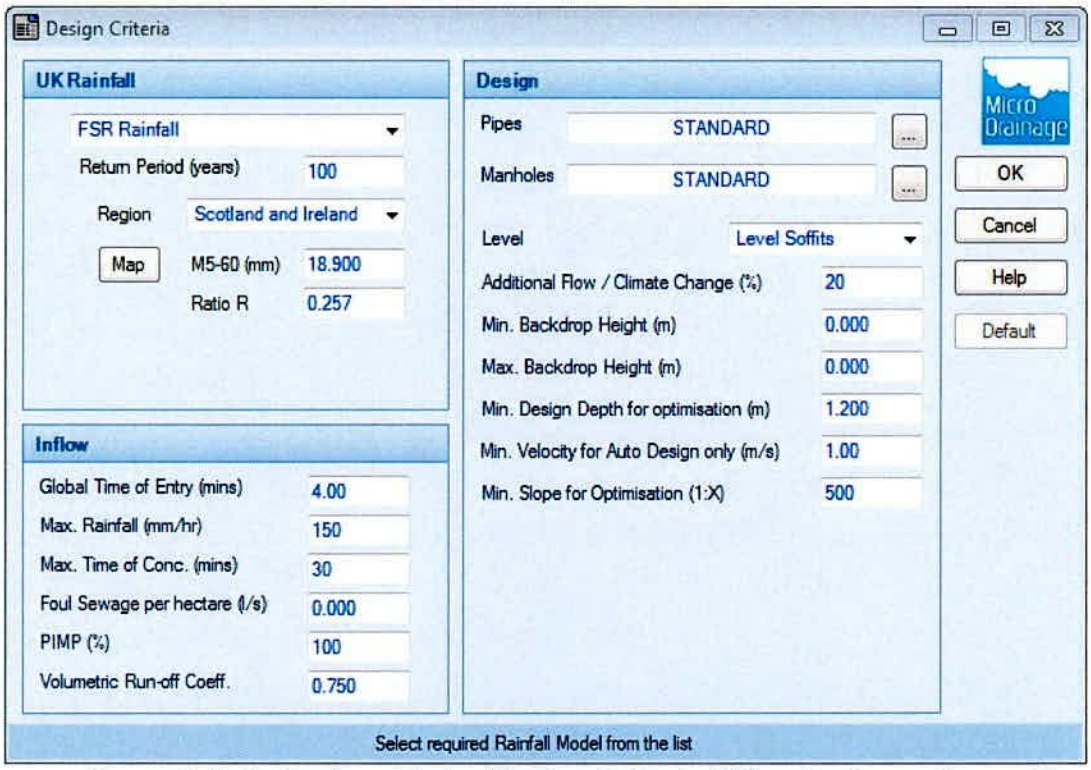

Figure 3.3.2: Surface Water Design Criteria (MicroDrainage Excerpt)

As indicated in *Figure 3.3.2*, the proposed network was designed to allow for an additional 20% increase in rainfall intensity, to allow for Climate Change, in accordance with the South Dublin County Council Development Plan 2016 – 2022. The MicroDrainage network design software applies to the Flood Studies Report (FSR) methodology for analysis of the rainfall profiles; however, the input design parameters, as shown in *Figure 3.3.2*, are the latest available rainfall data sourced from the Flood Studies Update (FSU) data i.e. The return period rainfall depth for varying durations, which determine the M5-60 and R-values, and Standard Annual Average Rainfall (SAAR); as sourced from Met Éireann.

and the GDRCOP for Drainage Works, with minimum full bore velocities of 1.0 m/s achieved throughout.

All main surface water carrier pipes have been sized to ensure no surcharging of the proposed drainage network for rainfall events up to, and including, the 1 in 5-year ARI event, with a projected climate change allowance of 20% increase in rainfall intensity.

3.3.6 Proposed Surface Water Attenuation Storage

Temporary underground attenuation is to be provided in order to restrict discharge rates from the development surface water network to the greenfield equivalent flow rate as detailed in *Section 3.2.3*. The attenuation has been designed to temporarily store the surface water runoff for design rainfall events up to, and including, the 1% AEP with a 20% increase in rainfall intensity; during rainfall events that results in flows exceeding the greenfield runoff.

The development's surface water network's primary attenuation, is to be provided in the form of a modular attenuation system providing 75.3m^3 of temporary storage, using ESS EcoCell or similar approved, under the green space within the development. The system has been sized to allow sufficient temporary storage of rainfall events up to and including the 1 in 100-year ARI (with a 20% allowance for climate change). Refer to ***Appendix F*** for attenuation system details.

3.4 Specific SuDS Measures Proposed

It is proposed to provide a Sustainable Drainage System (SuDS). Specific design requirements for SuDS components are established by the Construction Industry Research and Information Association's publication The SuDS Manual (C753). It is proposed that the following systems will be used:

- Attenuation Storage will be provided for runoff from all hardstanding surfaces to allow for the restriction of discharge rates to equivalent greenfield runoff rates. The proposed attenuation facility has capacity for the proposed development and accommodates the design 100-year return

3.7 Calculations

A computer model of the drainage systems has been developed using the MicroDrainage design software. Calculations for the design of surface drains have been compiled using the Modified Rational Method in accordance with I.S. EN 752. The performance of the proposed drainage systems has been assessed for 1-year, 30-year and 100-year return period storm events. Calculations generated by the MicroDrainage software are included for the surface water networks in ***Appendix B*** and discussed below in *Section 3.9*.

3.8 GDSDS Storm Water Review

The proposed storm water drainage system has been reviewed under the following four criteria:

(i) Criterion 1 – River Water Quality Protection;

(ii) Criterion 2 – River Regime Protection;

(iii) Criterion 3 – Level of Service (Flooding) site;

(iv) Criterion 4 – River Flood Protection.

3.9 Criterion 1 – River Water Protection

The drainage system for this development will contain a range of treatment methods for surface water as outlined earlier. The surface water runoff will pass through a Class 1 petrol interceptor. Low rainfall events and the first flush of higher rainfall events will be infiltrated to groundwater at the interception storage provided at the attenuation facility (subject to suitable ground conditions); this volume will infiltrate to groundwater and will not be discharged off site. The runoff from the proposed development will pass through the interception storage provided in the permitted drainage system, which provides 5mm rainfall interception storage.

3.10 Criterion 2 – River Regime Protection

Discharge will be limited to equivalent greenfield runoff rates, providing a total maximum discharge rate of 1.2 l/s for the entire landholding. This ensures that sufficient stormwater runoff retention is achieved to protect the river during extreme events.

in the 100-year return period storm event. Notwithstanding this, all roads within the proposed development have been designed to provide continuous overland flow routes through the development to avoid ponding at proposed houses. Therefore, the proposals satisfy Sub-Criterion 3.4.

3.12 Criterion 4 – River Flood Protection

Runoff from the site will be limited to the greenfield runoff rate calculated in accordance with IH124; the calculated greenfield flow rate is 2.4 l/s/ha, which equates to 1.2 l/s for the subject site. By limiting the runoff to this flow rate, this ensures that sufficient storm water runoff retention is achieved to protect the river during extreme events. Attenuation storage is provided for the 100-year return period storm event in the proposed and permitted attenuation facilities. Therefore, the proposals satisfy Criterion 4.

GDSDS and revised following later studies. These parameters are set out in *Table 2: Climate Change - Impact on Design Parameters*, below.

Design Category	Impact of Climate Change
Drainage	20% increase in rainfall
Fluvial (River)	20% increase in flood flow
Tidal/Coastal	Sea level rise of 500mm

Table 2: Climate Change - Impact on Design Parameters

4.2 Flood Risk Zones

The *PSFRM Guidelines* adopt a sequential approach to managing flood risk by reducing exposure to flooding through land-use planning. The approach adopted by the PSFRM Guidelines establishes three zones (*PSFRM Guidelines paragraph 2.23*) on a sliding scale of flood risk – refer to *Table 3: Flood Risk Zones*, below.

Zone A	**High Probability of Flooding** Where the annual probability of flooding is: greater than 1% for fluvial flooding or greater than 0.5% for coastal flooding
Zone B	**Moderate Probability of Flooding** Where the annual probability of flooding is: between 0.1% and 1% for fluvial flooding or between 0.1% and 0.5% for coastal flooding
Zone C	**Low Probability of Flooding** Where the annual probability of flooding is: less than 0.1% for fluvial flooding and less than 0.1% for coastal flooding

Table 3: Flood Risk Zones

Flood risk zones are determined on the basis of the probability of river and coastal flooding only (*PSFRM Guidelines paragraph 2.24*). Other sources of flooding (such as groundwater, infrastructure and pluvial) do not affect the delineation of flood risk zones. These other sources of flooding should be considered and mitigated in design. Flood risk zones are determined on the basis of the current flood risk,

Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Table 4: Development Vulnerability Class

4.4 Development 'Appropriateness'

The *PSFRM Guidelines* define the zones in which each class of development is appropriate – this is summarised in *Table 5: "Appropriateness" Matrix*, below. The *PSFRM Guidelines* recognises that flood risks should not be the only deciding factor in zoning for development. They also recognise that circumstances will exist where development of a site within a floodplain is desirable; in order to achieve compact and sustainable development of the core of urban settlements. In order to allow consideration of such development, the *PSFRM Guidelines* provide a **Justification Test**, which establishes the criteria under which desirable development of a site in a floodplain may be warranted.

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-compatible Development	Appropriate	Appropriate	Appropriate

Table 5: "Appropriateness" Matrix

A review of the OPWs Catchment Flood Risk Assessment Mapping indicates that there is no predicted flooding from this watercourse or in the vicinity of the subject site.

Figure 4.6: OPW Fluvial Flood Risk Mapping (excerpt from www.floodinfo.ie)

Therefore, the proposed development is not considered at risk of fluvial flooding from the River Owenadoher, Whitechurch Stream or the watercourse along its eastern boundary and is deemed acceptable for use.

4.7 Coastal Flooding

The proposed development located approximately 8km from the north eastern coast and located approximately 150m-200m from a section of the River Owenadoher which is affected by tidal changes. The proposed development is located outside of the extent of the predicted 1% AEP flood zone for coastal flooding. Refer to *Figure 4.7* for details.

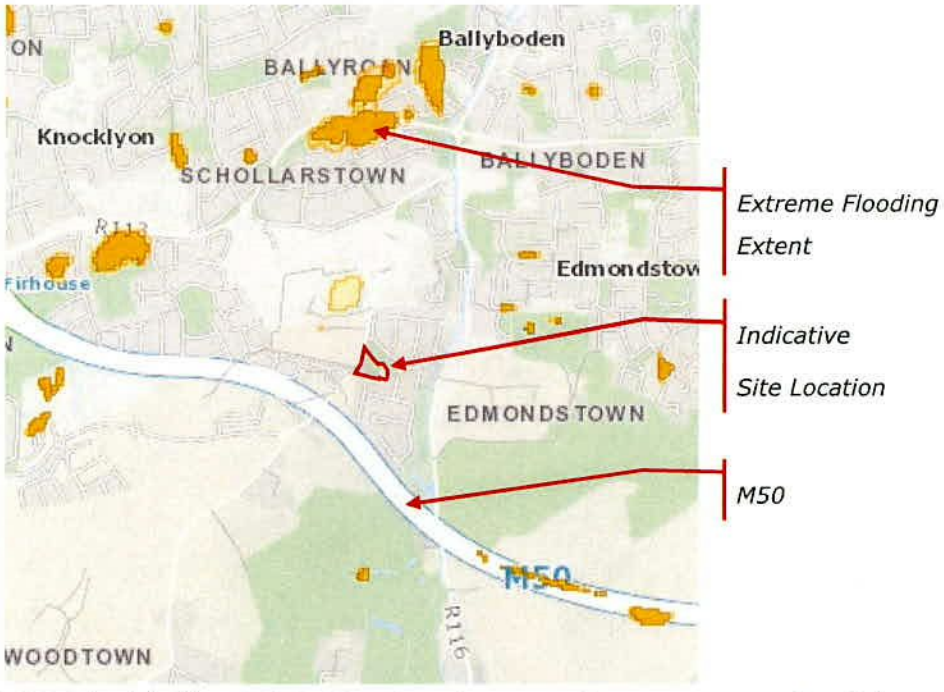

Figure 4.8: OPW Pluvial Flood Risk Mapping (excerpt from www.myplan.ie)

As detailed within *Section 3* of this report, the proposed surface water drainage network as part, of this development, has been designed to ensure that no flooding is experienced during design rainfall events up to and including the 1% AEP including an additional 20% intensity for climate change projections.

The above ensures that pluvial flooding is not considered a significant risk to the proposed the development, nor as a result of the proposed development.

6 POTABLE WATER SUPPLY

6.1 Overview

There is an existing 4 Asbestos 1973 watermain in the public road, Stocking Lane, on the west boundary of the subject site. It is proposed to connect the proposed watermain system to the existing public watermain at the west boundary.

The proposed watermain network will consist of HDPE DN100mm SDR 17 PE100 mains. The network will include hydrants as per Irish Water requirements. Hydrants have been provided at locations to ensure that no dwelling within the subject site will be farther than 46m from a hydrant and a hydrant shall not be closer than 6m to a property. The proposed watermains layout is shown on drawing **S627-OCSC-XX-XX-DR-C-0550**. The proposed watermain infrastructure is designed in accordance with Irish Water's *Code of Practice for Water Infrastructure* (IW-CDS-5020-03).

6.2 Connection to the Existing Network

The proposed watermain system connects to the existing public watermain uPVC 150mm-diameter in the public road, Stocking Lane, on the west boundary. The proposed development is residential and consists of 22nr apartments. The water volumetric calculations are contained in ***Appendix E***.

6.3 Water Saving Devices

In accordance with best practice, new water saving devices (low water usage appliances and aerated taps etc.) will be fitted within the subject site.

6.4 Water Meters

In accordance with the South Dublin County Council and Irish Water regulation a bulk water meter will be fitted at the proposed connection to the existing watermain. Individual water meters for each apartment will be provided inside the building.

7 TRAFFIC AND TRANSPORTATION

7.1 Site Accessibility

The development site is located directly adjacent a bus stop on Stocking Lane, a bus stop is located on either side of the road directly adjacent to the development site at its south west corner. The bus services adjacent to the proposed development site are summarised following:

Route	Description
15b	Ringsend Rd. (Barrow Street). – Stocking Avnue

Table 6: Local Bus Services

There are also additional services located on the Edmonsdtown Road that is located 850m (10 min walk) from the development site. these services that are a short walk away are summarized in the following table:

Route	Description
61	Eden Quay – Whitechurch
161	Rockbrook – Whitechurch – Nutgrove - Dundrum

Table 7: Local Bus Services

Existing cycle infrastructure, as published by the National Transport Authority (NTA) in their Greater Dublin Area Cycle Network Plan, is shown in *Figure 7.1* overleaf with the development site circled in red.

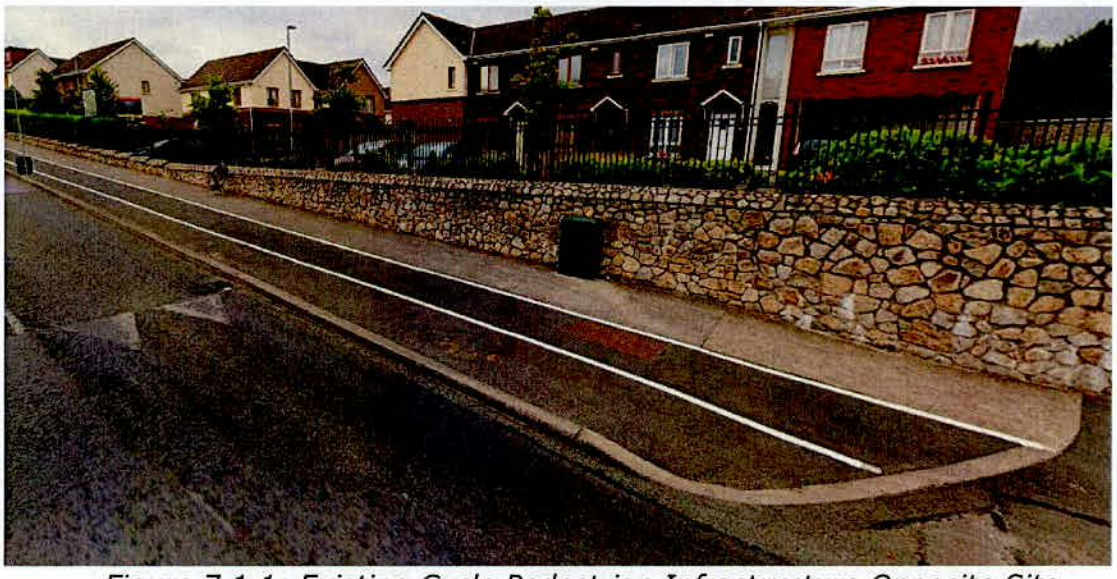

Figure 7.1.1: Existing Cycle Pedestrian Infrastructure Opposite Site

Further improvements planned by the NTA for the Greater Dublin Area can also be seen in their Greater Dublin Area Cycle Network Plan, section of this can be seen below in *Figure 7.1.2*.

In terms of pedestrian access, footpaths will be provided along the boundary of the site on Stocking Lane, this can be seen in OCSC layout **S627-OCSC-XX-XX-DR-C-0100**. There is existing high quality footpath along stocking lane, the provision of additional footpaths on the eastern side of Stocking Lane will greatly improve pedestrian access along Stocking Lane.

The proposed development includes an access on Stocking Lane which provides sole access to all car parking. A sightlines assessment of this entrance has been carried out and is shown on Drawing No. **S627-OCSC-XX-XX-DR-C-0101**.

7.2 Construction Traffic Impact

The construction period will be temporary in nature. Construction traffic is expected to consist of the following categories:

- Private vehicles owned and driven by site construction staff and by full time site supervisory staff and occasional professional supervisory staff i.e. design team members and supervisory staff from utility companies;
- Materials delivery and removal vehicles.

It is difficult to assess the exact quantum of traffic that will be generated during the construction period however, based on experience from similar developments, the following points are noted with regard to construction traffic:

- In general, the construction day will begin and end outside of peak travel hours. As a result the majority of workers travelling to and from the site will arrive before the a.m. peak hour and depart after the p.m. peak hour;
- Limited on-site parking will be provided to encourage staff to travel by more sustainable means including public transport and/or car sharing. There is also limited potential for off-site parking due to the high associated costs;
- Adequate on-site compounding will be provided to prevent any potential overflow onto the local transport network;

- Traffic to and from the development exceeds 10% of the traffic flow on the adjoining road;
- Traffic to and from the development exceeds 5% of the traffic flow on the adjoining road where congestion exists or the location is sensitive;
- Residential development in excess of 200 dwellings.

As outlined previously, the proposed development consists of just 24 residential units which is below the above threshold. In addition, the trip generation estimates are expected to be well below the additional thresholds identified due to the highly accessible nature of the development site. In addition, car parking provided at the site is expected to primarily fulfil a storage role as commuters use alternate means available to travel in the majority of instances.

Table 2.3 of the NRA guidelines also sets out sub-thresholds that provide guidance on the need for detailed analysis when the aforementioned limits are not met and where national roads are not impacted. A development is required to meet two or more of the following criteria to fall into this category:

- The character and total number of trips in / out combined per day are such that as to cause concern;
- The site is not consistent with national guidance or local plan policy or accessibility criteria contained in the Development Plan;
- The development is part of incremental development that will have significant transport implications;
- The development may generate traffic at peak times in a heavily trafficked/ congested area or near a junction with a main traffic route;
- The development may generate traffic, particularly heavy vehicles in a residential area;
- There are concerns over the development's potential effects on road safety;
- The development is in a tourist area with potential to cause congestion;
- The planning authority considers that the proposal will result in a material change in trips patterns or raises other significant transport implications

7.4 Parking

The provision of car parking at the proposed development will be in line with the South Dublin County Council Development Plan 2016-2022. This carries an associated maximum car parking allowance for residential developments. Parking rates are divided into two main categories:

- Zone 1: General rate applicable throughout the County
- Zone 2 (Residential): More restrictive rates for application within town and village centres, within 400 metres of a high quality public transport service (includes a train station, Luas station or bus stop with a high quality service).

The proposed development site is considered to be within Zone 1 as set out previously as it is not within 400m of a high quality public transport service. Therefore based on the above, the development plans sets out the following maximum parking rates for residential apartments.

- 1 car parking space per 1 bed unit
- 1.25 car parking space per 2 bed unit
- 1.5 car parking spaces per 3+ bed unit

Based on the above figures, the South Dublin County Development Plan 2016-2022 recommends a maximum of 28 no. car parking spaces (including 1 no. disabled space) to serve the proposed development

In this instance, it is proposed to provide 27 no. standard car parking spaces in total on site which equates to 1.13 spaces per unit. It is also proposed to provide 2 no. motorcycle spaces at the basement level. Of the proposed 27 no. standard car parking spaces , 23 no. car parking spaces at basement level (including 1 no. disabled parking space), 2 no. car parking spaces at gate lodge and 2 no. car parking spaces at Prospect House.

7.5 Access

The site has been designed in accordance with the *Design Manual for Urban Roads and Streets (DMURS)*. All footpaths provided with a minimum with of 1.8m and junction radii have been reduced in line with section 4.3.3 of the *DMURS.* The addition of the proposed development will result in additional footpaths along the western edge of Stocking Lane along the proposed development site where there are currently no pedestrian facilities. The roads and footpath layout associated with the proposed development can be seen in the layout S627-OCSC-XX-XX-DR-C-0100 issued with this application.

The provision of roads and footpaths were agreed with South Dublin County Council Assistant Engineer Robert Roche in the Land Use Planning and Transportation Department in June 2019 prior to the submission of this application.

UISCE ÉIREANN : IRISH WATER

Legend

- Pump Stations
- Irish Water
- Private
- Irish Water
- Non IW
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Overflow
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Syphon - Overflow
- Overflow
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Overflow
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Syphon - Overflow
- Overflow
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.900	Add Flow / Climate Change (%)	20
Ratio R	0.257	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)	1.200
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 Soffits

Network Design Table for Storm

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
S-1.000	26.074	0.261	100.0	0.037	4.00	0.0	0.600	o	150	Pipe/Conduit	
S-1.001	12.067	1.109	10.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-1.002	3.539	0.035	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-1.003	25.325	0.253	100.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-2.000	43.181	0.654	66.0	0.052	4.00	0.0	0.600	o	150	Pipe/Conduit	
S-2.001	20.299	0.308	66.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-2.002	29.191	0.108	269.3	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-1.004	1.885	0.011	170.0	0.000	0.00	0.0	0.600	o	300	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)
S-1.000	129.72	4.43	106.550	0.037	0.0	0.0	2.6	1.00	17.8	15.4
S-1.001	129.17	4.50	106.289	0.037	0.0	0.0	2.6	3.07	54.3	15.4
S-1.002	128.69	4.56	105.180	0.037	0.0	0.0	2.6	1.00	17.8	15.4
S-1.003	125.39	4.98	105.105	0.041	0.0	0.0	2.8	1.00	17.8	16.9
S-2.000	128.50	4.58	106.550	0.052	0.0	0.0	3.6	1.24	21.9	21.6
S-2.001	126.33	4.85	105.896	0.052	0.0	0.0	3.6	1.24	21.9	21.6
S-2.002	122.52	5.36	105.438	0.081	0.0	0.0	5.4	0.95	67.4	32.1
S-1.004	133.21	4.03	104.702	0.000	1.0	0.0	0.2	1.20	85.0	1.0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S-8, DS/PN: S-1.004, Volume (m³): 4.0

Unit Reference	MD-SHE-0054-1000-0451-1000
Design Head (m)	0.451
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	54
Invert Level (m)	104.777
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)	0.451	1.0	Kick-Flo®	0.303	0.8
Flush-Flo™	0.134	1.0	Mean Flow over Head Range	-	0.9

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)
0.100	1.0	1.200	1.5	3.000	2.4	7.000	3.5
0.200	1.0	1.400	1.7	3.500	2.5	7.500	3.7
0.300	0.9	1.600	1.8	4.000	2.7	8.000	3.8
0.400	0.9	1.800	1.9	4.500	2.8	8.500	3.9
0.500	1.0	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.1	2.200	2.0	5.500	3.1	9.500	4.1
0.800	1.3	2.400	2.1	6.000	3.3		
1.000	1.4	2.600	2.2	6.500	3.4		

Cellular Storage

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	6.8	6.8	0.450	6.8	6.8

Cellular Storage

Invert Level (m) 105.438 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	90.0	90.0	0.450	90.0	90.0

Infiltration Trench Manhole: S-12, DS/PN: S-3.002

Infiltration Coefficient Base (m/hr)	0.00500	Trench Width (m)	0.5
Infiltration Coefficient Side (m/hr)	0.00500	Trench Length (m)	9.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	0.40	Cap Volume Depth (m)	0.900
Invert Level (m)	105.245	Cap Infiltration Depth (m)	0.900

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

PN	US/MH Name	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S-1.000	S-1	1.1	16.8	OK
S-1.001	S-2	2.5	16.7	OK
S-1.002	S-3	0.4	2.9	SURCHARGED
S-1.003	S-4	0.5	3.5	SURCHARGED
S-2.000	S-5	1.4	21.3	SURCHARGED
S-2.001	S-6	1.3	21.1	SURCHARGED
S-2.002	S-7	0.4	7.5	SURCHARGED
S-1.004	S-8	0.5	1.4	SURCHARGED
S-1.005	S-9	0.5	1.3	OK*
S-3.000	S-10	1.2	14.9	OK
S-3.001	S-11	0.8	14.8	SURCHARGED*
S-3.002	S-12	1.0	14.9	OK
S-3.003	S-13	1.1	14.9	OK
S-1.006	S-14	1.0	16.0	OK

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APPENDIX C. WASTEWATER VOLUMETRIC CALCULATIONS

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APPENDIX D. WASTEWATER DRAINAGE DESIGN CALCULATIONS

Network Design Table for Foul - Unit

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
F-3.001	33.499	0.650	51.5	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F-3.002	19.789	0.099	200.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F-1.006	16.043	0.101	158.8	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F-1.007	16.298	0.700	23.3	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F-1.008	43.623	1.250	34.9	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F-1.009	17.614	0.750	23.5	0.000	0.0	0.0	1.500	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)
F-3.001	105.375	0.000	0.0	40.0	0.0	34	0.83	1.60	63.7	3.2
F-3.002	104.725	0.000	0.0	40.0	0.0	48	0.51	0.81	32.2	3.2
F-1.006	104.626	0.000	0.0	290.0	0.0	74	0.74	0.91	36.2	8.5
F-1.007	104.525	0.000	0.0	290.0	0.0	46	1.48	2.38	94.8	8.5
F-1.008	103.825	0.000	0.0	290.0	0.0	51	1.28	1.95	77.4	8.5
F-1.009	102.575	0.000	0.0	290.0	0.0	46	1.47	2.37	94.4	8.5

Free Flowing Outfall Details for Foul - Unit

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F-1.009	F-	102.800	101.825	0.000	0	0

JOB NAME:	JOB NO:	DATE:
Prospect House, Stocking Lane, Rathfarnham	S627	11/04/2019
TITLE:	**CALCS BY:**	**CHECK'D:**
Water Demand	FS	NMM

Zone	No. of Units (nr)	Occupancy (nr/m^2)	Population	Flow (l/unit/day)	Total Flow (m^3/day)	Average (l/s)	AvDay/PkWeek (Factor)	AvDay/PkWeek (l/s)	Pipe Sizing (Factor)	Pipe Sizing (l/s)
Residential										
Apartments	26	2.7	70.2	150	10.5	0.122	1.25	0.152	5.0	0.76

Flow rates from Appendix D of IW Code of Practice for Wastewater Infrastructure, December 2017 (IW-CDS-5030-03)

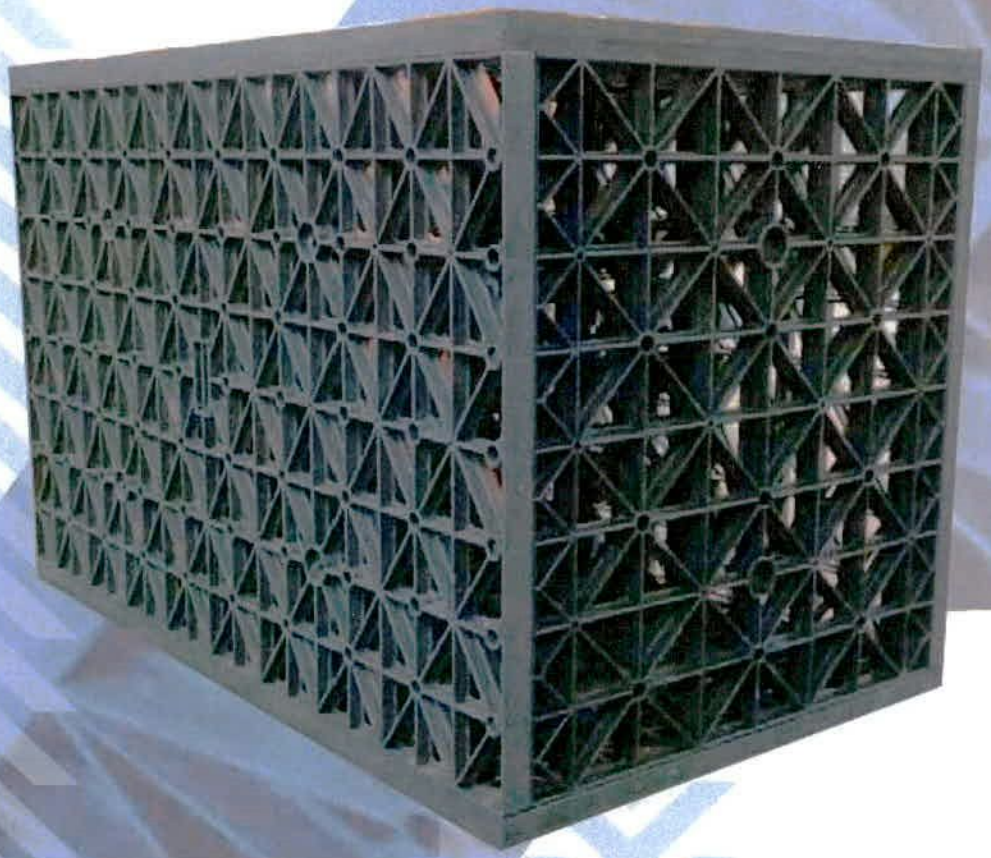
Peaking Factors from IW Code of Practice for Water Infrastructure, December 2017 (IW-CDS-5020-03)

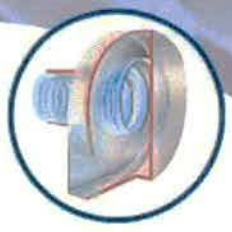
Modular Geo-Void Systems

Total Water Management

ESS EcoCell

Ecological Tank Systems



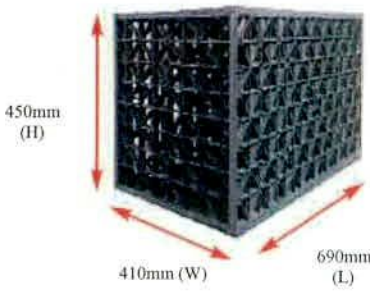


ENVIRONMENTAL SUSTAINABLE SOLUTIONS LTD

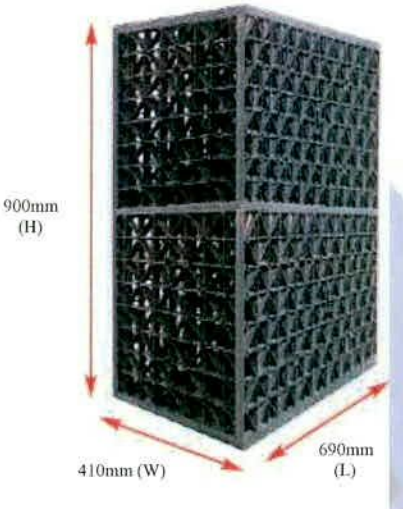
Protecting the Environment

Stormwater Storage Tank

SUITABLE FOR USE UNDER:
- Roadways
- Car parks
- Green areas



Single
8 Modules/m3
Flowrate - 2300 l/min



Double
4 Modules/m3
Flowrate - 4600 l/min

Triple
2.6 Modules/m3
Flowrate - 6900 l/min

Notes:
Blocks must be positioned in the correct orientation.
See opposite above

SPECIFICATION (SINGLE)

Weight (maximum)	9.17kg
Crush Strength (up to)	400kN/m2
Lateral Strength	80kN/m2
Minimum Cover (green areas)	500mm
(trafficked areas)	650mm
Maximum Cover	3m
Material	Polypropylene
Void Ratio (Internal)	>95%

Design Requirements:

Tank storage capacity (m3)
Depth restrictions
Location (Road, Car Park, Green Area)
Design constraints on site

A set of loading calculations specific to the site requirement will be done by ESS and submitted on all tanks

DESIGN CRITERIA

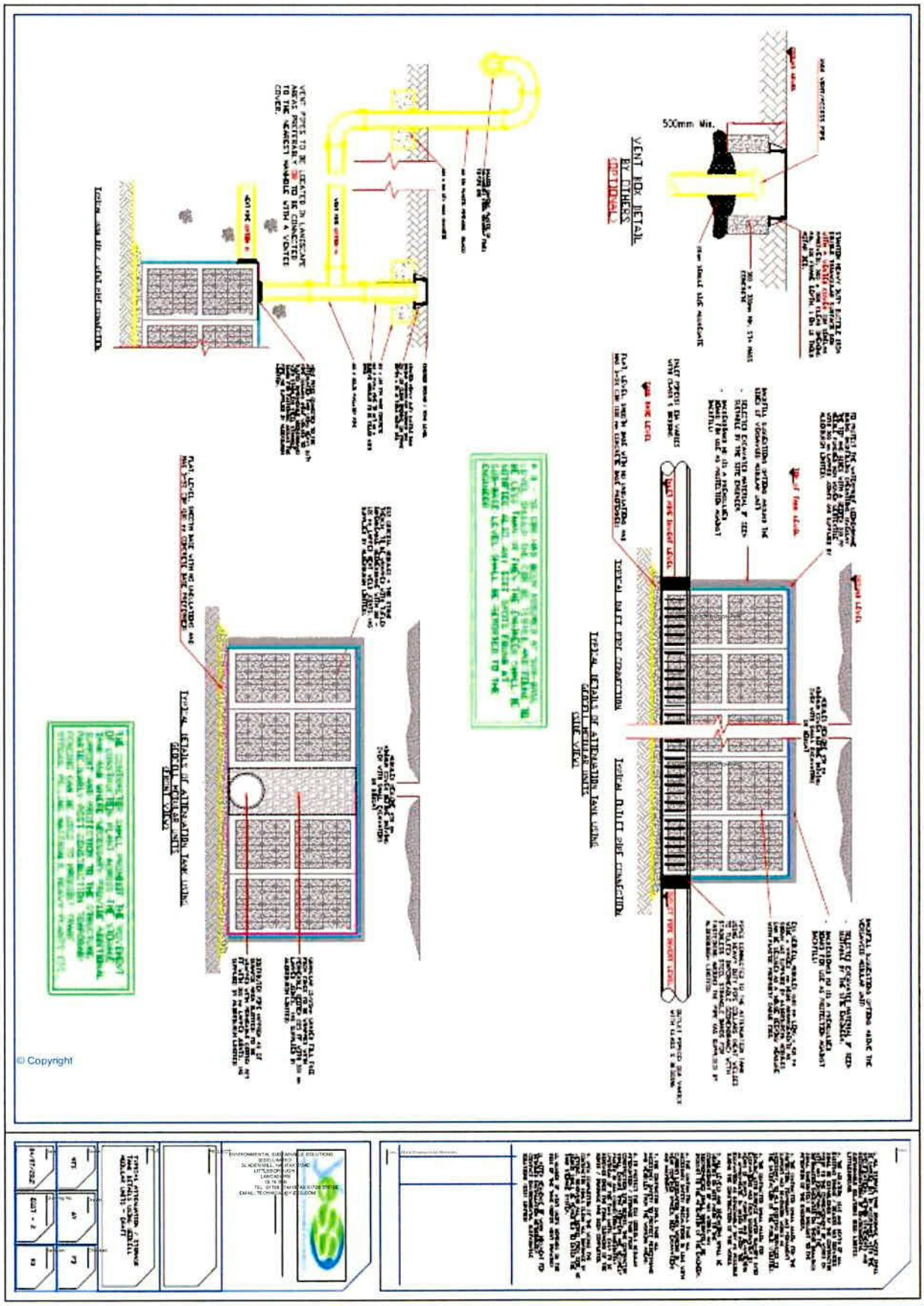
The attenuation tank is constructed using matrix module blocks. These blocks can take passing loads of up to 40 tonnes/m2. The void ratio of each block is 95%. The blocks are made from polypropylene.

The tank is sealed with a layer of Tuflex membrane, which is fully welded together to form a 100% seal. All pipe penetrations are fully sealed to the membrane. The Tuflex membrane is protected by a layer of heavy duty protection geotextile, to prevent damage from construction or backfilling. A number of air extraction vents/flushing points are placed in the roof of the tank.

Note:
It is vital that the underground tanks are fully sealed, otherwise ground water and silt particles may enter the void space and use up capacity. Preferably, the base of the tank should be 500mm above the ground water level. Otherwise ground water relief measures should be implemented.

Retention System

Typical on site collection and recycling arrangement using ESS Ecological Tank System



The ESS CombiSwale

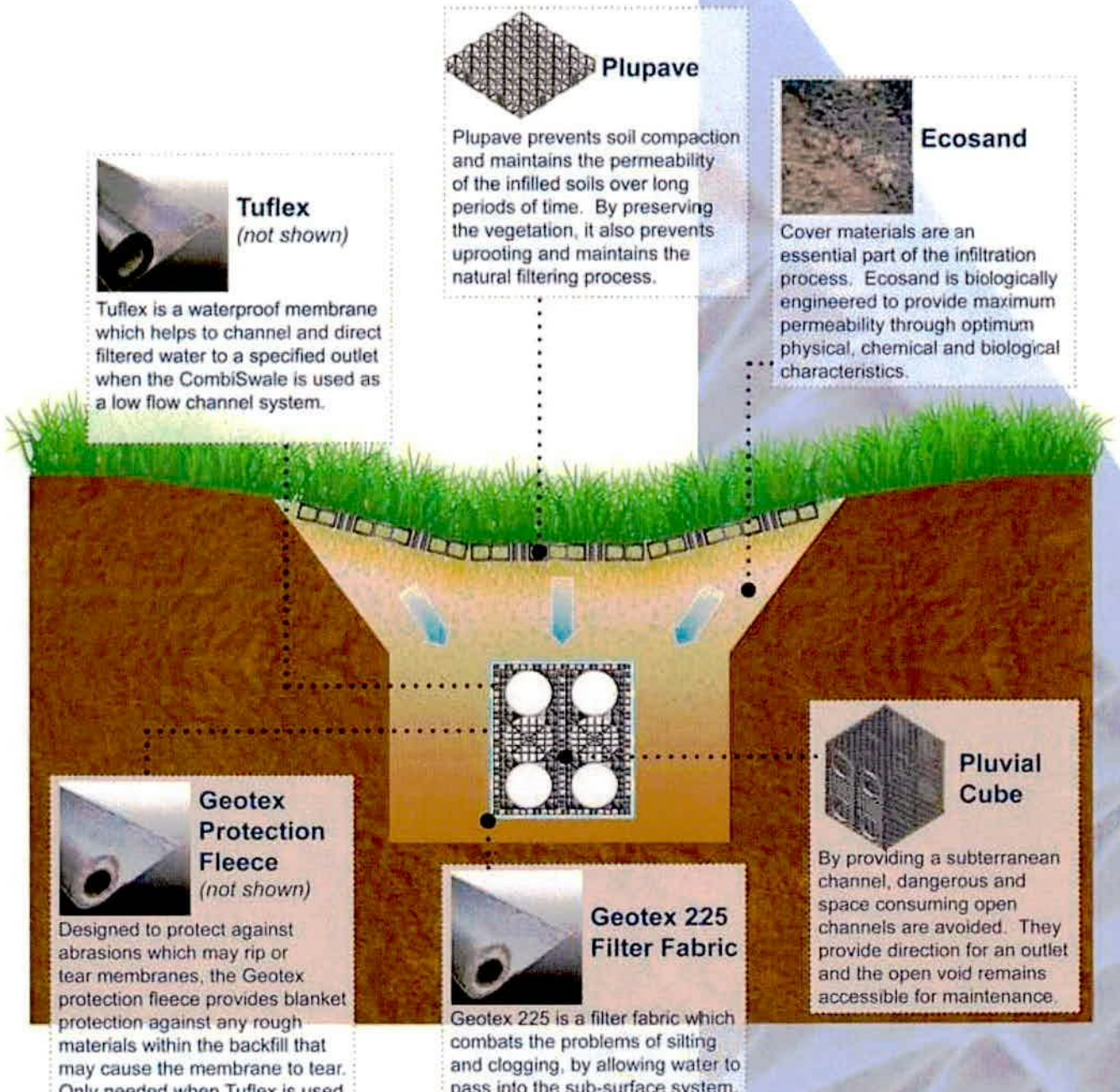
Please refer to separate data sheets for the following products

Water Sensitive Urban Channels

Surface and Sub-Surface Water Treatment

By combining surface and sub-surface channeling and treatment solutions, ESS has created the ideal in bioswale water management.

The CombiSwale system includes the addition of permeable sub-surface waterways that further restore water quality and recharge the natural environment. The sub-surface ESS channel system provides a unique way of working with nature to solve the enormous problems currently associated with open concrete channels and swales.



Plupave

Plupave prevents soil compaction and maintains the permeability of the infilled soils over long periods of time. By preserving the vegetation, it also prevents uprooting and maintains the natural filtering process.

Ecosand

Cover materials are an essential part of the infiltration process. Ecosand is biologically engineered to provide maximum permeability through optimum physical, chemical and biological characteristics.

Tuflex *(not shown)*

Tuflex is a waterproof membrane which helps to channel and direct filtered water to a specified outlet when the CombiSwale is used as a low flow channel system.

Pluvial Cube

By providing a subterranean channel, dangerous and space consuming open channels are avoided. They provide direction for an outlet and the open void remains accessible for maintenance.

Geotex Protection Fleece *(not shown)*

Designed to protect against abrasions which may rip or tear membranes, the Geotex protection fleece provides blanket protection against any rough materials within the backfill that may cause the membrane to tear. Only needed when Tuflex is used.

Geotex 225 Filter Fabric

Geotex 225 is a filter fabric which combats the problems of silting and clogging, by allowing water to pass into the sub-surface system, but preventing the movement of subsoils.