Waterman Moylan
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Engineering Assessment Report

Residential Development at Broomfield SHD Lands, Malahide

April 2022

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Comments

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Contents

Figures

Tables

Appendices

1. Introduction

1.1 Background of Report

This engineering assessment report has been prepared by Waterman Moylan as part of the planning documentation for a proposed residential development on lands at Broomfield, part of the Broomfield SHD lands, Malahide, Co. Dublin.

This report assesses wastewater and surface water drainage, water supply infrastructure and the road and transportation network in the vicinity of the site, and details the criteria used to design the proposed wastewater and surface water drainage, water supply and road networks.

1.2 Site Location and Description

The existing site access is from Back Road, 0.5km east of the junction of Back Road and Kinsealy Lane.

The overall proposed development is divided into 2 sites as indicated in *Figure 1* overleaf. The north site is located between the existing Ashwood Hall residential development to the west and the Dublin-Belfast rail line to the east. To the south is agricultural land, the north is bounded by existing residential properties fronting the Back Road.

The southern site is bound by the Hazelbrook development to the west, Brookfield development to the north and agricultural lands to the east. The southern boundary is formed by the Hazelbrook Stream.

The southern site is greenfield in nature. The northern site is predominantly greenfield and was the former location of a rugby club. There is a small area of hardstanding which was previously the club's car park, together with existing structures, formerly the clubhouse and outhouse. These have been extensively vandalised in the form of fire damage, and demolition of the remainder of the structures is included as part of the subject application. The subsoil in the area to the south of the former playing field is an infill area consisting of inert rubble which has been surveyed, sampled, and analysed. This rubble will be excavated and disposed of as appropriate. For further details please refer to the Preliminary Construction, Demolition & Waste Management Plan Report, submitted under a separate cover.

A topographic survey of the area indicated that the north site generally slopes uniformly from north-east to south, from a height of 20.5m to 11.5m, with an existing static ditch system along the south-east boundary, and ditch to the south-west. The southern site also slopes from north to south from a height of 6m to 4.7m with localised high points and has an existing ditch system along its north boundary and Hazelbrook Steam along the southern boundary.

The ditch systems referenced above join the Hazelbrook stream, which in turn outfalls to the Sluice River which in turn ultimately outfalls to the sea at Baldoyle Bay, C. 2.3km south-east of the subject site.

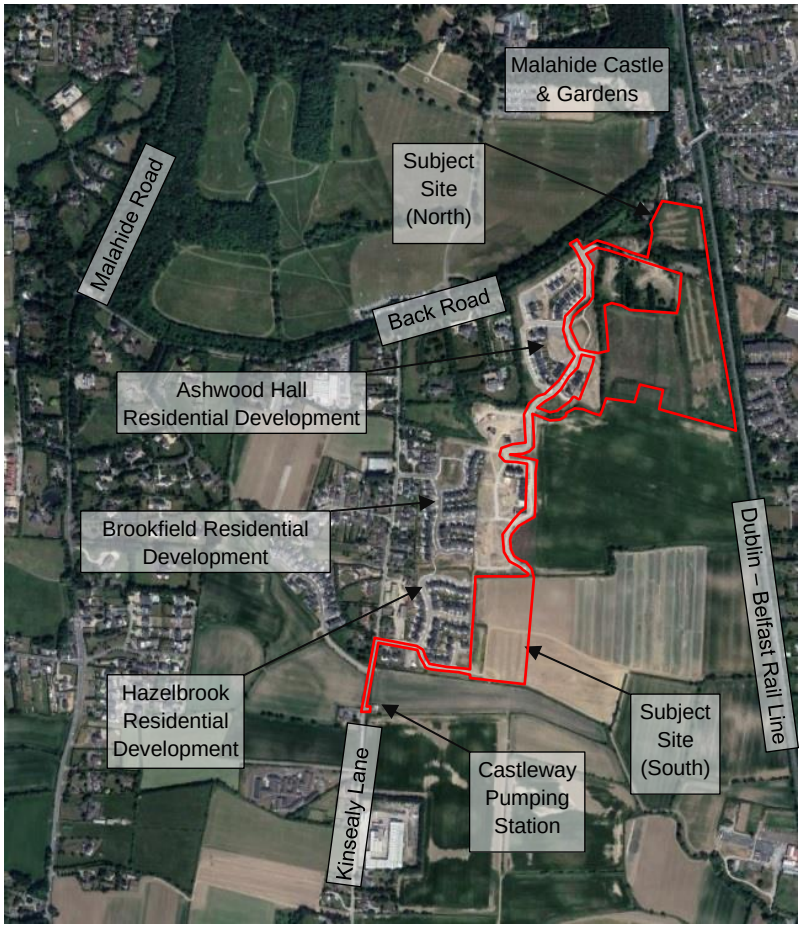


Figure 1 | *Site Location (Source: Google Earth)*

1.3 Proposed Development

The proposed development consists of a total of 415 No. residential units, comprising of 252 houses, 28 duplex units and 135 apartments as set out in the Schedule of Accommodation in *Table 1* below. The proposed development will also include the construction of a 476m² creche, projected to cater for 15 staff and 85 children.

Description	1-bed	2-bed	3-bed	4-bed	5-Bed	Total
House	-	-	192	48	12	252
Duplex	8	14	6	-	-	28
Apartment	37	93	5	-	-	135
Total	45	107	203	48	12	415

Table 1 | *Schedule of Accommodation*

The development includes all associated site works, undergrounding of overhead lines, boundary treatments, drainage, and service connections.

2. Foul Water Network

2.1 Existing Foul Water Network

The site is currently greenfield in nature. The adjacent residential developments, Hazelbrook & Ashwood Hall both have foul water spurs constructed for future connections to the proposed development. These existing developments drain by gravity in a south-westerly direction to the Kinsealy Lane sewer system, which in turn currently drains to Connolly Avenue pumping station. Connolly Avenue pumping station pumps north-eastwards to the gravity network in Malahide which ultimately drains to Malahide Wastewater Treatment Plant (WwTP).

It is noted that Connolly Avenue pumping station, the gravity foul water network in Malahide and Malahide WwTP all currently have capacity issues during heavy rainfall events.

2.2 Future Foul Water Network Upgrades

Irish Water have recently commissioned a new pumping station on Chapel Road discharging via a new rising main to the existing North Fringe Interceptor Sewer, at Marrsfield Avenue, Clongriffin. The Floraville pumping station, at the southern end of Kinsealy Lane has been decommissioned and will instead drain by gravity to the new Chapel Road pumping station. This has alleviated some of the constraints in the Connolly Avenue pumping station catchment.

During the pre-planning process in respect of this subject application, Irish Water further discussed the possibility of a new 'Castleway' pumping station on Kinsealy Lane, which would pump wastewater from the subject site and the surrounding area southwards to the newly commissioned gravity sewer at Chapel Road Pumping Station. This network has capacity available to serve the subject development and diverted flows from Connolly Avenue pumping station.

This long-term solution will relieve capacity constraints at Connolly Avenue Pumping Station, the Malahide foul water gravity network and within the Malahide WWTP catchment area, and this has been designed and sized to accommodate this subject development.

This Castleway pumping station has received a full Grant of Permission from Fingal County Council on 21st January 2022 under Planning Register Reference No. F21A/0451.

A letter from the Applicant of the Castleway pumping station (Carley Properties Ltd.) has been obtained, and states that Carley Properties Ltd. intend to develop this pumping station. The letter also confers the legal entitlement to Birchwell Developments Ltd. to develop the pumping station if so required, to ensure this development is not reliant on a third party to construct the pumping station.

Construction of the pumping station will be completed prior to the connection of units from this subject application.

A Confirmation of Feasibility Letter was issued by Irish Water on 13 January 2021, and is included as Appendix A. The confirmation of feasibility letter states that connection to the Irish Water network is feasible subject to delivery of the new Castleway pumping station and commissioning of the Chapel Road pumping station. Once again, Chapel Road pumping Station has since been commissioned.

2.3 Proposed Foul Water Network

It is proposed to drain wastewater from the proposed development in a south-westerly direction by gravity through a series of 150mm, 225mm, & 300mm diameter sewer networks to the existing sewer network in the Ashwood and Hazelbrook developments. It is further proposed to upgrade part of the existing foul drainage network in the Hazelbrook development from a 225mm to a 300mm diameter pipe network. This will continue to drain by gravity to the existing public sewer in Kinsealy Lane, which in turn currently discharges to Connolly Avenue Pumping Station. As part of the construction of the Castleway pumping station, this foul water sewer is proposed to be diverted from Connolly Avenue pumping station to the Castleway pumping station.

The existing foul networks in the adjacent residential developments, have been appropriately designed and constructed, including spurs for connection points, to accommodate the future connection of the proposed development. Letters of consent from the adjacent development owners have been obtained permitting connections to these privately owned networks. Please refer to the accompanying submission from Downey Planning for copies of the Letters of Consent.

The proposed internal foul drainage network has been designed and sized in accordance with the Irish Water code of Practice for Wastewater Infrastructure and Standard Details. Please refer to Drawing numbers: 18-091-P201 to P206, which show the proposed foul drainage layout, and existing foul water networks in adjacent estates, and subsequent route to the Castleway pumping station.

A Statement of Design Acceptance has also been issued by Irish Water and is provided in Appendix B.

2.4 Foul Water Drainage Calculations

The calculated foul water flows at the subject development are set out in *Table 2*, below. Domestic wastewater loads have been calculated based on 2.7 persons per unit with a per capita wastewater flow of 150 litres per head per day along with a 10% unit consumption allowance, in line with Section 3.6 of the Irish Water Code of Practice for Wastewater Infrastructure. A peak flow multiplier of 3 has been used, as per Section 2.2.5 of Appendix B of the Code of Practice.

It is calculated that the creche will generate flow for 100 persons (15 staff and 85 children), with a wastewater volume of 90 litres per head per day, based on the figure for the most similar type of usage: a non-residential school with canteen facilities, also as per Appendix C of the Code of Practice.

Description	Total Population	Load per Capita	Daily Load	Total DWF	Peak Flow
	No. People	*l/day*	*l/day*	*l/s*	*l/s*
252 Houses	680.4	150	112,266	1.299	3.897
28 Duplexes	75.6	150	12,474	0.144	0.432
135 Apartments	364.5	150	60,142.5	0.696	2.088
Creche	100	90	9,900	0.115	0.345
Total	**1,220.5**	**Varies**	**194,782.5**	**2.254**	**6.762**

Table 2 | *Calculation of Total Foul Water Flow from the Development*

The total dry weather flow from the development has been calculated as: 2.254 l/s, with a peak flow of 6.762 l/s.

2.5 Foul Water Drainage – General

Foul water sewers will be constructed strictly in accordance with Irish Water requirements. No private drainage will be located within public areas.

Drains will be laid to comply with the requirements of the latest Building Regulations, and in accordance with the recommendations contained in the Technical Guidance Document H.

3. Surface Water Network

3.1 Existing Surface Water Network

Surface water from the site discharges into a series of boundary ditches on the perimeter of the sites. The southern catchment of the south site drains directly to the Hazelbrook Stream. Part of the northern site's drainage ditch network on the southern boundary is a static/dry ditch. The remainder of the ditches drain to the Hazelbrook Stream, which is a tributary of the Sluice River that ultimately outfalls to the sea at Baldoyle Bay. Baldoyle Bay has been designated as an SPA (Special Protection Area) by the NPWS (National Park and Wildlife Service) and Local authority, under the RAMSAR Convention. It was declared a Statutory Nature Reserve in 1988 and supports several habitats as listed in the EU Habitats Directive.

3.2 SuDS

Sustainable Drainage System (SuDS) are a collection of water management practices that aim to align modern drainage systems with natural water processes.

By using SuDS techniques, water is either infiltrated or conveyed more slowly to the drainage system and ultimately more slowly to water courses via permeable paving, swales, green roofs, rainwater harvesting, detention basins, ponds, and wetlands.

Fingal County Council's document titled Green/Blue Infrastructure for Development advises that: "*These facilities are designed to prevent pollution of streams and rivers and to slow down runoff from sites, therefore helping to prevent downstream flooding and improve water quality. This closely mimics natural catchment behaviour where rainfall either infiltrates through the soil or runs off slowly over the ground surface to the nearest watercourse. This is known as the "treatment train" approach. SuDS devices should be placed at source, site, and regional levels. SuDS can also provide amenity benefits to local communities and benefits for biodiversity simultaneously".*

In the following sections of the surface water chapter, it will be outlined in detail how SuDS devices have been utilised and incorporated to the overall plan for the proposed development, and how their inclusion will mitigate the risk of localised and downstream flooding, while also promoting residential amenity and biodiversity.

The Fingal County Council SuDS selection checklist is included as Appendix C.

3.3 Proposed Surface Water Network and SuDS Strategy

It is proposed to construct a SW drainage network that will service and attenuate the development internally before discharging at the current greenfield (or allowable) rates to the local natural ditch systems. Surface drainage layout and attenuation strategy can be reviewed on drawing numbers 18-091-P201, P202, P203 & P205.

The location and extent of SuDS devices proposed for the development can be viewed on drawing 18-091-P235 and described below in Sections 3.3.1 to 3.3.4.

For storm water management purposes, it is proposed to divide the site into eight separate sub-catchments, as shown in *Figures 2 & 3* overleaf.

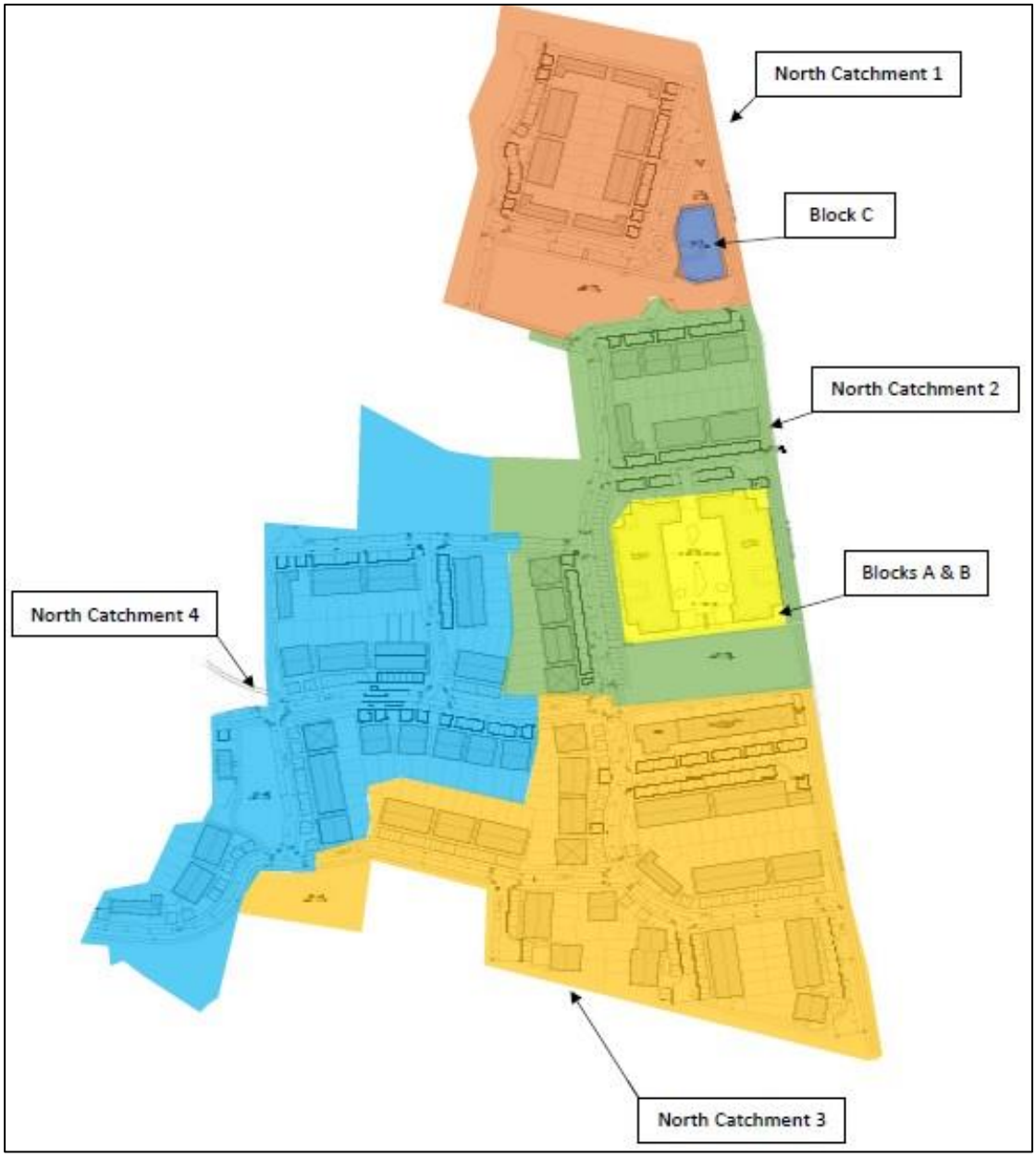


Figure 2 | *Sketch of North Site Catchments*

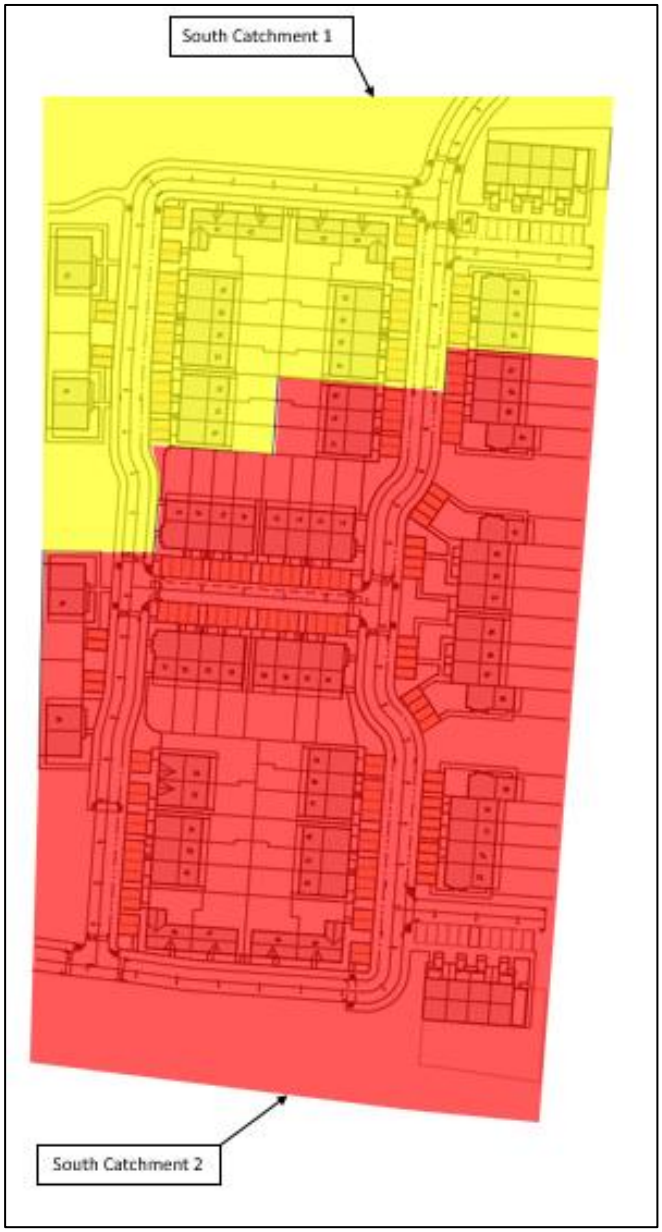


Figure 3 | *Sketch of South Site Catchments*

Storm water from each catchment will be attenuated and discharge at a controlled rate, limited to the greenfield equivalent runoff or 2 l/s/ha (whichever is greater), to ultimately outfall to the existing ditch system on the site, south catchment 2 however, will outfall directly to the Hazelbrook Stream. The proposed development will be designed to incorporate best drainage practice. Section 3.4, below, sets out the methodology used in determining the existing greenfield runoff rates and calculating attenuation storage requirements for the site.

It is proposed to incorporate a Storm Water Management Plan through the use of various SuDS techniques to treat and minimise surface water runoff from the site. The methodology involved in developing a Storm Water Management Plan for the subject site is based on recommendations set out in the Greater Dublin

Strategic Drainage Study (GDSDS) and in the SuDS Manual. Based on three key elements – Water Quantity, Water Quality and Amenity – the targets of the SuDS train concept have been implemented in the design, providing SuDS devices for each of the following:

- Source Control
- Site Control
- Regional Control

3.3.1 Source Control

Permeable Paving:

It is proposed to introduce permeable paving at all private driveways and parking courts throughout the development. Downpipes from the front of the houses and apartments will drain to filter drains beneath the permeable paving to facilitate maximum infiltration of surface water from driveways and roof areas.

The goal of permeable paving is to control stormwater at the source to reduce runoff. In addition to reducing surface runoff, permeable paving has the dual benefit of improving water quality by trapping suspended solids and filtering pollutants in the substrata layers.

Filter Drains:

It is proposed to install 225mm diameter filter drains, consisting of perforated pipes surrounded in filter stone around the perimeter of each apartment block. The filter drains will provide infiltration, optimise the retention time, and provide quality improvement to the storm water runoff, in particular the first flush from hardstanding areas. The proposed perforated pipes connect to the proposed surface water sewer network.

Green / Sedum Roof:

Section 3.6.7 of the Fingal County Council document Green/Blue Infrastructure for Development instructs that a green roof must be provided for a minimum of 60% of the total roof area, where it exceeds 300m², which in this case is applicable. It is proposed to introduce sedum roofing as a source control device on Apartment Blocks A, B, & C. The sedum roofing is proposed to cover a minimum of 60% of the total apartment roof area, totalling a cumulative green roof area of 1,949m^2. The sedum roofing typically consists of 75mm substrate with a sedum blanket.

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

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

A paper entitled *Green Roofs Over Dublin: A Green Roof Policy Guidance Paper for Dublin* was published in August 2008 with guidelines for Dublin City Council to develop planning directives for the incorporation of green roofs in new development. The table overleaf is taken from this document and shows the percentage of total rainfall retention over a 14-month period for different green roof treatments.

Slope	Media Depth	Light Rain *<2mm*	Medium Rain *2mm-6mm*	Heavy Rain *>6mm*	Overall
2.0%	25mm	95.1%	82.9%	64.7%	69.8%
2.0%	40mm	97.1%	85.5%	65.1%	70.1%
6.5%	40mm	94.9%	83.1%	59.5%	65.9%
6.5%	60mm	95.8%	84.6%	62.0%	68.1%

Table 3 *| Percentage of Total Rainfall Retention Over a 14-Month Period (Aug 2002-Oct 2003)*

The proposed sedum roofing shall be on flat roofs with 2% slope with a media depth of 75mm, exceeding the depths shown above. Thus, the percentage of total rainfall retention can be expected to exceed the tabulated figures.

3.3.2 Site Control

Roadside Bio-retention Tree Pits:

It is proposed to provide roadside trees throughout the development. Trees can help control storm water runoff because their leaves, stems, and roots slow rain from reaching the ground and capture and store rainfall to be released later. Trees help to attenuate flows, trap silts and pollutants, promote infiltration and prevent erosion. Incorporating tree planting offers multiple benefits, including attractive planting features, improved air quality and increased biodiversity whilst helping to ensure adaptation to climate change.

Swales:

Swales are grassed channels proposed to run parallel and adjacent to selected roads throughout the site. Rainfall from the road surface will be directed to gaps in the road kerbing and will flow to the swales. The swales will be linked back to the drainage network to prevent flooding in extreme weather events, where the volume of rainfall exceeds the percolation capacity of the swales.

Grassed swales enhance surface water runoff quality as they slow down water flow, allowing suspended particles to filter and settle out of suspension.

The inclusion of swales is as requested by Fingal County Council during an online meeting in order to provide additional surface SuDS, to mitigate against the requirement for underground attenuation tanks to be utilised by the development.

3.3.3 Regional Control

Detention Basin / Underground Attenuation System:

Detention basins were investigated to store and attenuate the surface water volumes calculated to be generated by the development. While generally a preferred option, in this specific situation due to existing site topography and surrounding ditch network, they would require engineering deep depressions into open spaces rendering them generally unusable for the provision of other general amenities, as they would full with surface water during heavy rainfall events and would remain unusable for a number of days after, and further goes against Fingal County Council's objective of keeping all SUDS's areas under 10% of the site green area. As such, detention basins are not proposed and instead attenuation tanks will be utilised as the more suitable attenuation strategy.

An online meeting was held between Waterman Moylan and Fingal County Council Drainage Department and Parks Department on 6 May 2021 (after the Tri-partite meeting). At this meeting, Fingal County Council advised that given the constraints; that while above ground attenuation is their preference, that in this instance attenuation tanks (see Section 3.3.4 below), would be accepted, however, further provision of surface SuDS, with a preference for above ground treatment in the form of swales should be incorporated to aid biodiversity. This request has been implemented with a dedicated drawing created which now identifies the location of all SuDS devices shown, as per drawing number: 18-091-P235.

Flow Control:

A flow control device (Hydrobrake or similar approved) is proposed at each sub-catchment attenuation feature, which will limit exiting flows to the greenfield equivalent runoff rate.

Attenuation tanks:

Attenuation tanks/systems are proposed to be utilised for all catchments within the development as discussed above. Each attenuation tank/system has been sized to accommodate attenuation from catchments for rainfall events greater than the 1-in-100-year event.

Please refer to Appendix D for attenuation calculations for each catchment.

The proposed attenuation tanks/systems to serve the apartment blocks (refer to catchments 2 & 4, in *Table 6*), will be located in areas to remain under private management, and will be privately maintained as such.

Petrol interceptor:

Class 1 petrol interceptors will be provided before the surface water outfalls to the local water courses.

3.4 Interception or Treatment Storage and Attenuation Storage

As noted above, the methodology involved in developing the Storm Water Management Plan for the subject site is based on recommendations set out in the Greater Dublin Strategic Drainage Study (GDSDS) and in the SuDS Manual. Appendix E of the Greater Dublin Strategic Drainage Study (GDSDS) sets out criteria for determining the provision of interception or treatment storage, attenuation storage and long-term storage at a development site. These calculations are summarised below:

3.4.1 Criterion 1: River Water Quality Protection

Criterion 1.1: Interception

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

Paved surfaces connected to drainage system	*110,448m² x 0.56 x 0.75 =* 46,388.16m²	*110,448m² site area* *56% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*46,388m² x 5mm x 0.8 =* **185.55m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

Table 4 | *Interception Calculation*

The required interception volume is 186m³. It is not proposed to provide the entire required interception volume. Criterion 1.2 will therefore be assessed to provide the required River Water Quality Protection in accordance with Criterion 1.

Criterion 1.2: Treatment Volume

For events larger than 5mm, and in situations where interception storage cannot be provided, surface water runoff treatment is provided utilising SuDS in accordance with the CIRIA design manual C521.

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

Paved surfaces draining to river	*110,448m² x 0.56 x 0.75 =* 46,388.16m²	*110,448m² site area* *51% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*46,388m² x 15mm x 0.8 =* **556.66m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

Table 5 | *Treatment Volume Calculation*

The required treatment volume for the site is met through the introduction of various SuDS features (which have been described in Section 3.2, above).

Permeable paving is proposed in private driveways and accounts for a total cumulative area of C. 9,034m². Assuming a subbase depth of 0.4m with 33% voids, this yields a treatment volume of 1,192m³.

As noted above, the green sedum roofing amounts to a cumulative area of approximately 1,949m² and shall consist of 75mm substrate with a sedum blanket. Assuming a 30% water volume retention, this amounts to approximately 44m³ of treatment storage volume. Filter drains, swales, raingardens, and roadside trees around the site provide further treatment volume.

These SuDS features provide ample treatment volume to meet the Criteria 1 requirements.

3.4.2 Criterion 2: River Regime Protection

Attenuation storage is provided to limit the discharge rate from the site into receiving waters. As per the GDSDS, the required attenuation volume is calculated assuming 80% runoff from paved areas (20% assumed as permeable paved parking bays, excludes calculations for apartment blocks which have been calculated as 100%), and has been calculated for the 1-year, 30-year and 100-year return periods, identifying the critical storm for each – refer to calculations included in Appendix D.

The calculations included in Appendix D have been based on the usage of soil type 4, as specified by Item 3 of the Surface Water section of the Fingal County Council Water Services Department Report, included as an appendix to the Fingal Planning Authority, Written Opinion Report. Utilising Soil Type 4 for attenuation calculations is also in-line with the data received from the Site Investigation Reports, which note the soil as generally having low permeability. This is reflected in the Site Investigation reports which notes an impermeable brown boulder clay throughout the site. See the Site Investigation reports accompanying report 18-081r.003.

As noted above, the site has been divided into eight sub-catchments which will be attenuated separately. Based on the calculations, included as Appendix D, the required attenuation storage volume for each sub-catchment is set out in *Table 6* below.

Catchment		Area	Allowable Discharge Rate	Required Attenuation Volume
		m^2	*l/s*	*m^3*
Catchment 1:	North 1	13,481	9.00	171.4
Catchment 2:	Block C	646	2	14.8
Catchment 3:	North 2	15,684	10.47	439.6
Catchment 4:	Blocks A & B	4,126	2.75	182.3
Catchment 5:	North 3	27,907	18.62	482.2
Catchment 6:	North 4	19,827	13.23	319.7
Catchment 7:	South 1	9,584	6.40	143.6
Catchment 8:	South 2	19,193	12.81	280.4
Total		**110,448**	**75.28**	**2,034**

Table 6 | *Attenuation Volume for Each Sub-Catchment*

The catchments will be attenuated in individual underground attenuation tanks, with some of the tanks located on the northern site running in a chain-like system. The proposed attenuation tanks will normally remain dry except in extreme weather events and will have a combined storm water storage capacity of 2,034m^3 minimum. This provides sufficient storage to accommodate the 1-in-100-year storm volume, accounting for a 20% increase due to climate change. Water will discharge from the tanks to the adjacent existing natural surface water networks via a Hydrobrake or similar approved flow control device at a controlled discharge rate limited to greenfield rates, as shown in the allowable discharge rate column of *Table 6*, above.

Catchments 2 & 4, which are comprised of apartment blocks are intended to have their tanks located in areas which will remain under private management, and as such, the tanks will be privately maintained.

3.4.3 Criterion 3: Levels of Service

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

Criterion 3.1: No external flooding except where specifically planned (30-year high intensity rainfall event).

Criterion 3.2: No internal flooding (100-year high intensity rainfall event).

Criterion 3.3: No internal flooding (100-year river event and critical duration for site storage).

Criterion 3.4: No flood routing off site except where specifically planned (100-year high intensity rainfall event).

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

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

As a result of the flood risk management and mitigation measures proposed, the residual risk of internal or external flooding for the 30-year and 100-year flood events is low, and accordingly all four of the above criteria have been met. Please refer to the accompanying Flood Risk Assessment report for the full analysis of the flood risk at the subject site.

3.4.4 Criterion 4: River Flood Protection

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

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

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

The extra runoff volume of the development runoff over greenfield runoff, Vol_{xs}, is calculated in Appendix D for each of the sub-catchments. Note that as stated in the GDSDS, this volume is not additional to the attenuation storage volume but is effectively an element of it.

3.5 Surface Water – General

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

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

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

3.6 Flood Risk Assessment

A site-specific Flood Risk Assessment has been carried out for the proposed development and accompanies this submission under separate cover.

4. Water Supply

4.1 Existing Water Supply

Irish Water records for the surrounding area have been provided by Fingal County Council.

There is an existing 12" Ø watermain located along Back Road.

100mm Ø HDPE spurs have been strategically provided in the sites to the west, Ashwood Hall adjacent to the north site & Hazelbrook adjacent to the south site. These spurs have been constructed in anticipation of servicing this application. The constructed watermain networks in both Hazelbrook and Ashwood Hall have yet to be Taken in Charge by Irish Water.

Irish water as part of the confirmation of feasibility, refer to appendix A, have advised of minor upgrade works required to be undertaken by the applicant to facilitate the proposed development.

4.2 Proposed Water Supply

For the north site, it is proposed to connect to the 150mm Ø watermain in the main access road, just off Back Road. It is also proposed to provide another 2 connections from the Ashwood Hall residential development to the west (both 100mm Ø). The proposed network consists of a 150mm Ø watermain running along the Main Access Roads, with a series of 100mm Ø branches and loops.

Similarly, the southern site is proposed to have 2 watermain connections (both 100mm Ø) to the Hazelbrook residential development on its western boundary.

As discussed in section 4.1 above, the spurs in the adjacent sites have been designed and located in anticipation of these connections from the proposed development. Letters of consent have been obtained from the adjacent development owners permitting these proposed connections. The proposed internal watermain layout, and the existing networks in the adjacent estates can be seen on Drawing numbers 18-091-P301-P306.

As noted in Section 2.2 above, a revised pre-connection enquiry was submitted to Irish Water; the response letter from Irish Water dated 12 June 2020 is included in Appendix A. In this letter, Irish Water states that a new connection to the existing network is feasible with some local upgrades. The local infrastructural upgrades required are: Approximately 395m of 6" CL to 200mm MDPE in Back Road, approximately 270m of 4" AC to 200mm MDPE in Back Road, and approximately 170m of 100mm uPVC to 160mm MDPE in Ashwood Hall Lane. These works will be agreed with Irish Water as part of the Connection Agreement, prior to commencement of the development.

A Statement of Design Acceptance from Irish water is provided in Appendix B.

4.3 Water Supply Calculations

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

The consumption demand of the creche facility is based on the outflow figure of 90 litres per head per day as per *Table 2*.

Description	Total Population	Water Demand	Average Demand	Average Peak Demand	Peak Demand
	No. People	*l/day*	*l/s*	*l/s*	*l/s*
252 Houses	680.4	112,266	1.299	1.624	8.120
28 Duplexes	75.6	12,474	0.144	0.180	0.900
135 Apartments	364.5	60,142.5	0.696	0.870	4.350
Creche	100	9,900	0.115	0.144	0.720
Total	**1,220.5**	**194,782.5**	**2.254**	**2.818**	**14.090**

Table 7 | *Calculation of Water Demand for the Development*

The average demand for the development is 2.254 l/s, with a peak demand of 14.090 l/s.

4.4 Water Supply – General

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

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

5. Roads and Transport Network

This section provides an overview of the existing and proposed road and transportation network in the vicinity of the site. A comprehensive Traffic and Transport Assessment and Travel Plan have been prepared by Waterman Moylan in accordance with the requirements of the Traffic and Transport Assessment Guidelines published by National Roads Authority in May 2014 and accompanies this submission under separate covers.

5.1 Existing Road Layout

Back Road is located to the north of the subject site, immediately north of Ashwood, and Kinsealy Lane is located to the west of the subject site, immediately west of Castleway and Hazelbrook.

Back Road is a 2-lane carriageway with pedestrian footpaths on both sides, it has a posted speed limit of 60km/hr and extends from the Malahide Road (R107) 1.8km east to the Malahide-Donaghmede Road (R124).

Kinsealy Lane is located to the west of the subject site and runs from the junction of the Back Road, south to the junction of Chapel Lane. It has a posted speed limit of 60km/hr. It is a 2 lane-carriageway, and has a footpath on at least 1 side of the road for a distance of 1.4km south from its junction with Back Road, to the entrance to the Sleepy Hollow residential development.

5.2 Proposed Road Layout

The site will be accessed to the north off back Road, via Ashwood.

As requested by Fingal County Council during the SHD pre-planning process, an additional vehicular access to the site is now proposed from Kinsealy Lane, via Hazelbrook. Hazelbrook lies to the west of the proposed southern site. The Hazelbrook development is accessed from Kinsealy Lane and was designed and constructed to allow for possible future connections to the subject site. This will benefit the southern site for vehicular, pedestrian and cycle access. It is considered that the route between the site entrance from the Hazelbrook residential development to the site entrance on Back Road, and vice versa, will not create a short-cut / “rat-run” if there is any potential build-up of traffic at the Kinsealy Lane-Back Road junction. This is owning to the fact the layout of the route through the proposed development is meandering, and has frequent interruptions such; as raised tables, pedestrian crossings and low radii corners which will effectively enforce a slower vehicular speed as per DMURS guidelines. Footpath widths are 2m minimum throughout, with carriageway widths generally between 5-5.5m wide. Horizontal and vertical deflections have been introduced to reduce vehicular speeds, and a swept path and sightlines analysis have been undertaken. Full DMURS details are included in the DMURS report submitted under a separate cover.

A redesign of the creche drop-off parking was also undertaken based on details discussed with Fingal County Council. The creche drop off spaces are located on the same side of the road as the creche, the parking pays are parallel, and a buffer strip has been provided between the bays and carriageway. A circulatory route has been provided for cars to exit the development via the same entrance point, so as to ensure that no 3-point turns are required.

The internal road network includes local access roads and “home-zones”, as shown on Waterman Moylan’s Road Surfacing Layout Drawing 18-091-P002. These homezones have been refined following guidance from An Bord Pleanála and Fingal County Council during the pre-planning process and are further described below in Section 5.3.

The road layout is shown the following drawing numbers: P002 Road Surfacing Layout, Road General Arrangement Drawing P100, Road Layout Drawings P101-103, Road Cross Sections Drawing P130 & Road Construction Details P131, included as part of the planning application package.

Appendices

A. Confirmation of Feasibility Letter - CDS19000369

Stephen Dent-Neville
EastPoint Business Park
Block S, Alfie Byrne Road
Dublin 3, Dublin

13 January 2021

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

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

www.water.ie

Dear Stephen Dent-Neville,

Re: Connection Reference No CDS19000369 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 450 units at Broomfield, Malahide, Dublin.

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at Broomfield, Malahide, Dublin.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Water

New connection to the existing network is feasible subject to following upgrades:

1. Approximately 395 m of 6'' CI to 200 mm MDPE in Back Road
2. Approximately 270 m of 4'' AC to 200 mm MDPE in Back Road
3. Approximately 170 m of 100 mm uPVC to 160 mm MDPE in Ashwood Hall Lane

Wastewater

New connection to the network is feasible subject to delivery of the following:

1. Castleway Pumping Station:
   a) Delivery of a new pumping station to serve the existing and future Connolly Avenue pumping station catchment.
   b) Procurement of additional lands to facilitate the provision of a total storage volume of 530m3. This includes 362m3 of existing storage at the site. An additional 168m3 storage volume and associated area is required.
   c) Identification of the required changes to the Malahide discharge licence.
   d) All environmental (assimilative capacity of receiving water), archaeological and statutory assessments.
   e) Increase the capacity of Chapel Road Pumping Station currently under construction (Irish Water Capital Investment Plan project) from 53l/s to 94l/s.
   f) Upgrade of the wastewater gravity network discharging into Castleway Pumping Station.
   g) Upgrade the wastewater network downstream of Castleway Pumping Station to connect to Chapel Road Pumping Station.
   h) Provision of Mechanical Electrical and Instrumentation, Control and Automation (MEICA).

i) Scope of works requirements to incorporate existing MEICA operational requirements (FCC/Irish Water).

Irish Water does not have any plans, in the current Capital Investment Programme (CIP), to undertake these upgrades to facilitate this connection. Should you wish to progress upgrades and associated works, Irish Water may require you to provide a contribution of a relevant portion of the costs for the required upgrades. Engagement with Irish Water will be required to agree the delivery mechanism for the upgrades.

2. Completion of Chapel Road Pumping Station and associated rising main to the North Fringe Sewer (Irish Water CIP - Local Network Reinforcement Project). This Project is currently in progress and scheduled to be completed by Q4 2021 (this may be subject to change).

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

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

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

B. Irish Water Statement of Design Acceptance

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

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

www.water.ie

Richard Wallace
Kinsealy Hall
Chapel Road
Kinsealy, Malahide
Co. Dublin

3 February 2022

Re: Design Submission for Broomfield, Malahide, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS19000369

Dear Richard Wallace,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Dario Alvarez
Email: dalvarez@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

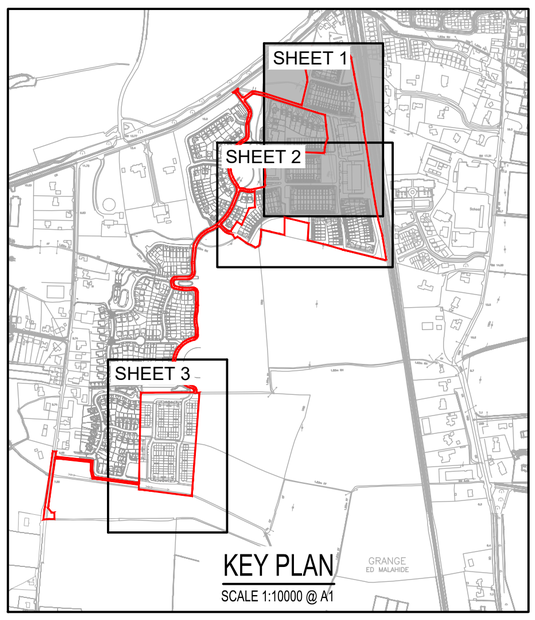
Document Title & Revision

- 18-091-P301A Watermain Layout Sheet 1 of 3
- 18-091-P302A Watermain Layout Sheet 2 of 3
- 18-091-P303A Watermain Layout Sheet 3 of 3
- 18-091-P201A Drainage Layout Sheet 1 of 4
- 18-091-P202A Drainage Layout Sheet 2 of 4
- 18-091-P203A Drainage Layout Sheet 3 of 4
- 18-091-P204A Drainage Layout Sheet 4 of 4
- 18-091-P240 Foul Drainage Longitudinal Sections Sheet 1 of 3
- 18-091-P241 Foul Drainage Longitudinal Sections Sheet 2 of 3
- 18-091-P242 Foul Drainage Longitudinal Sections Sheet 3 of 3

Standard Details/Code of Practice Exemption: N/A

*For further information, visit **www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.



LEGEND:

XXXmm ø	PROPOSED 100ø HDPE WATERMAIN WITH PIPE SIZE
XXXmm ø	PROPOSED 150ø HDPE WATERMAIN WITH PIPE SIZE
XXXmm ø WM	EXISTING WATERMAIN WITH PIPE SIZE
SV	PROPOSED SLUICE VALVE
H	PROPOSED HYDRANT
ScV	PROPOSED SCOUR VALVE
AV	PROPOSED AIR VALVE
NRV	PROPOSED NON-RETURN VALVE
M	PROPOSED BULK WATER METER
SWMH	SURFACE WATER MANHOLE
WATERMAIN ScV NRV SWMH	TYPICAL SCHEMATIC CONNECTION OF OFFLINE SCOUR VALVE
BB	PROPOSED BOUNDARY BOX AND CONNECTION
LP	ROAD LOW POINT
HP	ROAD HIGH POINT

NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.
3. ALL PIPE MATERIALS SHALL BE IN ACCORDANCE WITH SECTION 3.9 OF THE IRISH WATER CODE OF PRACTICE FOR WATER INFRASTRUCTURE. WATERMAINS SHALL BE EITHER DUCTILE IRON (DI) OR POLYETHYLENE (PE), WITH PE80 OR PE100 RATING (MDPE, HDPEOR HPPE). ALL PLASTIC WATER PIPES SHALL BE BLUE IN COLOUR.
4. ALL SERVICE CONNECTIONS TO BE 25ø HDPE(SDR-17).
5. ALL WATERMAINS UNDER ROADS OR AT ROAD CROSSINGS TO BE HDPE OR DUCTILE IRON.
6. HDPE DISTRIBUTION PIPES TO BE PE-100(SDR-17).
7. DUCTILE IRON PIPES TO IS EN 545 WITH C40 POWER RATING.
8. AIR VALVE AND HYDRANTS COVERS, WHERE LOCATED IN GRASS AREAS, SHALL BE SURROUNDED BY A CONCRETE PLINTH, 200mm ALL ROUND AND 100mm DEEP FORMED WITH C20/25 CONCRETE, 20mm AGGREGATE SIZE, BEDDED IN CLAUSE 804 MATERIAL. THE PLINTH SHALL INCORPORATE MILD STEEL REINFORCED LINKS AND SHALL HAVE BULL-NOSE FINISH AROUND ITS EXTERNAL PERIMETER.
9. THRUST BLOCKS SHALL BE PROVIDED AT EACH BEND ALONG THE COURSE OF THE WATERMAIN.
10. PLANTING ADJACENT TO WATER INFRASTRUCTURE SHALL COMPLY WITH IRISH WATER STANDARD DETAIL STD-W-12A.
11. HORIZONTAL AND VERTICAL SERVICE LAYOUT DISTANCES SHALL BE AS PER IRISH WATER STANDARD DETAIL STD-W-11.
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REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD, DUBLIN D03 H3F4 IRELAND.
Tel: (01) 664 8900 Fax: (01) 661 3618
Email: info@waterman-moylan.ie www.waterman-moylan.ie

CLIENT **BIRCHWELL DEVELOPMENTS LTD**

ARCHITECT **McCROSSAN O'ROURKE MANNING ARCHITECTS**

PROJECT **BROOMFIELD SHD**

TITLE **WATERMAIN LAYOUT SHEET 1 OF 3**

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P301	A

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

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

CLIENT **BIRCHWELL DEVELOPMENTS LTD**

ARCHITECT **McCROSSAN O'ROURKE MANNING ARCHITECTS**

PROJECT **BROOMFIELD SHD**

TITLE **WATERMAIN LAYOUT SHEET 2 OF 3**

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P302	A

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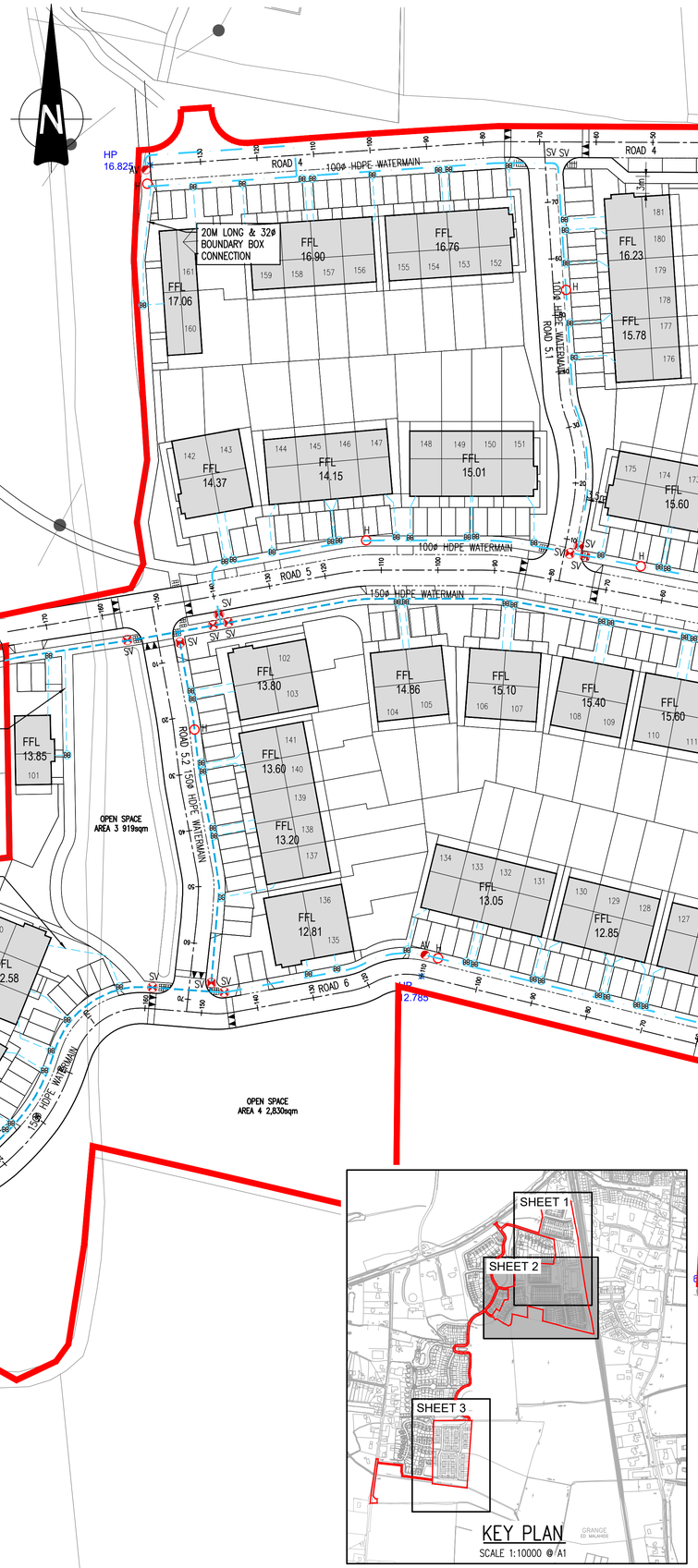
- XXXmm ø — PROPOSED 100ø HDPE WATERMAIN WITH PIPE SIZE
- XXXmm ø — PROPOSED 150ø HDPE WATERMAIN WITH PIPE SIZE
- XXXmm ø WM — EXISTING WATERMAIN WITH PIPE SIZE
- SV — PROPOSED SLUICE VALVE
- H — PROPOSED HYDRANT
- ScV — PROPOSED SCOUR VALVE
- AV — PROPOSED AIR VALVE
- NRV — PROPOSED NON-RETURN VALVE
- M — PROPOSED BULK WATER METER
- SWMH — SURFACE WATER MANHOLE
- WATERMAIN ScV NRV SWMH — TYPICAL SCHEMATIC CONNECTION OF OFFLINE SCOUR VALVE
- PROPOSED BOUNDARY BOX AND CONNECTION
- LP — ROAD LOW POINT
- HP — ROAD HIGH POINT



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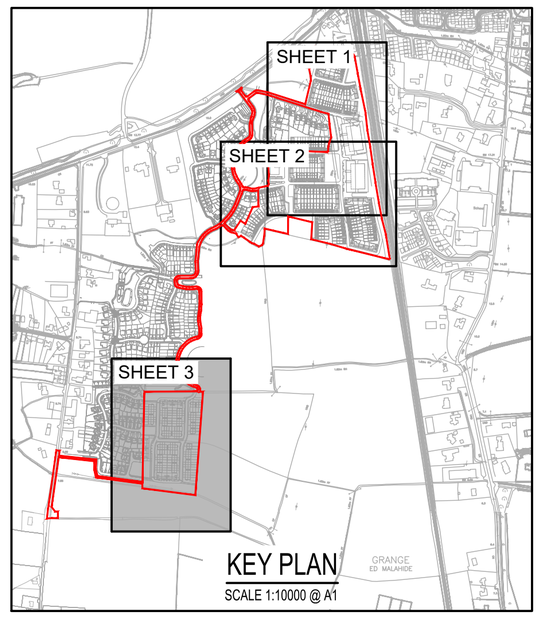

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1:500 0 10.0 20.0 30.0 40.0 50.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD, DUBLIN D03 H3F4 IRELAND.
Tel: (01) 664 8900 Fax: (01) 661 3618
Email: info@waterman-moylan.ie www.waterman-moylan.ie

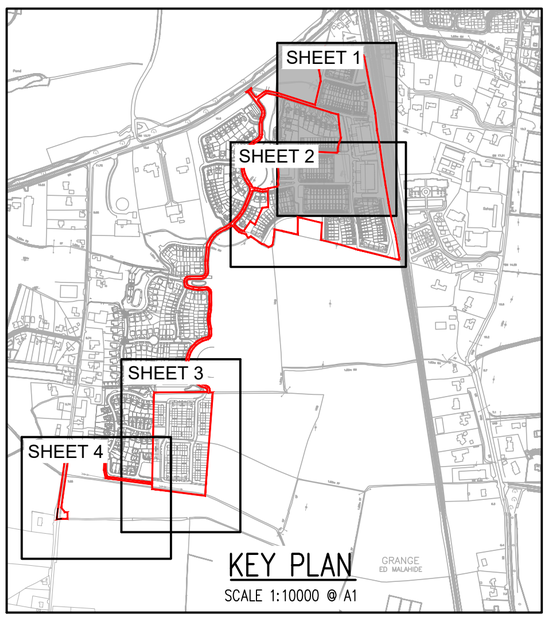
CLIENT BIRCHWELL DEVELOPMENTS LTD

ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT BROOMFIELD SHD

TITLE WATERMAIN LAYOUT SHEET 3 OF 3

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P303	A



NOTE:
ALL INDIVIDUAL PRIVATE FOUL WATER DRAINS TO BE 100ø PIPES, MIN AT 1/60, MAX AT 1/30.
ALL COLLECTOR FOUL WATER DRAINS TO BE 150ø PIPES.

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LEGEND:

FS — EXF CL X IL X	EXISTING FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
SW — EXS CL X IL X	EXISTING SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
XXXmmø @ 1/XXX uPVC SN8 — FX CL X IL X	PROPOSED FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
XXXmmø @ 1/XXX — SX CL X IL X	PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
150ø SIC	PROPOSED PRIVATE SURFACE WATER DRAINAGE PIPE AND INSPECTION CHAMBER
100ø FIC	PROPOSED PRIVATE FOUL WATER DRAINAGE PIPE AND INSPECTION CHAMBER
SWALE	PROPOSED SWALE WITH PERFORATED PIPE
G	PROPOSED GULLY AND CONNECTION
	PROPOSED PERMEABLE PAVING
	UNDERGROUND ATTENUATION STORAGE TANK
	PROPOSED GREEN ROOF
	PROPOSED BIO-RETENTION TREE PIT

NORTH CATCHMENT 1
UNDERGROUND ATTENUATION STORAGE
17M X 9M X 1.2M
VOLUME REQUIRED 171.4M³
VOLUME PROVIDED 183.6M³
ALLOWABLE DISCHARGE 9L/S

BLOCK C
UNDERGROUND ATTENUATION STORAGE
4M X 4M X 1.2M
VOLUME REQUIRED 14.8M³
VOLUME PROVIDED 16M³
ALLOWABLE DISCHARGE 2L/S

BLOCK A 54 UNITS
BLOCK B 54 UNITS
BLOCK C 25 UNITS FFL18
DUPLEX BLOCK 16 UNITS
FIRST/PODIUM FFL 21.4

1:500 0 10.0 20.0 30.0 40.0 50.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **PLANNING**

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD, DUBLIN D03 H3F4 IRELAND.
Tel: (01) 664 8900 Fax: (01) 661 3618
Email: info@waterman-moylan.ie www.waterman-moylan.ie

CLIENT BIRCHWELL DEVELOPMENTS LTD
ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS
PROJECT BROOMFIELD SHD
TITLE DRAINAGE LAYOUT SHEET 1 OF 4

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P201	A

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

Waterman Moylan
Engineering Consultants
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD,
DUBLIN D03 H3F4 IRELAND. Tel: (01) 664 8900
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CLIENT BIRCHWELL DEVELOPMENTS LTD

ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS

PROJECT BROOMFIELD SHD

TITLE DRAINAGE LAYOUT SHEET 2 OF 4

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P202	A

1:500 0 10.0 20.0 30.0 40.0 50.0m

1:1 0 10 20 30 40 50 60 70 80 90 100

NOTES:

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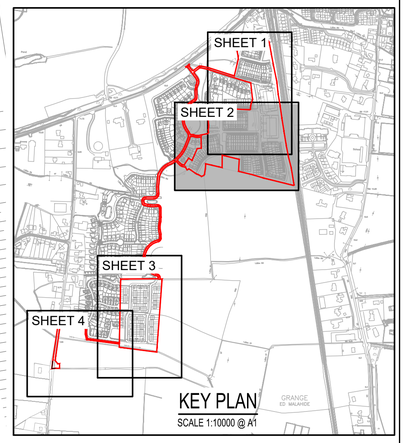
3. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT ALL WORKS ARE CONSTRUCTED IN ACCORDANCE WITH THE IRISH WATER CODE OF PRACTICE AND STANDARD DETAILS. THE CODE OF PRACTICE AND STANDARD DETAILS ARE AVAILABLE TO DOWNLOAD FROM THE IRISH WATER WEBSITE AT WWW.WATER.IE/CONNECTIONS/DEVELOPER-SERVICES/ WHERE THE DETAILS CONTAINED ON THIS DRAWING DIFFER FROM THE IRISH WATER CODE OF PRACTICE OR STANDARD DETAILS THIS MUST BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY. IRISH WATER STANDARDS WILL TAKE PRECEDENCE.



LEGEND:

- FS — EXF CL X IL X — EXISTING FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- SW — EXS CL X IL X — EXISTING SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- XXXmmø @ 1/XXX uPVC SN8 — FX CL X IL X — PROPOSED FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- XXXmmø @ 1/XXX — SX CL X IL X — PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- 150ø SIC — PROPOSED PRIVATE SURFACE WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- 100ø FIC — PROPOSED PRIVATE FOUL WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- SWALE — PROPOSED SWALE WITH PERFORATED PIPE
- G ■ — PROPOSED GULLY AND CONNECTION
- PROPOSED PERMEABLE PAVING
- UNDERGROUND ATTENUATION STORAGE TANK
- PROPOSED GREEN ROOF
- PROPOSED BIO-RETENTION TREE PIT

BLOCK A/B
UNDERGROUND ATTENUATION STORAGE
10M X 16M X 1.2M
VOLUME REQUIRED 183M³
VOLUME PROVIDED 192M³
ALLOWABLE DISCHARGE 2.75L/S

NORTH CATCHMENT 2
UNDERGROUND ATTENUATION STORAGE
12M X 31M 1.2M
VOLUME REQUIRED 446M³
VOLUME PROVIDED 446M³
ALLOWABLE DISCHARGE 10.5L/S

NORTH CATCHMENT 3
UNDERGROUND ATTENUATION STORAGE
11M X 38M X 1.2M
VOLUME REQUIRED 483M³
VOLUME PROVIDED 502M³
ALLOWABLE DISCHARGE 18.6L/S

NORTH CATCHMENT 4
UNDERGROUND ATTENUATION STORAGE
9M X 30M X 1.2M
VOLUME REQUIRED 320M³
VOLUME PROVIDED 324M³
ALLOWABLE DISCHARGE 12.8L/S

NOTE:
ALL INDIVIDUAL PRIVATE FOUL WATER DRAINS TO BE 100ø PIPES, MIN AT 1/60, MAX AT 1/30.
ALL COLLECTOR FOUL WATER DRAINS TO BE 150ø PIPES.

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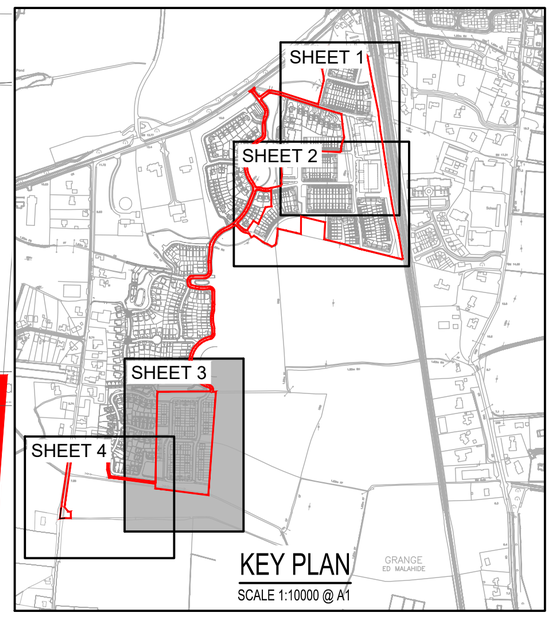

LEGEND:

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- XXXmmø @ 1/XXX uPVC SN8 — FX CL X IL X — PROPOSED FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- XXXmmø @ 1/XXX — SX CL X IL X — PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- 150ø SIC — PROPOSED PRIVATE SURFACE WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- 100ø FIC — PROPOSED PRIVATE FOUL WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- SWALE — PROPOSED SWALE WITH PERFORATED PIPE
- G = — PROPOSED GULLY AND CONNECTION
- PROPOSED PERMEABLE PAVING
- UNDERGROUND ATTENUATION STORAGE TANK
- PROPOSED GREEN ROOF
- PROPOSED BIO-RETENTION TREE PIT

NOTE:
ALL INDIVIDUAL PRIVATE FOUL WATER DRAINS TO BE 100ø PIPES, MIN AT 1/60, MAX AT 1/30.
ALL COLLECTOR FOUL WATER DRAINS TO BE 150ø PIPES.

1:500 0 10.0 20.0 30.0 40.0 50.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

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CLIENT **BIRCHWELL DEVELOPMENTS LTD**

ARCHITECT **McCROSSAN O'ROURKE MANNING ARCHITECTS**

PROJECT **BROOMFIELD SHD**

TITLE **DRAINAGE LAYOUT SHEET 3 OF 4**

DRAWN	DESIGNED	APPROVED	DATE
PJD	RW	MD	NOV '20
SCALE	JOB NO.	DRG. NO.	REVISION
1:500 @ A1	18-091	P203	A

Jan 28, 2022 - 1:50pm Drawing Location: M:\Projects\18\18-091- Broomfield LAP Malahide\Drawings\Waterman Moylan\Civil\Planning\Autocad Drawings\18-091-P201-P202-P203-P204 Drainage Layout.dwg

NOTES:

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LEGEND:

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- EXS CL X IL X — EXISTING SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- FX CL X IL X — PROPOSED FOUL WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- SX CL X IL X — PROPOSED SURFACE WATER SEWER WITH PIPE SIZE, GRADE, MANHOLE REF. AND INVERT LEVEL
- SIC — PROPOSED PRIVATE SURFACE WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- FIC — PROPOSED PRIVATE FOUL WATER DRAINAGE PIPE AND INSPECTION CHAMBER
- PROPOSED SWALE WITH PERFORATED PIPE
- PROPOSED GULLY AND CONNECTION
- PROPOSED PERMEABLE PAVING
- UNDERGROUND ATTENUATION STORAGE TANK
- PROPOSED GREEN ROOF
- PROPOSED BIO-RETENTION TREE PIT

EXF CL 4.7 IL 2.60
EXF CL 4.93 IL 4.50
EXF CL 5.65 IL 4.41
EXF CL 5.16 IL 3.01
EXF CL 4.70 IL 2.95
EXF CL 4.570 IL 2.810
EXF CL 4.630 IL 2.990
EXF CL 4.630 IL 3.030
EXF CL 4.630 IL 3.030
EXF CL 4.630 IL 3.030

F21A/0451
DIVERT EXISTING 225ø FW & RE-DIRECT TO APPROVED CASTLEWAY PUMPING STATION

EXFMH IL 3.43
EXF1.0 IL 3.43
EXF1.1 IL 3.65
EXF2.0 IL 3.65
EXS20.0 IL 4.10
EXS19.0 IL 3.65
EXS18.0 IL 3.60
EXS18.1 IL 3.28
EXS18.2 IL 4.10
EXS16.0 IL 3.00

225mmø @ 1/200
225mmø @ 1/180
225mmø @ 1/150
300ø @ 1/250

EXISTING 2m WIDEx35m LONG INFILTRATION OUTFALL DRAIN (TBC ON SITE)

EXISTING SW OUTFALL (TBC)

CONNECT TO EXISTING FOUL WATER SEWER

225mmEXSPUR EXFOR EXFUTURE CONNECTION

OPEN SPACE AREA 9 580sqm

APPROVED NEW CASTLEWAY PUMPING STATION REG.REF 21A/0451

APPROVED RISING MAIN TO NEW FLORAVILLE MANHOLE REG.REF F21A/0451

SHEET 1
SHEET 2
SHEET 3
SHEET 4
KEY PLAN
SCALE 1:10000 @ A1

1:500 0 10.0 20.0 30.0 40.0 50.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD
A	21/01/22	FINAL SHD SUBMISSION	PJD	MD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

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CLIENT BIRCHWELL DEVELOPMENTS LTD
ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS
PROJECT BROOMFIELD SHD
TITLE DRAINAGE LAYOUT SHEET 4 OF 4

DRAWN	DESIGNED	APPROVED	DATE
PJD	MD	MD	DEC '21
SCALE	JOB NO.	DRG. NO.	REVISION
AS SHOWN @ A1	18-091	P204	A

NOTES:

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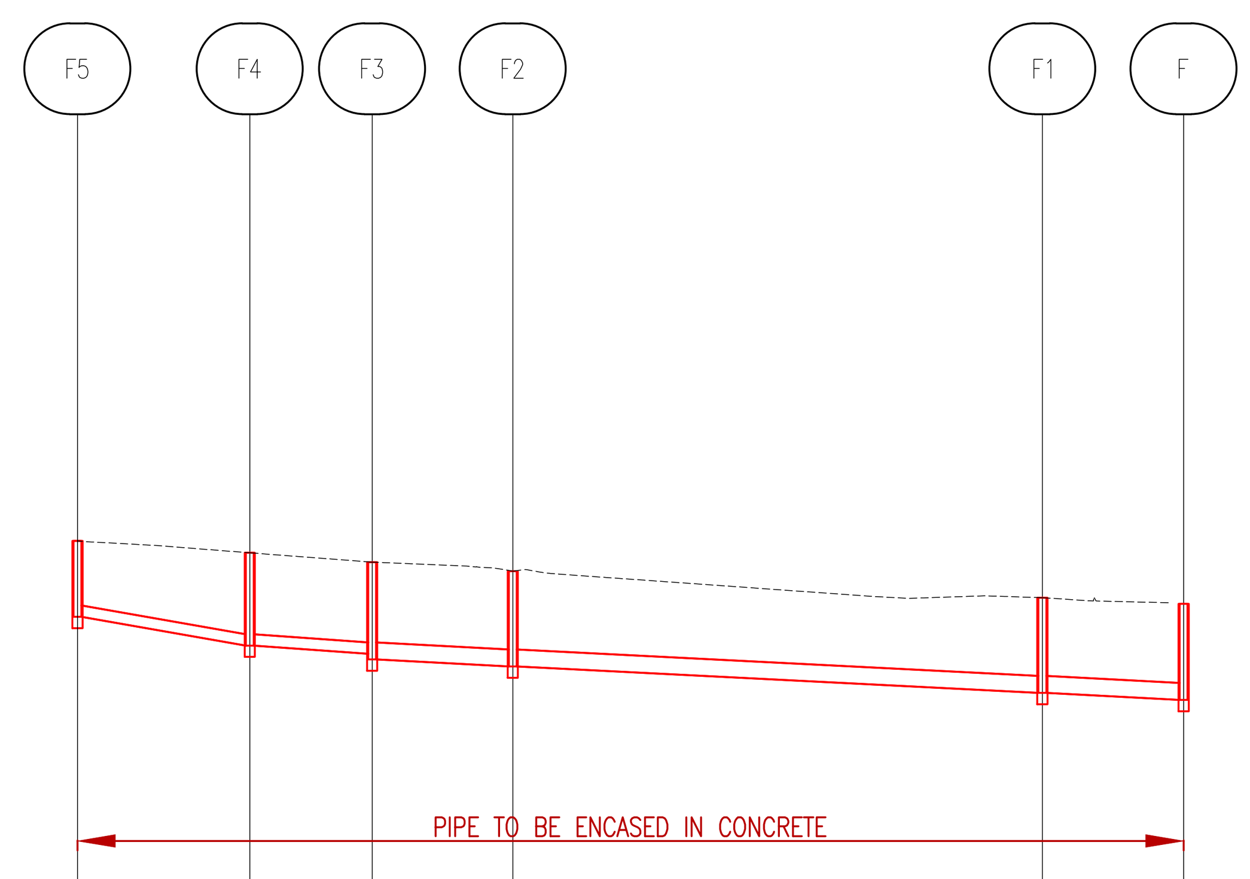
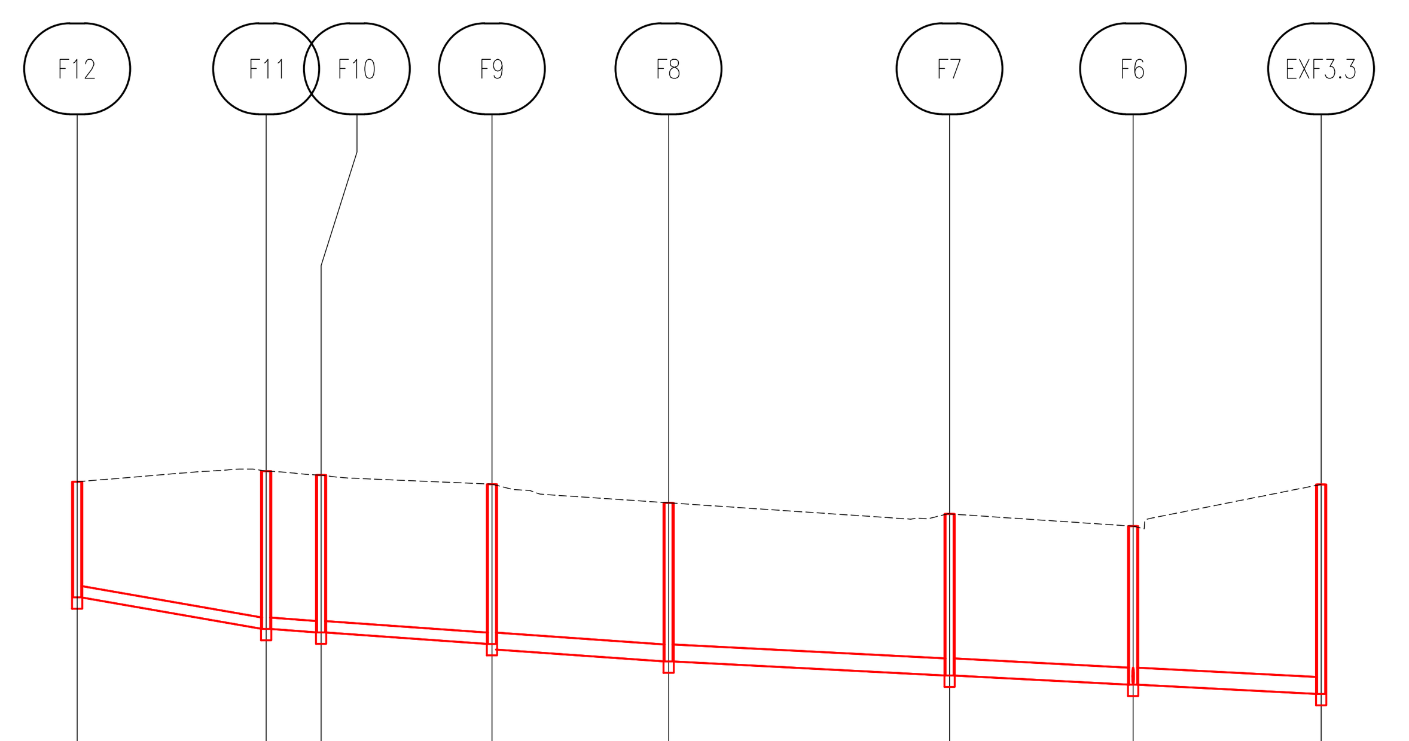


DATUM R.L. 0.000

Manhole	F5	F4	F3	F2	F1	F
DEPTH TO INVERT OF SEWER	1.003	1.226	1.211 / 1.286	1.259	1.259	1.270
INVERT LEVEL	5.229	4.849	4.741 / 4.666	4.573	4.223	4.130
DESIGN SURFACE LEVEL	6.232	6.075	5.952	5.832	5.482	5.400
EXISITNG GROUND LEVEL	6.232	6.075	5.952	5.832	5.482	5.400
RUNNING CHAINAGE	0.000	22.773	38.945	57.529	127.520	146.179

Length	F5–F4	F4–F3	F3–F2	F2–F1	F1–F
GRADE	1in60	1in150	1in200	1in200	1in201
DIAMETER	150	150	225	225	225
Length	22.773	16.172	18.584	69.991	18.659

F001

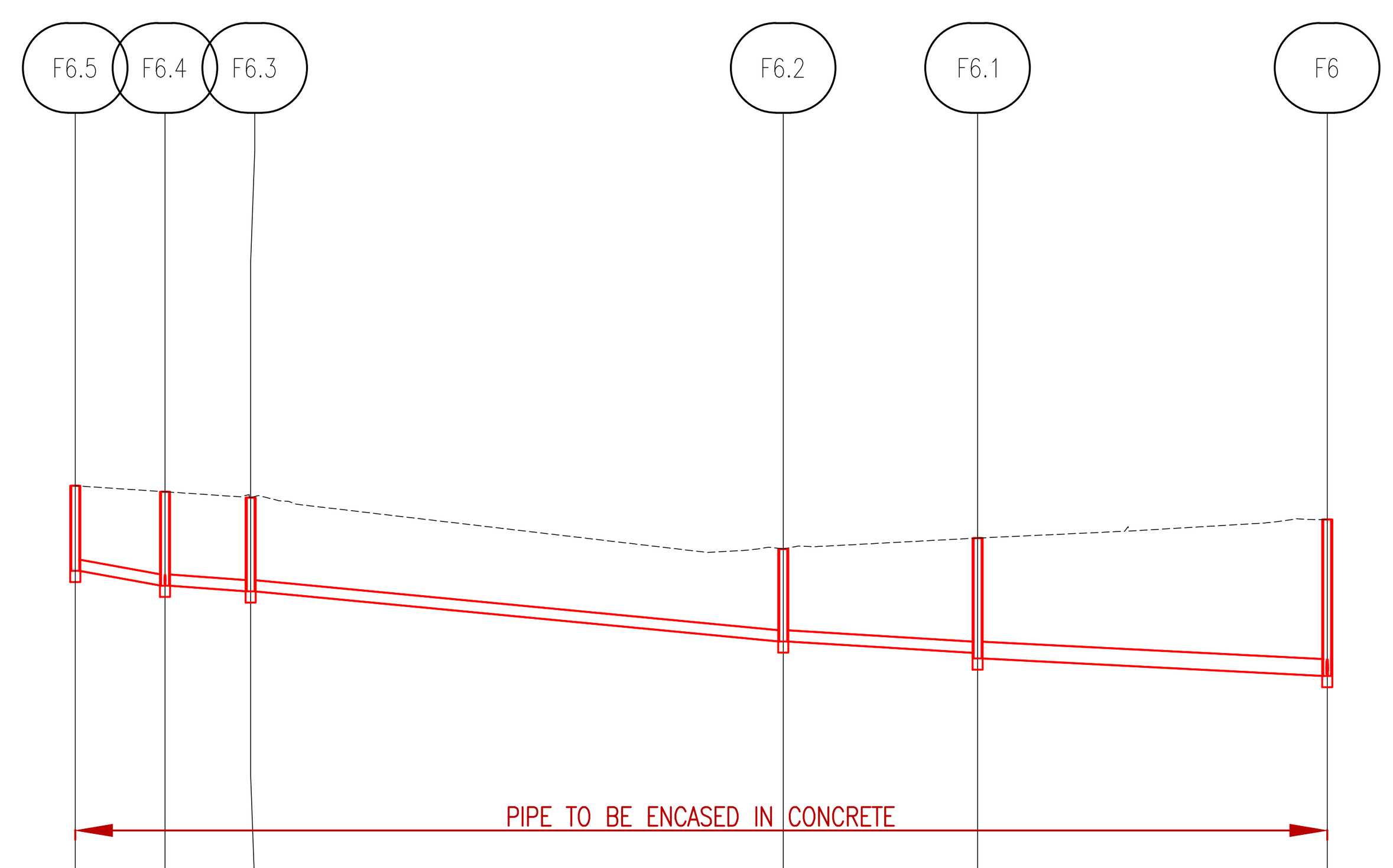


DATUM R.L. 0.000

Manhole	F12	F11	F10	F9	F8	F7	F6	EXF3.3
DEPTH TO INVERT OF SEWER	1.529	2.084	2.080	2.110	2.020 / 2.095	2.135	2.095	2.770
INVERT LEVEL	5.487	5.071	5.023	4.872	4.716 / 4.641	4.455	4.334	4.210
DESIGN SURFACE LEVEL	7.016	7.155	7.103	6.982	6.736	6.590	6.429	6.980
EXISITNG GROUND LEVEL	7.016	7.155	7.103	6.982	6.736	6.590	6.429	6.980
RUNNING CHAINAGE	0.000	24.977	32.234	54.815	78.156	115.295	139.543	164.402

Length	F12–F11	F11–F10	F10–F9	F9–F8	F8–F7	F7–F6	F6–EXF3.3
GRADE	1in60	1in151	1in150	1in150	1in200	1in200	1in200
DIAMETER	150	150	150	225	225	225	225
Length	24.977	7.256	22.581	23.341	37.139	24.248	24.859

F004

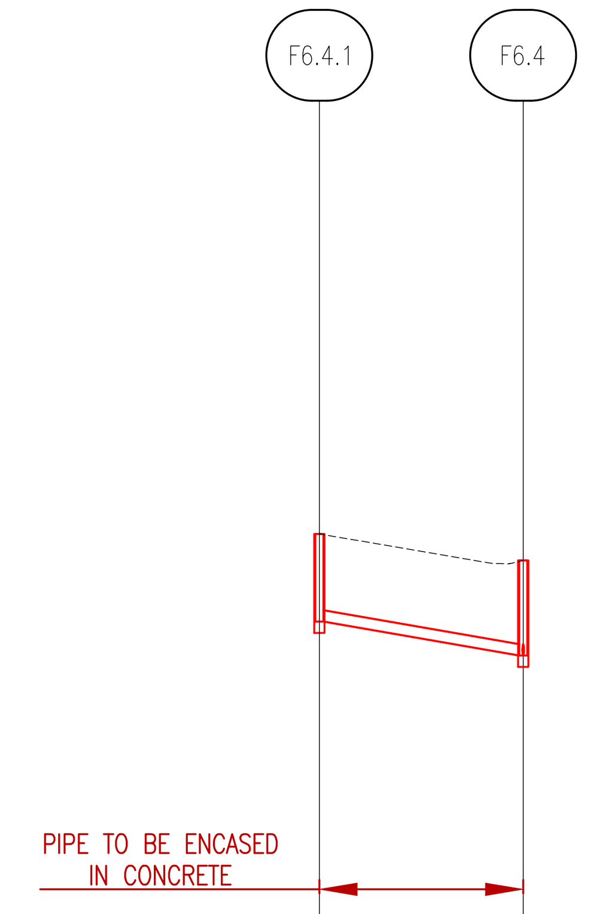


DATUM R.L. 0.000

Manhole	F6.5	F6.4	F6.3	F6.2	F6.1	F6
DEPTH TO INVERT OF SEWER	1.137	1.258	1.256	1.237	1.536 / 1.611	2.095
INVERT LEVEL	5.742	5.542	5.466	4.796	4.643 / 4.568	4.334
DESIGN SURFACE LEVEL	6.879	6.800	6.722	6.033	6.179	6.429
EXISITNG GROUND LEVEL	6.879	6.800	6.722	6.033	6.179	6.429
RUNNING CHAINAGE	0.000	12.006	23.465	94.680	120.682	167.427

Length	F6.5–F6.4	F6.4–F6.3	F6.3–F6.2	F6.2–F6.1	F6.1–F6
GRADE	1in60	1in151	1in106	1in170	1in200
DIAMETER	150	150	150	150	225
Length	12.006	11.458	71.216	26.001	46.745

F005

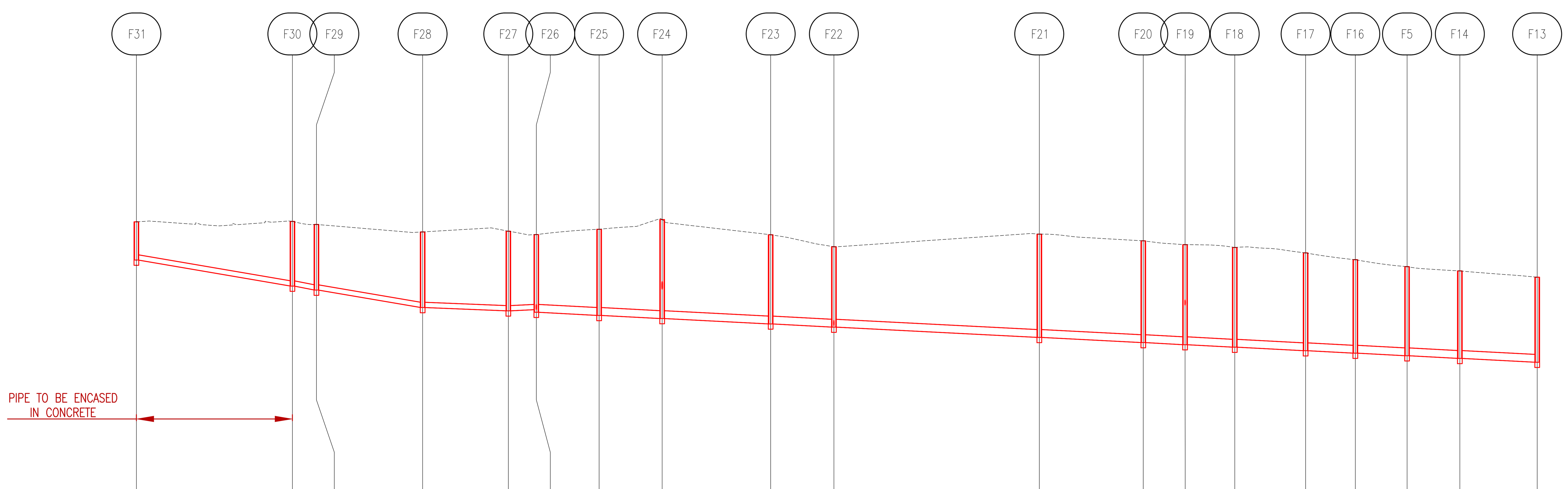


DATUM R.L. 0.000

Manhole	F6.4.1	F6.4
DEPTH TO INVERT OF SEWER	1.157	1.258
INVERT LEVEL	5.991	5.542
DESIGN SURFACE LEVEL	7.148	6.800
EXISITNG GROUND LEVEL	7.148	6.800
RUNNING CHAINAGE	0.000	26.917

Length	F6.4.1–F6.4
GRADE	1in60
DIAMETER	150
Length	26.917

F006



DATUM R.L. 4.000

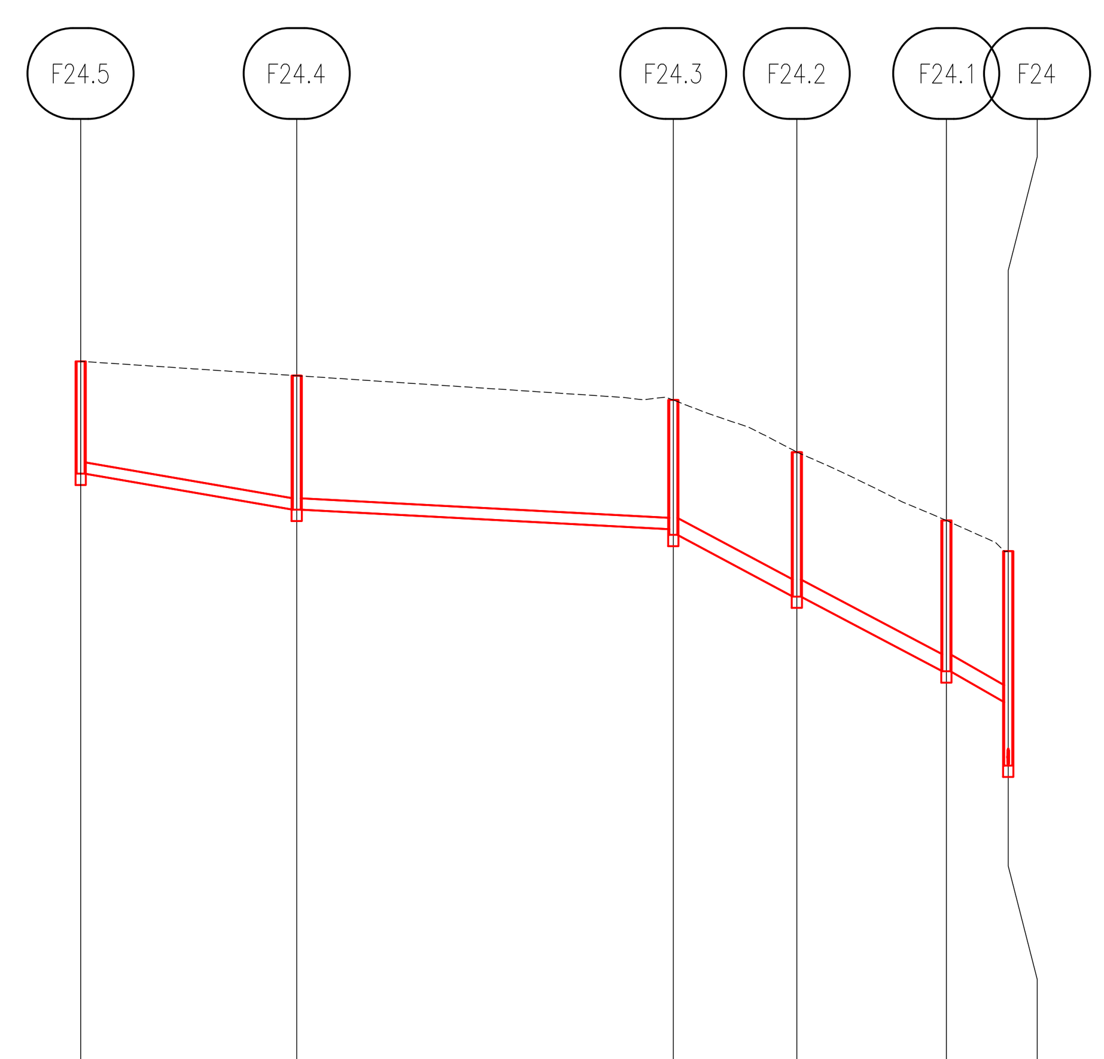
Manhole	F31	F30	F29	F28	F27	F26	F25	F24	F23	F22
DEPTH TO INVERT OF SEWER	1.093	1.853	1.878	2.164	2.279	2.148 / 2.223	2.465	2.833	2.554	2.302
INVERT LEVEL	12.002	11.256	11.142	10.642	10.547	10.582 / 10.507	10.417	10.327	10.172	10.081
DESIGN SURFACE LEVEL	13.095	13.109	13.020	12.806	12.826	12.730	12.882	13.160	12.726	12.383
EXISITNG GROUND LEVEL	13.095	13.109	13.020	12.806	12.826	12.730	12.882	13.160	12.726	12.383
RUNNING CHAINAGE	0.000	44.643	51.507	81.903	106.432	114.432	132.413	150.448	181.504	199.589

Manhole	F21	F20	F19	F18	F17	F16	F5	F14	F13
DEPTH TO INVERT OF SEWER	2.954	2.912	2.863	2.854	2.799	2.676	2.550	2.503	2.435
INVERT LEVEL	9.788	9.639	9.579	9.508	9.407	9.336	9.263	9.187	9.076
DESIGN SURFACE LEVEL	12.742	12.551	12.442	12.362	12.206	12.012	11.813	11.690	11.511
EXISITNG GROUND LEVEL	12.742	12.551	12.442	12.362	12.206	12.012	11.813	11.690	11.511
RUNNING CHAINAGE	258.367	288.121	300.075	314.292	334.574	348.792	363.602	378.712	400.836

Length	F31–F30	F30–F29	F29–F28	F28–F27	F27–F26	F26–F25	F25–F24	F24–F23	F23–F22
GRADE	1in60	1in60	1in61	1in258	1in−229	1in200	1in200	1in200	1in199
DIAMETER	150	150	150	150	150	225	225	225	225
Length	44.643	6.864	30.396	24.529	8.001	17.981	18.035	31.056	18.085

Length	F22–F21	F21–F20	F20–F19	F19–F18	F18–F17	F17–F16	F16–F5	F5–F14	F14–F13
GRADE	1in201	1in200	1in199	1in200	1in201	1in200	1in203	1in199	1in199
DIAMETER	225	225	225	225	225	225	225	225	225
Length	58.778	29.755	11.954	14.216	20.282	14.218	14.809	15.110	22.125

F007



DATUM R.L. 6.000

Manhole	F24.5	F24.4	F24.3	F24.2	F24.1	F24
DEPTH TO INVERT OF SEWER	1.485	1.771	1.706 / 1.781	1.908	1.993	1.996 / 2.833
INVERT LEVEL	14.184	13.708	13.451 / 13.376	12.560	11.573	11.164 / 10.327
DESIGN SURFACE LEVEL	15.669	15.479	15.157	14.468	13.566	13.160
EXISITNG GROUND LEVEL	15.669	15.479	15.157	14.468	13.566	13.160
RUNNING CHAINAGE	0.000	28.547	78.283	94.603	114.342	122.514

Length	F24.5–F24.4	F24.4–F24.3	F24.3–F24.2	F24.2–F24.1	F24.1–F24
GRADE	1in60	1in194	1in20	1in20	1in20
DIAMETER	150	150	225	225	225
Length	28.547	49.736	16.319	19.739	8.172

F008

NOTE:
WHERE COVER TO PIPE IS LESS THAN 1.2M
PIPE SHALL BE ENCASED IN CONCRETE

1:1000 0 20.0 40.0 60.0 80.0 100.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

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CLIENT BIRCHWELL DEVELOPMENTS LTD
ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS
PROJECT BROOMFIELD SHD
TITLE FOUL DRAINAGE LONGITUDINAL SECTIONS SHEET 1 OF 3

DRAWN	DESIGNED	APPROVED	DATE
PJD	NS	MD	JAN 22'
SCALE	JOB NO.	DRG. NO.	REVISION
AS SHOWN @ A1	18-091	P240	

NOTES:

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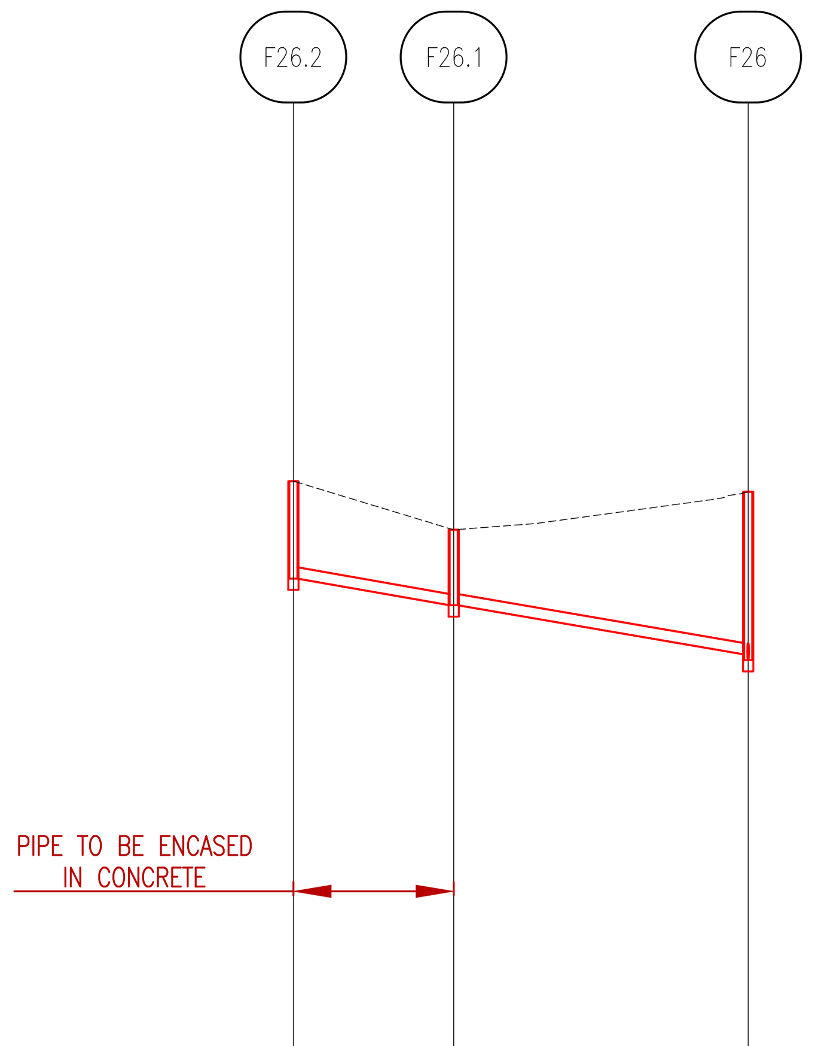
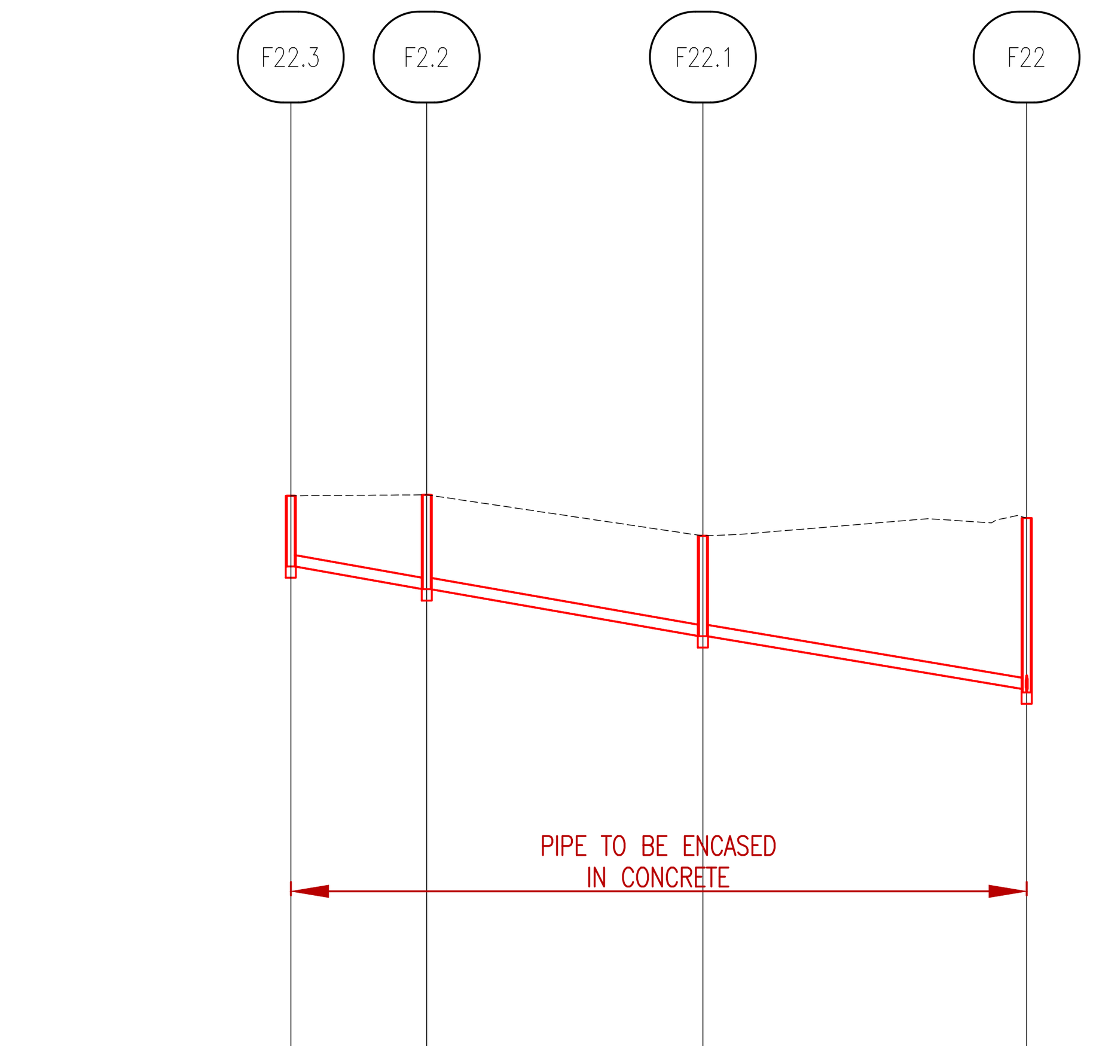


DATUM R.L. 5.000

Manhole	Grade (to next)	Diameter	Depth to invert of sewer	Invert level	Design surface level	Exisitng ground level	Running chainage	Length (to next)
F26.2	1in60	150	1.287	11.584	12.871	12.871	0.000	21.187
F26.1	1in60	150	0.997	11.231	12.228	12.228	21.187	38.920
F26			2.147 / 2.223	10.582 / 10.507	12.730	12.730	60.108	

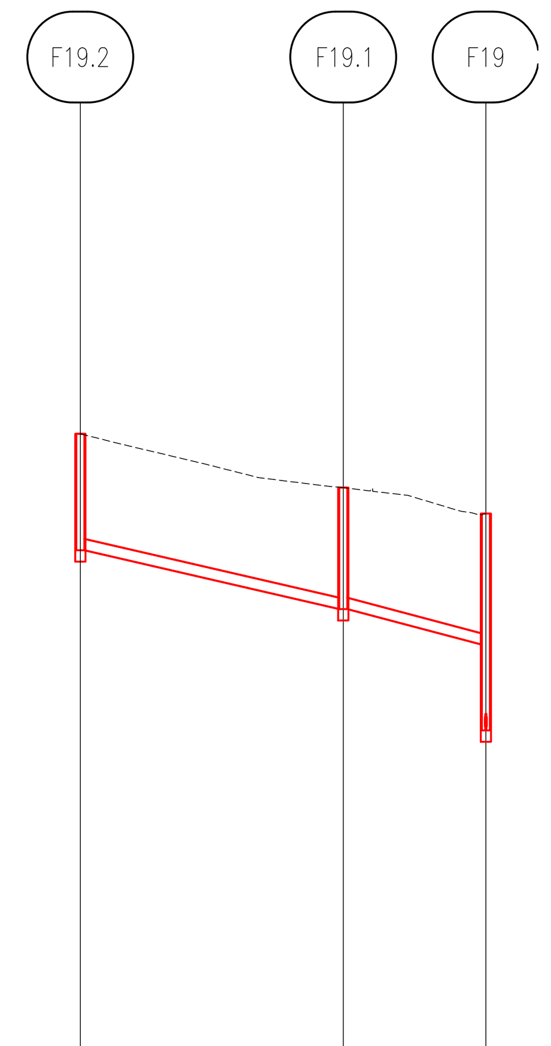
F009



DATUM R.L. 5.000

Manhole	Grade (to next)	Diameter	Depth to invert of sewer	Invert level	Design surface level	Exisitng ground level	Running chainage	Length (to next)
F22.3	1in59	150	0.932	11.745	12.677	12.677	0.000	17.965
F2.2	1in59	150	1.247	11.443	12.690	12.690	17.965	36.510
F22.1	1in61	150	1.324	10.824	12.148	12.148	54.475	42.791
F22			2.259 / 2.302	10.124 / 10.081	12.383	12.383	97.266	

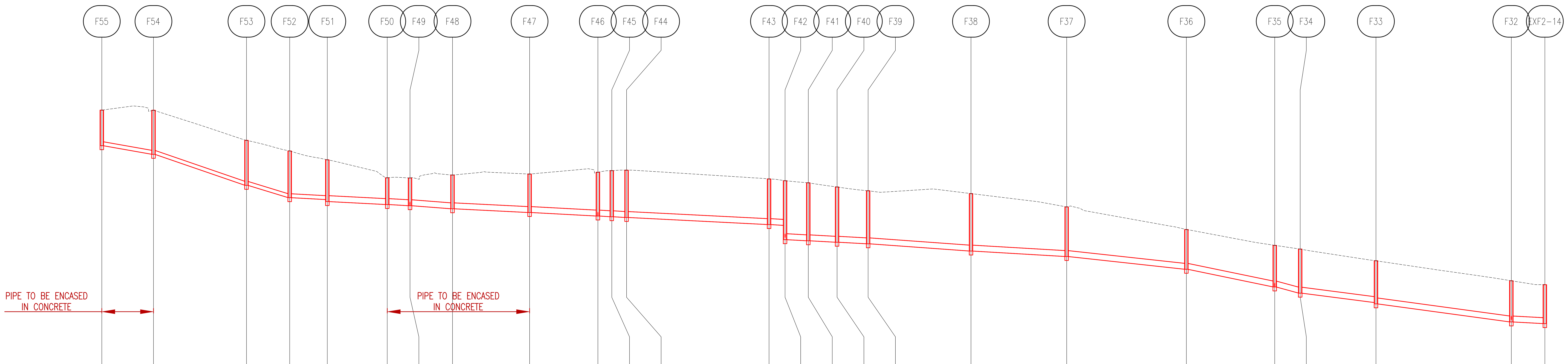
F010



DATUM R.L. 5.000

Manhole	Grade (to next)	Diameter	Depth to invert of sewer	Invert level	Design surface level	Exisitng ground level	Running chainage	Length (to next)
F19.2	1in45	150	1.537	11.958	13.495	13.495	0.000	34.733
F19.1	1in40	150	1.605	11.181	12.786	12.786	34.733	18.832
F19			1.732 / 2.863	10.710 / 9.579	12.442	12.442	53.565	

F011



DATUM R.L. 10.000

Manhole	Grade (to next)	Diameter	Depth to invert of sewer	Invert level	Design surface level	Exisitng ground level	Running chainage	Length (to next)
F55	1in60	150	1.350	18.752	20.102	20.102	0.000	19.621
F54	1in30	150	1.674	18.425	20.099	20.099	19.621	35.307
F53	1in35	150	1.707	17.248	18.955	18.955	54.928	16.396
F52	1in199	150	1.775	16.779	18.554	18.554	71.324	14.297
F51	1in201	225	1.509 / 1.584	16.707 / 16.632	18.216	18.216	85.621	22.743
F50	1in201	225	1.017	16.519	17.536	17.536	108.364	8.641
F49	1in138	225	1.051	16.476	17.527	17.527	117.005	16.137
F48	1in206	225	1.279	16.359	17.638	17.638	133.143	29.264
F47	1in194	225	1.460	16.217	17.677	17.677	162.407	25.935
F46	1in202	225	1.661	16.083	17.744	17.744	188.342	5.257
F45	1in201	225	1.749	16.057	17.806	17.806	193.599	5.622
F44	1in200	225	1.794	16.029	17.823	17.823	199.221	54.093
F43	1in203	225	1.732	15.759	17.491	17.491	253.314	6.087
F42	1in200	225	1.694 / 2.236	15.729 / 15.187	17.423	17.423	259.400	8.813
F41	1in199	225	2.202	15.143	17.345	17.345	268.213	10.931
F40	1in200	225	2.099	15.088	17.187	17.187	279.144	11.798
F39	1in142	225	2.013	15.029	17.042	17.042	290.943	39.051
F38	1in175	225	2.181	14.754	16.935	16.935	329.994	36.304
F37	1in94	225	1.883	14.546	16.429	16.429	366.298	45.459
F36	1in50	225	1.509	14.062	15.571	15.571	411.757	33.538
F35	1in41	225	1.580	13.391	14.971	14.971	445.295	9.684
F34	1in80	225	1.673	13.157	14.830	14.830	454.979	28.752
F33	1in75	225	1.588 / 1.636	12.798 / 12.750	14.386	14.386	483.730	51.403
F32	1in199	225	1.563	12.064	13.627	13.627	535.134	12.724
EXF2-14			1.478	12.000	13.478	13.478	547.858	

F012

NOTE:
WHERE COVER TO PIPE IS LESS THAN 1.2M PIPE SHALL BE ENCASED IN CONCRETE

1:1000 0 20.0 40.0 60.0 80.0 100.0m
1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

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Engineering Consultants
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Email: info@waterman-moylan.ie www.waterman-moylan.ie

CLIENT BIRCHWELL DEVELOPMENTS LTD
ARCHITECT McCROSSAN O'ROURKE MANNING ARCHITECTS

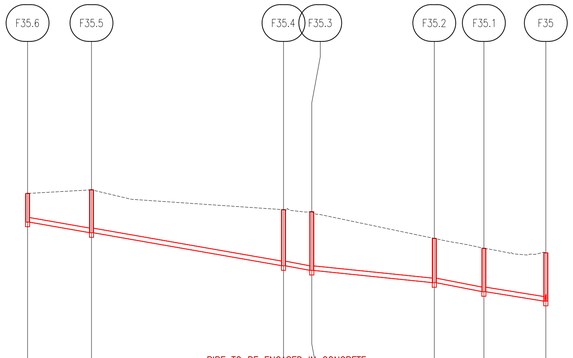
PROJECT
BROOMFIELD SHD

TITLE
FOUL DRAINAGE LONGITUDINAL SECTIONS
SHEET 2 OF 3

DRAWN	DESIGNED	APPROVED	DATE
PJD	MD	MD	JAN 22'
SCALE	JOB NO.	DRG. NO.	REVISION
AS SHOWN @ A1	18-091	P241	

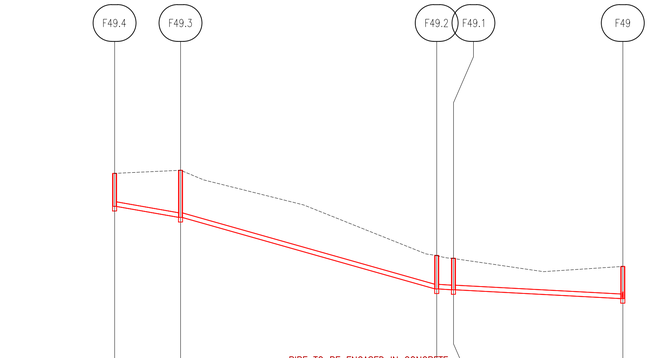
NOTES:

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



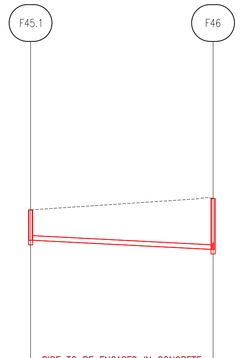
DATUM R.L.	−3.000													
GRADE		1in60		1in58			1in60		1in100		1in55		1in65	
DIAMETER		150		150			150		150		150		150	
DEPTH TO INVERT OF SEWER	0.935		1.401			1.828		1.917		1.447		1.415		1.560
INVERT LEVEL	15.974		15.626			14.550		14.396		13.996		13.702		13.391
DESIGN SURFACE LEVEL	16.909	17.027			16.378	16.313			15.443	15.443	15.117	15.117	14.971	14.971
EXISITNG GROUND LEVEL	16.177	17.027			16.378	16.313			15.443	15.443	15.117	15.117	14.971	14.971
RUNNING CHAINAGE	0.000	20.872	20.872	62.691	83.564	89.216	92.780	40.016	132.796	16.181	148.976	20.221	169.198	

F014



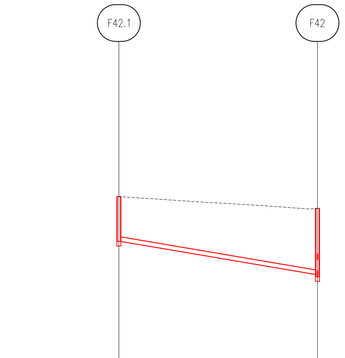
DATUM R.L.	0.000									
GRADE	1in60		1in36			1in203		1in191		
DIAMETER	150		150			150		150		
DEPTH TO INVERT OF SEWER	1.078	1.538			1.092		1.029		1.051	
INVERT LEVEL	19.486	19.127			16.792		16.765		16.476	
DESIGN SURFACE LEVEL	20.564	20.665		17.884		17.794		17.527		
EXISITNG GROUND LEVEL	20.564	20.665		17.884		17.794		17.527		
RUNNING CHAINAGE	0.000	21.527	21.527	83.637	105.165	3.475	110.640	55.286	165.926	

F015



DATUM R.L.	10.000			
GRADE	1in200			
DIAMETER	150			
DEPTH TO INVERT OF SEWER	0.991			1.661
INVERT LEVEL	16.381			16.683
DESIGN SURFACE LEVEL	17.372		17.744	
EXISITNG GROUND LEVEL	17.372		17.744	
RUNNING CHAINAGE	0.000	59.583		59.583

F016



DATUM R.L.	10.000		
GRADE	1in60		
DIAMETER	150		
DEPTH TO INVERT OF SEWER	1.465		2.161 2.236
INVERT LEVEL	16.343		15.262 15.187
DESIGN SURFACE LEVEL	17.808	17.423	
EXISITNG GROUND LEVEL	17.808	17.423	
RUNNING CHAINAGE	0.000	64.847	64.847

F017

NOTE:
WHERE COVER TO PIPE IS LESS THAN 1.2M
PIPE SHALL BE ENCASED IN CONCRETE

1:1000 0 20.0 40.0 60.0 80.0 100.0m

1:1 0 10 20 30 40 50 60 70 80 90 100

REV.	DATE	AMENDMENT	DRN	APPD

STATUS **FOR PLANNING NOT FOR CONSTRUCTION**

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CLIENT **BIRCHWELL DEVELOPMENTS LTD**

ARCHITECT **McCROSSAN O'ROURKE MANNING ARCHITECTS**

PROJECT **BROOMFIELD SHD**

TITLE **FOUL DRAINAGE LONGITUDINAL SECTIONS SHEET 3 OF 3**

DRAWN	DESIGNED	APPROVED	DATE
PJD	NS	MD	JAN 22'
SCALE	JOB NO.	DRG. NO.	REVISION
1000H, 100V	18-091	P242	

C. Fingal County Council SuDS Selection Checklist

Suds Measures	Measures to be used on this site	Rationale for selecting/not selecting measure	Checklist submitted? See no. 8 below
Source Control			
Swales	✓	Located on the edges of open spaces as topography allows.	
Tree Pits	✓	Roadside tree pits are to be provided throughout the development. Trees help to attenuate flows, trap silts and pollutants, promote infiltration and prevent erosion.	
Rainwater Butts			
Rainwater harvesting			
Soakaways	✓	Soakaway filters drain to partly replace static ditch on the southern boundary of the north site.	
Infiltration trenches			
Permeable pavement (Grasscrete, Block paving, Porous Asphalt etc.)	✓	All private driveways are to be permeable paving with underlying filter drains. Downpipes from the front of the houses will also drain to the filter drain under the permeable paving to facilitate maximum infiltration of surface water from driveways and roof areas.	
Green Roofs	✓	Areas of green roof are to be provided at the apartment buildings.	
Filter strips	✓	Filter drains incorporated around apartment blocks, under permeable paving and in open spaces as appropriate.	
Bio-retention systems/Raingardens			
Blue Roofs			
Filter Drain	✓	Filter drains are to be incorporated around the perimeter of each apartment block to allow for infiltration of surface water.	
Site Control			
Detention Basins			
Retention basins			
Regional Control			
Ponds			
Wetlands			
Other			
Petrol/Oil interceptor	✓	A Class 1 petrol interceptor will be provided before the surface water outfall to the public surface water network.	
Attenuation tank – only as a last resort where other measures are not feasible	✓	Attenuation tanks to be utilised throughout the development. Detention basins are not considered as a feasible option. Privately managed and maintained attenuation tanks will be utilised for the apartment blocks. Storage for all tanks is designed to have capacity for greater than the 1-in-100-year	

		storm plus 20% for climate change. All outflows will be limited to greenfield rates (or allowable) via hydrobrake system	
Oversized pipes– only as a last resort where other measures are not feasible			

Note:

1. Fingal has a preference for above ground Green Infrastructure rather than tanks or oversized pipes . Above ground flows through swales, basins etc are encouraged.
2. Demonstrate SUDS system will have sufficient Pollutant removal efficiency in accordance with Ciria Suds Manual C753
3. Basins sides should be no steeper than 1:4 and no deeper than 1.2m in the 1%AEP
4. Culverting shall be avoided where possible
5. De-culverting is encouraged.
6. Please submit evidence of infiltration rates
7. To account for climate change in the design of the drainage system rainfall intensities should be factored up by 20%
8. The Applicant must provide Suds checklists in accordance with the Appendix B of the Ciria Suds manual C753

Appendix	**Name**
B3	Full planning
B4	Scheme design
B5	Health and safety
B6	Infiltration assessment
B7	Proprietary treatment
B9	filter strip
B11	filter drain
B13	swale
B15	bioretention
B16	pervious pavement
B17	attenuation tank
B19	basin
B21	pond wetland

Flood risk to be assessed

Flood risk	Applicable to subject site	Measures to reduce risk	Residual risk
Fluvial			
Pluvial			
Coastal			
Groundwater			
Dam/Embankment/Canal bank breach			
Network drainage			
Snow melt			
Watermain burst			

Note:

Models should consider the risk when outlets are surcharged

Climate Change scenarios to be considered both MRFS and HEFS

D. GDSDS Attenuation Calculations

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	North Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	13,481m²
Paved Area	Total	47%	6,336m²
	Drained	90%	5,702m²
Soil Area	Total	53%	7,145m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.01348km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.009m³/s
$Q_{BARrural}$ = 8.995 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	7.65	18.89	23.39
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	8.99	8.99	8.99

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	RW
Approved by:	SDN

Summary

Catchment	North Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**19.01m³**
Treatment Volume	**57.02m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	31.08m³
1-in-30-Year Storm	81.88m³
1-in-100-Year Storm	58.41m³
Reduction of Long-Term Storage	-17.05m³
Volume Required	**154.33m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**17.05m³**
Long Term Storage *(Interception provided)*	**-1.96m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	31.08m³
1-in-30-Year Storm	81.88m³
1-in-100-Year Storm	58.41m³
Total	**171.38m³**

The maximum attenuation volume required is 171.38m³

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Calculation By:	RW
Approved by:	SDN

Criterion 1
River Protection Volume

Catchment	North Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*13481m² x 0.47 x 0.75 =* 4,752.05m²	*13,481m² site area* *47% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*4752.0525m² x 5mm x 0.8 =* **19.01m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*13481m² x 0.47 x 0.75 =* 4,752.05m²	*13,481m² site area* *47% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*4752.0525m² x 15mm x 0.8 =* **57.02m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	North Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	22.81	0.00	22.81	41.1	8.99	16.2	13.81	24.9
1	33.33	15.21	0.00	15.21	54.7	8.99	32.4	6.21	22.4
2	21.83	9.96	0.00	9.96	71.7	8.99	64.8	0.97	7.0
4	14.75	6.73	0.00	6.73	96.9	6.73	96.9	0.00	0.0
6	11.83	5.40	0.00	5.40	116.6	5.40	116.6	0.00	0.0
12	7.50	3.42	0.00	3.42	147.8	3.42	147.8	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	61.43	0.00	61.43	110.6	8.99	11.9	52.44	69.5
1	84.43	38.52	0.00	38.52	138.7	8.99	24.8	29.52	81.4
2	52.22	23.82	0.00	23.82	171.5	8.99	49.7	14.83	81.9
4	32.23	14.70	0.00	14.70	211.7	8.99	90.3	5.71	57.3
6	25.18	11.49	0.00	11.49	248.2	8.99	104.6	2.49	29.0
12	15.74	7.18	0.00	7.18	310.2	7.18	0.0	0.00	0.0

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	85.16	0.00	85.16	153.3	8.99	3.6	76.16	30.3
1	116.67	53.22	0.00	53.22	191.6	8.99	10.7	44.23	52.5
2	70.00	31.93	0.00	31.93	229.9	8.99	22.9	22.94	58.4
4	42.50	19.39	0.00	19.39	279.2	8.99	37.1	10.39	42.9
6	32.78	14.95	0.00	14.95	323.0	8.99	33.1	5.96	21.9
12	20.00	9.12	0.00	9.12	394.2	8.99	-7,053.8	0.13	-101.2

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Calculation By:	RW
Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	North Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	1.348 Ha	*… Area of site*
PIMP	=	47%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 17.05m³

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	Block C
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	646m²
Paved Area	Total	100%	646m²
	Drained	100%	646m²
Soil Area	Total	0%	0m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.00065km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.000m³/s
$Q_{BARrural}$ = 0.431 l/s
$Q_{BARrural}$ = 30.960 l/s/Ha

… *Note: where greenfield runoff value is <2l/s, a value of 2l/s shall be taken*

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	1.70	4.20	5.20
Q_{BAR} (l/s/Ha)	26.32	65.02	80.50
Allowable Discharge	2.00	2.00	2.00

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	RW
Approved by:	SDN

Summary

Catchment	Block C
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**1.94m³**
Treatment Volume	**5.81m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	1.31m³
1-in-30-Year Storm	7.88m³
1-in-100-Year Storm	5.58m³
Reduction of Long-Term Storage	-15.09m³
Volume Required	**-0.32m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**15.09m³**
Long Term Storage *(Interception provided)*	**13.16m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	1.31m³
1-in-30-Year Storm	7.88m³
1-in-100-Year Storm	5.58m³
Total	**14.77m³**

The maximum attenuation volume required is 14.77m³

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Criterion 1
River Protection Volume

Catchment	Block C
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*646m² x 1 x 0.75 =* 484.50m²	*646m² site area* *100% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*484.5m² x 5mm x 0.8 =* **1.94m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*646m² x 1 x 0.75 =* 484.50m²	*646m² site area* *100% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*484.5m² x 15mm x 0.8 =* **5.81m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	Block C
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	2.58	0.00	2.58	4.7	2.00	3.6	0.58	1.1
1	33.33	1.72	0.00	1.72	6.2	1.72	6.2	0.00	0.0
2	21.83	1.13	0.00	1.13	8.1	1.13	8.1	0.00	0.0
4	14.75	0.76	0.00	0.76	11.0	0.76	11.0	0.00	0.0
6	11.83	0.61	0.00	0.61	13.2	0.61	13.2	0.00	0.0
12	7.50	0.39	0.00	0.39	16.7	0.39	16.7	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	6.96	0.00	6.96	12.5	2.00	3.2	4.96	7.9
1	84.43	4.36	0.00	4.36	15.7	2.00	6.3	2.36	7.5
2	52.22	2.70	0.00	2.70	19.4	2.00	11.4	0.70	4.0
4	32.23	1.67	0.00	1.67	24.0	1.67	0.0	0.00	0.0
6	25.18	1.30	0.00	1.30	28.1	1.30	0.0	0.00	0.0
12	15.74	0.81	0.00	0.81	35.1	0.81	0.0	0.00	0.0

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	9.65	0.00	9.65	17.4	2.00	1.3	7.65	4.8
1	116.67	6.03	0.00	6.03	21.7	2.00	2.8	4.03	5.6
2	70.00	3.62	0.00	3.62	26.0	2.00	3.4	1.62	2.7
4	42.50	2.20	0.00	2.20	31.6	2.00	-62.1	0.20	-6.1
6	32.78	1.69	0.00	1.69	36.6	1.69	0.0	0.00	0.0
12	20.00	1.03	0.00	1.03	44.7	1.03	0.0	0.00	0.0

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Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	Block C
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	0.065 Ha	*… Area of site*
PIMP	=	100%	*… Impermeable area of total site*
α0.8	=	100%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 15.09m³

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Project Data

Catchment	North Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	15,684m²
Paved Area	Total	81%	12,704m²
	Drained	90%	11,434m²
Soil Area	Total	19%	2,980m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.01568km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.010m³/s
$Q_{BARrural}$ = 10.465 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	8.90	21.98	27.21
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	10.46	10.46	10.46

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	Return Period *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	RW
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Summary

Catchment	North Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**38.11m³**
Treatment Volume	**114.34m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	90.11m³
1-in-30-Year Storm	201.67m³
1-in-100-Year Storm	147.80m³
Reduction of Long-Term Storage	-185.20m³
Volume Required	**254.39m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**185.20m³**
Long Term Storage *(Interception provided)*	**147.08m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	90.11m³
1-in-30-Year Storm	201.67m³
1-in-100-Year Storm	147.80m³
Total	**439.58m³**

The maximum attenuation volume required is 439.58m³

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Calculation By:	RW
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Criterion 1
River Protection Volume

Catchment	North Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*15684m² x 0.81 x 0.75 =* 9,528.03m²	*15,684m² site area* *81% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*9528.03m² x 5mm x 0.8 =* **38.11m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*15684m² x 0.81 x 0.75 =* 9,528.03m²	*15,684m² site area* *81% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*9528.03m² x 15mm x 0.8 =* **114.34m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	North Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	45.73	0.00	45.73	82.3	10.46	18.8	35.27	63.5
1	33.33	30.49	0.00	30.49	109.8	10.46	37.7	20.02	72.1
2	21.83	19.97	0.00	19.97	143.8	10.46	75.3	9.51	68.4
4	14.75	13.49	0.00	13.49	194.3	10.46	150.7	3.03	43.6
6	11.83	10.82	0.00	10.82	233.8	10.46	226.0	0.36	7.8
12	7.50	6.86	0.00	6.86	296.4	6.86	296.4	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	123.18	0.00	123.18	221.7	10.46	12.1	112.71	130.8
1	84.43	77.23	0.00	77.23	278.0	10.46	26.4	66.77	168.3
2	52.22	47.76	0.00	47.76	343.9	10.46	55.1	37.30	196.5
4	32.23	29.48	0.00	29.48	424.5	10.46	111.0	19.01	201.7
6	25.18	23.03	0.00	23.03	497.6	10.46	166.0	12.57	199.4
12	15.74	14.40	0.00	14.40	622.0	10.46	260.3	3.93	97.9

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	170.74	0.00	170.74	307.3	10.46	1.0	160.28	14.7
1	116.67	106.71	0.00	106.71	384.2	10.46	7.9	96.25	72.7
2	70.00	64.03	0.00	64.03	461.0	10.46	21.9	53.56	111.9
4	42.50	38.87	0.00	38.87	559.8	10.46	49.9	28.41	135.3
6	32.78	29.98	0.00	29.98	647.6	10.46	79.3	19.52	147.8
12	20.00	18.29	0.00	18.29	790.3	10.46	86.2	7.83	64.5

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Calculation By:	RW
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Criterion 4
River Flood Protection

Catchment	North Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	1.568 Ha	*… Area of site*
PIMP	=	81%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 185.20m³

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Project Data

Catchment	Blocks A & B
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	4,126m²
Paved Area	Total	100%	4,126m²
	Drained	100%	4,126m²
Soil Area	Total	0%	0m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.00413km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.003m³/s
$Q_{BARrural}$ = 2.753 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	2.34	5.78	7.16
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	2.75	2.75	2.75

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	RW
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Summary

Catchment	Blocks A & B
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**12.38m³**
Treatment Volume	**37.13m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	40.08m³
1-in-30-Year Storm	88.02m³
1-in-100-Year Storm	54.15m³
Reduction of Long-Term Storage	-96.40m³
Volume Required	**85.85m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**96.40m³**
Long Term Storage *(Interception provided)*	**84.02m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	40.08m³
1-in-30-Year Storm	88.02m³
1-in-100-Year Storm	54.15m³
Total	**182.25m³**

The maximum attenuation volume required is 182.25m³

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Calculation By:	RW
Approved by:	SDN

Criterion 1
River Protection Volume

Catchment	Blocks A & B
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*4126m² x 1 x 0.75 =* 3,094.50m²	*4,126m² site area* *100% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*3094.5m² x 5mm x 0.8 =* **12.38m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*4126m² x 1 x 0.75 =* 3,094.50m²	*4,126m² site area* *100% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*3094.5m² x 15mm x 0.8 =* **37.13m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	Blocks A & B
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	16.50	0.00	16.50	29.7	2.75	5.0	13.75	24.8
1	33.33	11.00	0.00	11.00	39.6	2.75	9.9	8.25	29.7
2	21.83	7.21	0.00	7.21	51.9	2.75	19.8	4.45	32.1
4	14.75	4.87	0.00	4.87	70.1	2.75	39.6	2.12	30.5
6	11.83	3.91	0.00	3.91	84.4	2.75	59.5	1.15	24.9
12	7.50	2.48	0.00	2.48	106.9	2.48	106.9	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	44.45	0.00	44.45	80.0	2.75	2.8	41.70	43.0
1	84.43	27.87	0.00	27.87	100.3	2.75	6.4	25.12	58.4
2	52.22	17.24	0.00	17.24	124.1	2.75	13.7	14.48	72.2
4	32.23	10.64	0.00	10.64	153.2	2.75	28.4	7.88	81.5
6	25.18	8.31	0.00	8.31	179.6	2.75	43.6	5.56	88.0
12	15.74	5.20	0.00	5.20	224.5	2.75	82.8	2.44	73.5

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	61.61	0.00	61.61	110.9	2.75	-0.7	58.86	-14.1
1	116.67	38.51	0.00	38.51	138.6	2.75	0.7	35.76	8.6
2	70.00	23.11	0.00	23.11	166.4	2.75	3.6	20.35	26.5
4	42.50	14.03	0.00	14.03	202.0	2.75	10.3	11.28	42.3
6	32.78	10.82	0.00	10.82	233.7	2.75	18.5	8.07	54.1
12	20.00	6.60	0.00	6.60	285.2	2.75	33.0	3.85	46.2

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Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	Blocks A & B
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	0.413 Ha	*… Area of site*
PIMP	=	100%	*… Impermeable area of total site*
α0.8	=	100%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 96.40m³

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Approved by:	SDN

Project Data

Catchment	North Catchment 3
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	27,907m²
Paved Area	Total	59%	16,465m²
	Drained	90%	14,819m²
Soil Area	Total	41%	11,442m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.02791km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.019m³/s
$Q_{BARrural}$ = 18.620 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	15.83	39.10	48.41
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	18.62	18.62	18.62

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	Return Period *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Summary

Catchment	North Catchment 3
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**49.40m³**
Treatment Volume	**148.19m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	94.03m³
1-in-30-Year Storm	236.40m³
1-in-100-Year Storm	151.79m³
Reduction of Long-Term Storage	-139.14m³
Volume Required	**343.09m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**139.14m³**
Long Term Storage *(Interception provided)*	**89.74m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	94.03m³
1-in-30-Year Storm	236.40m³
1-in-100-Year Storm	151.79m³
Total	**482.23m³**

The maximum attenuation volume required is 482.23m³

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Calculation By:	RW
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Criterion 1
River Protection Volume

Catchment	North Catchment 3
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*27907m² x 0.59 x 0.75 =* 12,348.85m²	*27,907m² site area* *59% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*12348.8475m² x 5mm x 0.8 =* **49.40m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*27907m² x 0.59 x 0.75 =* 12,348.85m²	*27,907m² site area* *59% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*12348.8475m² x 15mm x 0.8 =* **148.19m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
Approved by:	SDN

Criterion 2
River Regime Protection

Catchment	North Catchment 3
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	59.27	0.00	59.27	106.7	18.62	33.5	40.65	73.2
1	33.33	39.52	0.00	39.52	142.3	18.62	67.0	20.90	75.2
2	21.83	25.88	0.00	25.88	186.4	18.62	134.1	7.26	52.3
4	14.75	17.49	0.00	17.49	251.8	17.49	251.8	0.00	0.0
6	11.83	14.03	0.00	14.03	303.0	14.03	303.0	0.00	0.0
12	7.50	8.89	0.00	8.89	384.1	8.89	384.1	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	159.65	0.00	159.65	287.4	18.62	23.6	141.03	178.6
1	84.43	100.09	0.00	100.09	360.3	18.62	49.8	81.47	218.1
2	52.22	61.90	0.00	61.90	445.7	18.62	101.7	43.28	236.4
4	32.23	38.20	0.00	38.20	550.1	18.62	196.6	19.58	206.8
6	25.18	29.85	0.00	29.85	644.9	18.62	277.5	11.23	167.4
12	15.74	18.66	0.00	18.66	806.2	18.62	-33,195.5	0.04	-73.4

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	221.29	0.00	221.29	398.3	18.62	4.9	202.67	53.2
1	116.67	138.31	0.00	138.31	497.9	18.62	18.6	119.69	119.2
2	70.00	82.98	0.00	82.98	597.5	18.62	43.9	64.36	151.8
4	42.50	50.38	0.00	50.38	725.5	18.62	85.4	31.76	145.8
6	32.78	38.86	0.00	38.86	839.3	18.62	115.5	20.24	125.5
12	20.00	23.71	0.00	23.71	1,024.3	18.62	-335.7	5.09	-91.8

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Criterion 4
River Flood Protection

Catchment	North Catchment 3
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	2.791 Ha	*… Area of site*
PIMP	=	59%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 139.14m³

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	North Catchment 4
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Development Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	19,827m²
Paved Area	Total	56%	11,103m²
	Drained	90%	9,993m²
Soil Area	Total	44%	8,724m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.01983km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.013m³/s
$Q_{BARrural}$ = 13.229 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	11.24	27.78	34.40
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	13.23	13.23	13.23

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	Return Period *(Years)*						
(Hours)	1	5	10	20	30	50	100
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Summary

Catchment	North Catchment 4
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Development Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**33.31m³**
Treatment Volume	**99.93m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	60.38m³
1-in-30-Year Storm	157.00m³
1-in-100-Year Storm	102.36m³
Reduction of Long-Term Storage	-80.41m³
Volume Required	**239.33m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**80.41m³**
Long Term Storage *(Interception provided)*	**47.10m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	60.38m³
1-in-30-Year Storm	157.00m³
1-in-100-Year Storm	102.36m³
Total	**319.74m³**

The maximum attenuation volume required is 319.74m³

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Criterion 1
River Protection Volume

Catchment	North Catchment 4
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Development Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*19827m² x 0.56 x 0.75 =* 8,327.34m²	*19,827m² site area* *56% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*8327.34m² x 5mm x 0.8 =* **33.31m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*19827m² x 0.56 x 0.75 =* 8,327.34m²	*19,827m² site area* *56% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*8327.34m² x 15mm x 0.8 =* **99.93m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	North Catchment 4
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Development Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	39.97	0.00	39.97	71.9	13.23	23.8	26.74	48.1
1	33.33	26.65	0.00	26.65	95.9	13.23	47.6	13.42	48.3
2	21.83	17.45	0.00	17.45	125.7	13.23	95.2	4.22	30.4
4	14.75	11.79	0.00	11.79	169.8	11.79	169.8	0.00	0.0
6	11.83	9.46	0.00	9.46	204.3	9.46	204.3	0.00	0.0
12	7.50	6.00	0.00	6.00	259.0	6.00	259.0	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	107.66	0.00	107.66	193.8	13.23	17.0	94.43	121.7
1	84.43	67.50	0.00	67.50	243.0	13.23	35.8	54.27	147.1
2	52.22	41.74	0.00	41.74	300.6	13.23	72.8	28.51	157.0
4	32.23	25.76	0.00	25.76	371.0	13.23	139.5	12.53	132.2
6	25.18	20.13	0.00	20.13	434.9	13.23	193.2	6.90	100.8
12	15.74	12.58	0.00	12.58	543.6	12.58	0.0	0.00	0.0

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	149.23	0.00	149.23	268.6	13.23	3.8	136.00	39.5
1	116.67	93.27	0.00	93.27	335.8	13.23	13.7	80.04	82.8
2	70.00	55.96	0.00	55.96	402.9	13.23	31.7	42.73	102.4
4	42.50	33.98	0.00	33.98	489.2	13.23	59.6	20.75	93.4
6	32.78	26.20	0.00	26.20	566.0	13.23	76.4	12.97	74.9
12	20.00	15.99	0.00	15.99	690.7	13.23	-412.8	2.76	-86.1

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Calculation By:	RW
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Criterion 4
River Flood Protection

Catchment	North Catchment 4
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Development Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	1.983 Ha	*… Area of site*
PIMP	=	56%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 80.41m³

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Calculation By:	RW
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Project Data

Catchment	South Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	08/06/2021

Description		%	Area
Total Site Area		-	9,584m²
Paved Area	Total	53%	5,080m²
	Drained	90%	4,572m²
Soil Area	Total	47%	4,504m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.00958km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.006m³/s
$Q_{BARrural}$ = 6.395 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	5.44	13.43	16.63
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	6.39	6.39	6.39

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	Return Period *(Years)*						
(Hours)	1	5	10	20	30	50	100
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Calculation By:	RW
Approved by:	SDN

Summary

Catchment	South Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	08/06/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**15.24m³**
Treatment Volume	**45.72m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	26.76m³
1-in-30-Year Storm	70.05m³
1-in-100-Year Storm	46.83m³
Reduction of Long-Term Storage	-29.95m³
Volume Required	**113.68m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**29.95m³**
Long Term Storage *(Interception provided)*	**14.71m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	26.76m³
1-in-30-Year Storm	70.05m³
1-in-100-Year Storm	46.83m³
Total	**143.63m³**

The maximum attenuation volume required is 143.63m³

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Criterion 1
River Protection Volume

Catchment	South Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	08/06/2021

1.1 Interception

Paved surfaces connected to drainage system	*9584m² x 0.53 x 0.75 =* 3,809.64m²	*9,584m² site area* *53% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*3809.64m² x 5mm x 0.8 =* **15.24m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*9584m² x 0.53 x 0.75 =* 3,809.64m²	*9,584m² site area* *53% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*3809.64m² x 15mm x 0.8 =* **45.72m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Criterion 2
River Regime Protection

Catchment	South Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	08/06/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	18.29	0.00	18.29	32.9	6.39	11.5	11.89	21.4
1	33.33	12.19	0.00	12.19	43.9	6.39	23.0	5.80	20.9
2	21.83	7.99	0.00	7.99	57.5	6.39	46.0	1.59	11.4
4	14.75	5.39	0.00	5.39	77.7	5.39	77.7	0.00	0.0
6	11.83	4.33	0.00	4.33	93.5	4.33	93.5	0.00	0.0
12	7.50	2.74	0.00	2.74	118.5	2.74	118.5	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	49.25	0.00	49.25	88.7	6.39	8.3	42.86	55.7
1	84.43	30.88	0.00	30.88	111.2	6.39	17.4	24.48	66.7
2	52.22	19.10	0.00	19.10	137.5	6.39	35.3	12.70	70.1
4	32.23	11.79	0.00	11.79	169.7	6.39	66.7	5.39	56.2
6	25.18	9.21	0.00	9.21	198.9	6.39	89.5	2.82	39.4
12	15.74	5.76	0.00	5.76	248.7	5.76	0.0	0.00	0.0

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	68.27	0.00	68.27	122.9	6.39	2.1	61.87	19.9
1	116.67	42.67	0.00	42.67	153.6	6.39	6.9	36.27	39.1
2	70.00	25.60	0.00	25.60	184.3	6.39	15.6	19.21	46.8
4	42.50	15.54	0.00	15.54	223.8	6.39	28.2	9.15	40.3
6	32.78	11.99	0.00	11.99	258.9	6.39	33.6	5.59	29.4
12	20.00	7.31	0.00	7.31	316.0	6.39	-359.6	0.92	-51.7

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Calculation By:	RW
Approved by:	SDN

Criterion 4
River Flood Protection

Catchment	South Catchment 1
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	08/06/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	0.958 Ha	*… Area of site*
PIMP	=	53%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 29.95m³

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Calculation By:	RW
Approved by:	SDN

Project Data

Catchment	South Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Description		%	Area
Total Site Area		-	19,193m²
Paved Area	Total	52%	9,980m²
	Drained	90%	8,982m²
Soil Area	Total	48%	9,213m²
	Drained	0%	0m²

Soil Type:	Type 4
SPR Index (from FSR):	0.47
SAAR:	923mm
Rain Data:	Dublin Airport
Climate Change Factor:	20%

Greenfield Runoff:

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

Area = 0.01919km² … *Total site area in km²*
SAAR = 923mm … *Standard Average Annual Rainfall in mm*
SOIL = 0.47 … *The "SPR" index from FSR*

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

$Q_{BARrural}$ = 0.013m³/s
$Q_{BARrural}$ = 12.806 l/s
$Q_{BARrural}$ = 6.672 l/s/Ha

Return Period	1-year	30-year	100-year
Growth Factor	0.85	2.10	2.60
Q_{BAR} (l/s)	10.89	26.89	33.30
Q_{BAR} (l/s/Ha)	5.67	14.01	17.35
Allowable Discharge	12.81	12.81	12.81

Rainfall Data:

Rain Data From: Dublin Airport
Climate Change Factor: 20%

Duration	**Return Period** *(Years)*						
(Hours)	**1**	**5**	**10**	**20**	**30**	**50**	**100**
0.5	9.0	14.4	17.9	22.0	24.2	28.8	33.6
1	12.0	18.6	22.9	27.6	30.4	36.0	42.0
2	15.7	23.8	28.8	34.8	37.6	43.2	50.4
4	21.2	31.2	37.2	43.2	46.4	52.8	61.2
6	25.6	37.2	43.2	50.4	54.4	62.4	70.8
12	32.4	46.8	18.0	63.6	68.0	76.8	86.4

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Summary

Catchment	South Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Summary of GDSDS Calculations:

Criterion 1: River Protection Volume

Interception Volume	**29.94m³**
Treatment Volume	**89.82m³**

Criterion 2: River Regime Protection

1-in-1-Year Storm	52.03m³
1-in-30-Year Storm	136.33m³
1-in-100-Year Storm	92.01m³
Reduction of Long-Term Storage	-54.03m³
Volume Required	**226.34m³**

… Includes head-loss correction

Criterion 4: River Flood Protection

Long Term Storage *(no interception provided)*	**54.03m³**
Long Term Storage *(Interception provided)*	**24.09m³**

Total Attenuation Volume Requirement:

1-in-100 Year Storm

1-in-1-Year Storm	52.03m³
1-in-30-Year Storm	136.33m³
1-in-100-Year Storm	92.01m³
Total	**280.37m³**

The maximum attenuation volume required is 280.37m³

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Criterion 1
River Protection Volume

Catchment	South Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1.1 Interception

Paved surfaces connected to drainage system	*19193m² x 0.52 x 0.75 =* 7,485.27m²	*19,193m² site area* *52% of the site is paved* *75% of the paved area*
Volume of Interception Storage	*7485.27m² x 5mm x 0.8 =* **29.94m³**	*Paved area directly drained* *5mm rainfall depth* *80% paved runoff factor*

1.2 Treatment Volume

Paved surfaces draining to river	*19193m² x 0.52 x 0.75 =* 7,485.27m²	*19,193m² site area* *52% of the site is paved* *75% of the paved area*
Volume of Treatment Storage	*7485.27m² x 15mm x 0.8 =* **89.82m³**	*Paved area directly drained* *15mm rainfall depth* *80% runoff from paved surfaces*

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Calculation By:	RW
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Criterion 2
River Regime Protection

Catchment	South Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

1-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	50.00	35.93	0.00	35.93	64.7	12.81	23.1	23.12	41.6
1	33.33	23.95	0.00	23.95	86.2	12.81	46.1	11.15	40.1
2	21.83	15.69	0.00	15.69	113.0	12.81	92.2	2.88	20.8
4	14.75	10.60	0.00	10.60	152.6	10.60	152.6	0.00	0.0
6	11.83	8.50	0.00	8.50	183.7	8.50	183.7	0.00	0.0
12	7.50	5.39	0.00	5.39	232.8	5.39	232.8	0.00	0.0

30-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	134.67	96.77	0.00	96.77	174.2	12.81	16.7	83.96	109.5
1	84.43	60.67	0.00	60.67	218.4	12.81	35.0	47.87	130.7
2	52.22	37.52	0.00	37.52	270.2	12.81	70.6	24.72	136.3
4	32.23	23.16	0.00	23.16	333.5	12.81	132.9	10.35	107.4
6	25.18	18.10	0.00	18.10	390.9	12.81	175.9	5.29	72.6
12	15.74	11.31	0.00	11.31	488.7	11.31	0.0	0.00	0.0

100-Year Return Period
(Climate Change Factor = 20%)

Duration	Rainfall Rate	Runoff = Rainfall Rate x Area x Soil Type				Discharge		Storage	
		Paved	Green	Total	Volume	Rate	Volume	Rate	Volume
Hours	*(l/s/Ha)*	l/s	l/s	l/s	m³	l/s	m³	l/s	m³
0.5	186.67	134.14	0.00	134.14	241.4	12.81	4.3	121.33	40.4
1	116.67	83.84	0.00	83.84	301.8	12.81	14.0	71.03	77.7
2	70.00	50.30	0.00	50.30	362.2	12.81	31.4	37.49	92.0
4	42.50	30.54	0.00	30.54	439.8	12.81	55.9	17.73	77.4
6	32.78	23.55	0.00	23.55	508.8	12.81	64.6	10.75	54.2
12	20.00	14.37	0.00	14.37	620.9	12.81	-902.4	1.57	-110.3

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Criterion 4
River Flood Protection

Catchment	South Catchment 2
Project Name	Broomfield, Malahide
Project Number	18-091
Client	Birchwell Developments Ltd.
Architect	MCORM
Status	Planning - Rev. B
Date	21/09/2021

Vol_{XS} = RD x A x 10 [(PIMP/100 x α0.8) + (1 - (PIMP/100))(β x Soil) - Soil]

Vol_{XS}			*… Extra runoff volume of development over Greenfield runoff*
RD	=	71 mm	*… Rainfall depth of the 100 year, 6 hour event mm*
A	=	1.919 Ha	*… Area of site*
PIMP	=	52%	*… Impermeable area of total site*
α0.8	=	90%	*… Proportion of paved area drained to drainage network or river with 80% runoff*
β	=	60%	*… Proportion of pervious area drained to the network or river*
Soil	=	0.47	*… SPR index*

Vol_{XS} = 54.03m³

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