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Engineering Services Report

Proposed 16No. Unit Apartment Development

Parnell Road, Bray, Co Wicklow

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McMahon Associates

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1.0 Introduction

McMahon Associates have prepared this Engineering Services Report to describe the proposed drainage, water services, roads and DMURS strategy to be adopted for a proposed 16No. Unit Apartment Development at Parnell Road, Bray, Co. Wicklow.

2.0 Existing Site and Services

The proposed 16No. Unit Housing Development is situated in a brownfield site accessed from a side street namely Parnell Road to the west of Bray Main Street R761. The proposed site was previously a car mechanic garage and is approximately 0.09 hectares in size, refer to drawing C-01. The site is bounded by Parnell Road to the south, commercial premises to the east and north and residential dwellings to the west. Access to the proposed site is from the south via an existing entrance and access way between boundary wall to the west and an existing building to the east side of the access. The proposed Units are located to the north end of the proposed site. The proposed site is enclosed by a boundary wall or borders onto an existing stone building, refer to drawing C-01. There is an existing public footpath that crosses the entrance.

The topography within the site is generally flat with the Finished Floor Level (FFL) of the existing building at 27.00mAOD, the levels vary slightly through the site ranging from approx. 26.70 to 27.37mAOD. There is a localised high spot reaching 27.63mAOD against the boundary wall at the northwest of the site.

2.1 Existing Foul Water

Uisce Éireann (UÉ) record mapping shows an existing 225mm diameter combined sewer on Parnell Road at the entrance to the proposed development. The UÉ record mapping also shows an existing 300mm diameter combined sewer on Bull Lane to the north of the proposed site. Refer to Appendix A for Uisce Éireann record mapping.

The GPR survey undertaken within the site identified local foul sewers running to a manhole at the northeast corner of the site. It is assumed that this drainage was from the existing garage premises.

2.2 Existing Storm Water

There was no separate existing storm sewers identified within the proposed site or the surrounding area. Please see section 2.1 above for details on the Combined Sewer in the vicinity of the proposed site. Refer to Appendix A for Uisce Éireann record mapping.

2.3 Existing Watermain Infrastructure

There is an existing 100mm diameter watermain along Parnell Road and passes by the entrance of the proposed site. This watermain connects to a 225mm diameter trunk main along the R761 road. Uisce Éireann record mapping is available in Appendix A.

3.0 Foul Water Drainage Design *(Refer to Drawing C-02)*

As noted earlier in the report, there is an existing combined sewer on Parnell Road to the south of the proposed site. The proposed 150mm diameter foul sewer and 1200mm diameter manholes servicing the site will connect to a proposed combined sewer and manhole on the existing combined sewer .

Wastewater from the proposed units will be collected by a proposed 100mm diameter foul gravity sewer via soil vent pipes and inspection chambers before being discharged via saddle connections to the 150mm diameter foul main. There will be 16No Units in this development once it is completed and operational, therefore average foul wastewater discharge, dry weather flow (DWF), will be 0.083l/s, with peak usage, 6 times DWF, of 0.50 l/s.

Foul wastewater drainage network for the proposed units will be separated from the surface water sewers initially but will combine in the last manhole within the site prior to discharging to the existing combined sewer. This is to avoid multiple connections to the existing manhole. If a public storm sewer is provided along Parnell Road in future the storm could be separated from the foul. The design will comply with the latest *"Technical Guidance Document H - Drainage and Waste Water Disposal"*. The pipes are designed with a roughness coefficient (ks) of 0.15mm and designed to achieve a minimum self-cleansing velocity of 0.75m/s when flowing half full. Details of the foul drainage pipe design can be found in Appendix C.

All drainage pipes will need to be supported off firm bearing. This may require all soft material to be excavated underneath the pipe runs and backfilled with stone. The depth of this will vary depending on location and depth of invert of the pipe.

4.0 Surface Water Drainage Strategy (Refer to Drawing *C-02)*

The proposed surface water drainage strategy has been designed to capture and control surface water onsite, before discharging it at the current brownfield rate to ensure that the proposed development will not have a detrimental impact on flood risk on and offsite.

The surface water strategy follows the principle of Sustainable Drainage Systems (SuDS), whereby surface water is collected at source and the rate, volume and quality of runoff controlled and improved. The use of SuDS is discussed further in the sections below.

The proposed discharge rate is outlined in Section 4.1 below.

4.1 Surface Water Runoff Rate

The proposed surface water drainage network has been designed to discharge at the brownfield rate. This replicates the current rate of discharge from the site and therefore does not increase flow from the site to the surrounding area. This brown field runoff rate was calculated using the Qbar formula based on the area of existing hardstanding on the site. The brownfield rate was calculated to be 6.0l/s. This calculation can be seen in Appendix B.

4.2 SuDS Selection

The proposed surface water drainage system will drain by gravity and will initially be kept separate from the foul drainage system but will combine in the last manhole within the site prior to discharging to the existing combined sewer. A new storm sewer system is proposed to collect runoff from the proposed Units roof, the surrounding footpaths and roadway.

Roof run-off collection will be via rainwater pipes (RWPs). These RWPs will discharge to gully traps and then into the proposed storm sewers at the base of the Units before discharging into the storm sewer main.

The permeable paving around the Units will provide surface treatment before the run-off enters the pipe network. Subsoil pipes along the low edge of the permeable paving will connect to the piped network.

It is proposed to collect the road run-off using gullies located at the entrance to the site and regular spacing along the road to take surface water from the road and into the piped network.

The green area to the northwest of the site and to the front of the proposed building will be a raingarden area collecting and retaining surface run-off prior to filtering through the raingardens and reaching the perforated pipes under draining the area and discharging to the storm drainage.

Pipes carrying surface water are sized to cater for rainfall intensity of 50mm/hr applied to all roofs and pavements. Surface water runoff was calculated using design software Micro Drainage and the Modified Rational Method. A pipe roughness coefficient (k_s) of 0.15mm was used for surface water drainage design. Pipe sizes and gradients for each pipe were determined using the Wallingford hydraulic design tables. Full detail of Surface water drainage design can be found in Appendix C.

4.3 Attenuation Storage Calculation

The volume of attenuation storage to be provided within the site has been calculated using Microdrainage software, which models the individual drainage elements such as manholes, pipes, flow controls as an entire system using site specific rainfall data. From this data, the M5-60 (5Year, 60 minute event) and R value (ratio of the M5-60 to the M5 – 2day) are calculated and inputted into the software along with the Standard Average Annual Rainfall (SAAR) from Met Éireann's archival data. The modelling network can be seen in Appendix C.

The contributing area for the site was calculated and runoff coefficients applied to each surface type, 0.95 – Roof; 0.9 – hardstanding areas; 0.6 Perm paving; 0.3 – landscaped areas.

A climate change increase of 20% has been allowed for in the design. The maximum volume of storage required in the attenuation storage to the south in the 1 in 100year rainfall event + 20% climate change is 15.2m^3 of storage in the critical 180 minute summer storm.

It is proposed that the surface water storage will be catered for with raingardens and underground within the attenuation storage.

4.4 Flow Controls

1No. flow control has been modelled and can be seen in the results in Appendix C. The flow control will be on the final Storm manhole prior to discharging to the combined manhole and will limit the run-off to the brownfield rate of 6.0l/s. It is proposed to use a vortex flow control device in this manhole.

5.0 Flood Summary *(Refer to Appendix D)*

McMahon Associates have reviewed the flood maps by OPW which shows that the proposed site is not located within a flood zone, therefore compatible with all forms of development. The nearest flood event on the map is along the River Dargle approx. 400m north of the proposed site.

6.0 Watermain Design *(Refer to drawing C-03)*

The watermain for this development will be connected to the existing 100mm diameter watermain on Parnell Road to the south of the site, subject to Uisce Éireann approval. The 100mm watermain will have 1No. fire hydrant so that all Units are within 46m of the hydrant in line with TGD Part B. The hydrant will be located a minimum of 6m away from the Units.

The watermain will have a bulk meter chamber prior to the connection into the apartment building to comply with Uisce Éireann Code of Practice.

All junctions on the watermain will have a 3-way sluice valve arrangement as per Uisce Éireann Code of Practice. An air valve is located at the high point in the network to the north of the site.

7.0 Design Manual for Urban Roads & Streets (DMURS)

7.1 Street Design - Movement & Speed

A 4.8m wide shared surface access into the site will be provided from Parnell Road at the southern end of the development which will cater for vehicles and pedestrians alike. The design speed of the shared surface within the development will be 20km/h, which is consistent with DMURS guidance.

There is no parking provided within the residential development therefore vehicle movements will be infrequent and mainly for drop off/pick-ups, deliveries and refuse collection. Therefore the normal visibility splay requirements in DMURS have been reduced to maintain existing on-street parking at the current level. This is deemed acceptable as the traffic movements will be very infrequent due to no permanent parking facilities being provided in the development.

The kerb radii for the entrance are designed at 1.0m, which is suitable where design speeds are low and movements by larger vehicles are infrequent as specified by Section 4.3.3 of DMURS. This 1.0m radius will also allow pedestrians to have visibility along the shared access road before crossing. The use of smaller radius again will limit the entry / exit speeds and contribute to the self-regulation of speed in the development.

As the access is relatively restricted at 4.8m wide and 20m long and it leads to a cul-de-sac, speeds will be regulated naturally within the development. No further speed control measures are deemed necessary.

The layout of the entrance and shared surface design are all deemed compliant with the principles of DMURS of having a balanced approach to speed with self-regulating access.

7.2 Street Design - Streetscape

Signage within the development will be limited to the speed limit sign visible on entering and the yield sign at the exit of the development. As noted above the layout proposed is a shared surface and self-regulating which reduces the reliance on line-markings and signs. It is proposed to have yield markings at the exit but no further road markings internally within the development. This is in accordance with DMURS which takes a “less is more” approach to road markings and signs which contribute to the self-regulation of speed.

The shared surface finish should clearly indicate to drivers that they have entered a shared surface space by using a contrasting finish to the roadway. Tactile paving is proposed at pedestrian crossing points to inform pedestrians in changes to the road function and assist visually impaired users.

As the development is residential, the need for active street edges to contribute to traffic calming will be provided by pedestrian movements on the shared surface. The access between the existing boundary wall and existing building will contribute to the sense of enclosure and traffic calming. A moderate level of passive surveillance will be maintained within the development by the overlooking apartment Units.

Although the development is residential, street furniture is minimal. Street lighting will be provided to ensure the development remains safe, with lighting columns placed to not interfere with pedestrian movements and minimise light spill off site.

7.3 Street Design – Pedestrian / Cyclist Movements

The proposed footpaths within the development are all minimum 1.8m wide and therefore comply with the minimum standards set out in DMURS. The width of 1.8m is in keeping with the low level of pedestrian movements expected with local streets.

Verge and strips have been excluded from the design to maintain the sense of enclosure of the development.

1No. uncontrolled crossings have been provided to link the footpaths on opposite sides of the entrance. Buff coloured tactile paving to be provided at each side of pedestrian crossing. Tactile surface to be installed to a depth of 3No full pavers at the junction. This ensures the movement of pedestrians across the development entrance is safe and comfortable. No pedestrians crossing are required within the development as a shared surface is provided.

Corner radii have been provided in accordance with DMURS to ensure vehicle speeds are minimised, while also allowing Refuse Truck and Pumped Fire Engine to safely access the site. This contributes to the safety of pedestrians and cyclists.

A shared surface is provided within the development and given the low flow and low speed nature of the development, cyclists and vehicles will be able to safely share the access.

7.4 Street Design – Carriageway Conditions

No parking is provided within the residential development therefore vehicle use of the shared access will be infrequent. A speed ramp is in place on Parnell Road on the east side of entrance which will promote lower speeds past the development entrance.

With the existing parking spaces remaining in place a refuse truck and a pumped fire appliance measuring 7.90 meters in length, 2.50 meters in width, and 3.30 meters in height can reverse into the development. Refer to Drawing C-07.

The carriageway width from the main entrance and along the access route to the turning head is approx. 4.4m. This is keeping within recommended width of 4.8m in DMURS for shared surfaces.

There are no horizontal curvatures within the road layout. Vertical alignments have been designed to suit the existing topography and the proposed surface water drainage system.

7.5 Street Design – Parking

Given the location of the development is located just off the Main Street in Bray town centre and there are several bus routes available with regular service within walking distance, and the restricted size of the development, no parking spaces have been proposed.

8.0 Conclusion

The proposed development will incorporate a robust surface water strategy to ensure flood risk on and offsite will not be affected by the proposed development.

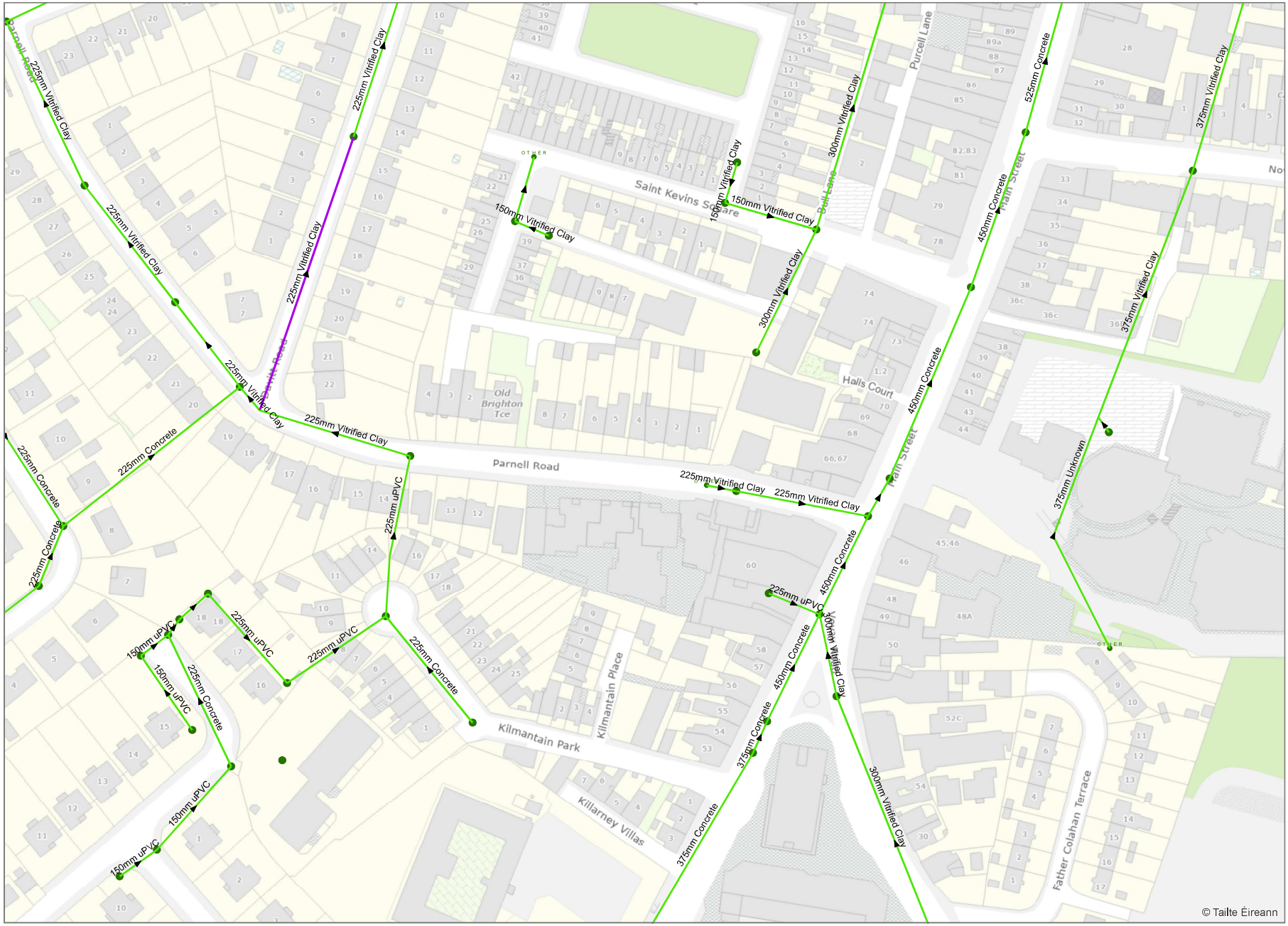
Surface water falling on the development will be collected via permeable paving, raingardens, subsoil pipes, roof downpipes and road gullies and conveyed to the south of the site where surface water will be stored in an underground attenuation system before being discharged at brownfield rate.

Through this mixture of source control and water improvement elements of SuDS the surface water runoff will be of an improved quality. It is concluded that the proposed strategy is beneficial to the site and greater area.

The shared surface, proposed junction and footpaths all have been designed in accordance with DMURS best practice and take account of its philosophy. The layout is considered to contribute to a self-regulating environment which takes account of all users.

Appendix A:

- Existing Services Record Mapping
    - Uisce Éireann Foul Sewer Record
    - Uisce Éireann Watermain Record



Uisce Éireann
Irish Water

Legend

Sewer Gravity Mains (Irish Water owned)

Liquid

Overflow

Sewer

Manhole

Standard

Other;

0 10 20 40 m

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A3:	1:1,250
Drawing No.:	IW-AGG-2018-000
Drawn By:	JJ
Checked By:	<Add Name>
Approved By:	<Add Name>
Drawn Date	03/02/2026
Checked Date:	<dd/mm/yyyy>
Approved Date:	<dd/mm/yyyy>

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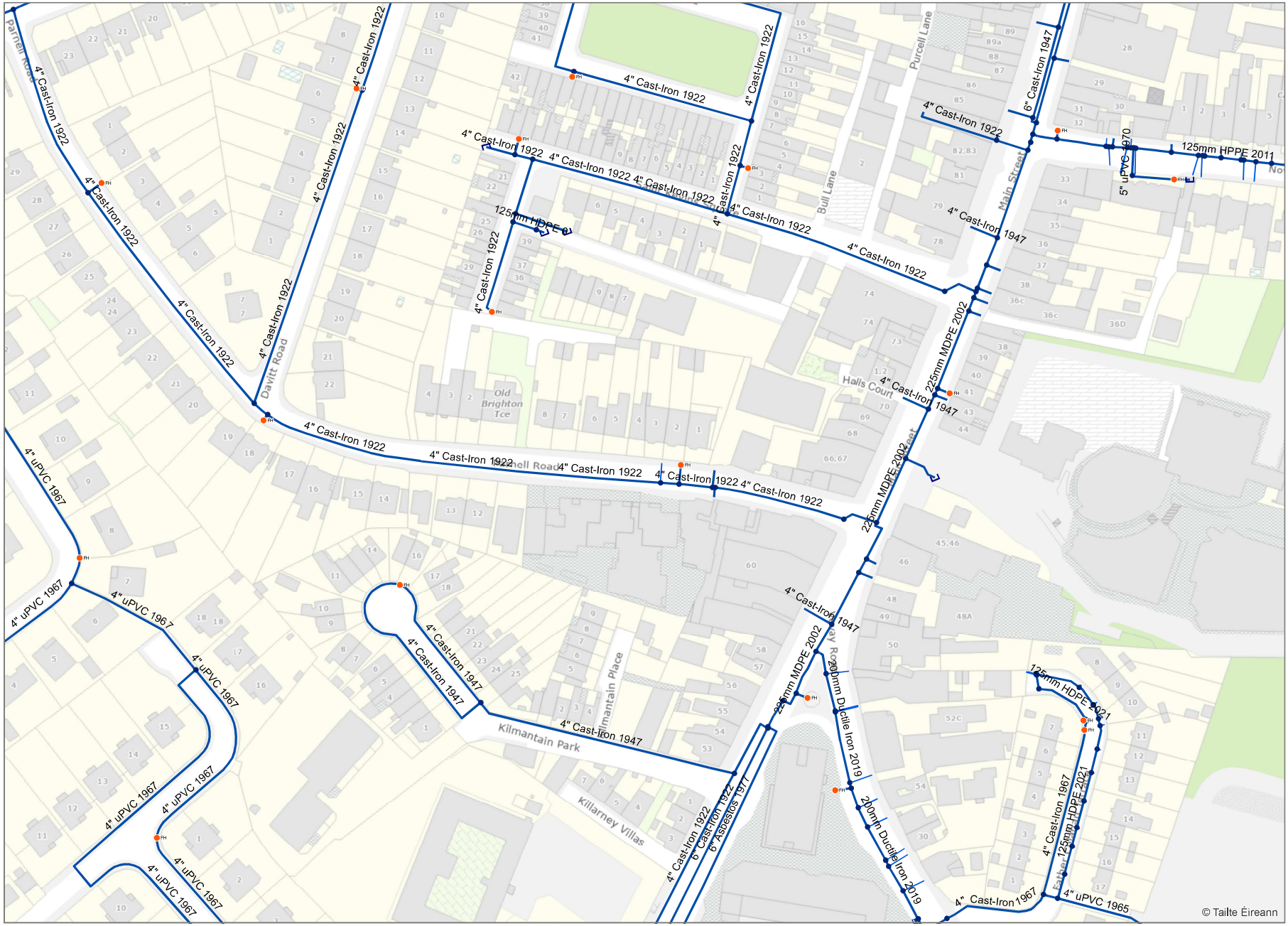
Sewer Network



Uisce Éireann
Irish Water

Legend

Flow Control Valves
- PRV

Water Hydrants
- Fire Hydrant

Water Fittings
- Cap
- Other Fitting

Water Mains(Irish Water Owned)
- Potable Water

Water Lateral Lines
- Irish Water

0 10 20 40 m

Coordinate System: TM65 Irish Grid
Projection: Transverse Mercator

Scale @ A3:	1:1,250
Drawing No.:	IW-AGG-2018-000
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Checked By:	<Add Name>
Approved By:	<Add Name>
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DRAFT

Water Network

Appendix B:

- Met Éireann Rainfall Data
- QBAR Calculation.

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 326236, Northing: 218457,

	Interval		Years									
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	2.4,	3.5,	4.0,	4.9,	5.5,	5.9,	7.5,	9.2,	10.4,	12.0,	13.5,	14.6,	15.4,
10 mins	3.4,	4.8,	5.6,	6.8,	7.6,	8.3,	10.4,	12.8,	14.4,	16.7,	18.8,	20.4,	21.5,
15 mins	3.9,	5.7,	6.6,	8.0,	9.0,	9.7,	12.2,	15.1,	17.0,	19.7,	22.1,	24.0,	25.3,
30 mins	5.2,	7.4,	8.6,	10.3,	11.5,	12.5,	15.5,	19.0,	21.3,	24.5,	27.4,	29.7,	31.2,
1 hours	6.9,	9.6,	11.1,	13.3,	14.8,	15.9,	19.7,	23.9,	26.6,	30.5,	34.0,	36.7,	38.5,
2 hours	9.1,	12.6,	14.4,	17.1,	18.9,	20.3,	24.9,	30.0,	33.4,	38.0,	42.2,	45.3,	47.5,
3 hours	10.7,	14.7,	16.8,	19.8,	21.9,	23.5,	28.6,	34.3,	38.1,	43.2,	47.8,	51.3,	53.7,
4 hours	12.0,	16.4,	18.7,	22.0,	24.3,	26.0,	31.6,	37.8,	41.8,	47.4,	52.3,	56.1,	58.6,
6 hours	14.2,	19.1,	21.7,	25.5,	28.1,	30.0,	36.3,	43.2,	47.7,	53.9,	59.3,	63.5,	66.2,
9 hours	16.7,	22.3,	25.3,	29.6,	32.5,	34.7,	41.7,	49.4,	54.4,	61.2,	67.3,	71.8,	74.9,
12 hours	18.7,	25.0,	28.2,	32.9,	36.0,	38.4,	46.0,	54.3,	59.7,	67.1,	73.5,	78.5,	81.7,
18 hours	22.0,	29.1,	32.8,	38.1,	41.6,	44.3,	52.8,	62.1,	68.1,	76.3,	83.4,	88.8,	92.4,
24 hours	24.8,	32.5,	36.5,	42.3,	46.1,	49.1,	58.3,	68.3,	74.7,	83.5,	91.2,	97.0,	100.9,
2 days	30.9,	39.7,	44.1,	50.5,	54.7,	57.8,	67.7,	78.3,	85.0,	94.2,	102.1,	108.0,	112.0,
3 days	36.1,	45.7,	50.6,	57.5,	61.9,	65.3,	75.8,	87.1,	94.1,	103.7,	111.9,	118.0,	122.1,
4 days	40.7,	51.2,	56.3,	63.7,	68.4,	72.0,	83.2,	94.9,	102.3,	112.3,	120.8,	127.2,	131.4,
6 days	49.1,	60.9,	66.7,	74.9,	80.1,	84.0,	96.2,	109.0,	116.9,	127.6,	136.7,	143.5,	148.0,
8 days	56.8,	69.7,	76.0,	84.9,	90.6,	94.8,	107.9,	121.6,	130.1,	141.4,	151.0,	158.2,	162.9,
10 days	63.9,	77.9,	84.7,	94.2,	100.3,	104.8,	118.8,	133.2,	142.2,	154.1,	164.2,	171.7,	176.7,
12 days	70.7,	85.7,	92.9,	103.1,	109.5,	114.3,	129.0,	144.2,	153.6,	166.1,	176.6,	184.4,	189.6,
16 days	83.6,	100.4,	108.4,	119.6,	126.7,	132.0,	148.1,	164.6,	174.8,	188.3,	199.6,	208.0,	213.5,
20 days	95.8,	114.2,	123.0,	135.2,	142.8,	148.5,	165.9,	183.6,	194.5,	208.9,	220.9,	229.9,	235.7,
25 days	110.5,	130.7,	140.3,	153.6,	161.9,	168.1,	186.9,	206.0,	217.7,	233.1,	246.0,	255.5,	261.7,

NOTES:
These values are derived from a Depth Duration Frequency (DDF) Model update 2023
For details refer to:
'Mateus C., and Coonan, B. 2023. Estimation of point rainfall frequencies in Ireland. Technical Note No. 68. Met Eireann',
Available for download at:
http://hdl.handle.net/2262/102417

M5-60 = 15.9
R - 15.9 / 57.8 = 0.275
SAAR = 890mm

P3953 Parnell Road, Bray, Co. Wicklow

Qbar = 2.78 x C.I.A

C = 1
I = 50 mm/hr
A = 0.0432 Hect

Qbar = 6.00 l/s

Existing Hardstanding		
Building Roof	415.5	m2
Substation Roof/concrete	7.2	m2
Canopy	9.75	m2
Total	432.45	m2

Appendix C:

- Surface water drainage design
    - 1 in 1 year + 20% Climate Change Results
    - 1 in 30 year + 20% Climate Change Results
    - 1 in 100 year +20% Climate Change Results
- Foul Network Design

McMahon Associates		Page 1
Consulting Engineers 50 Dobbin Street Armagh BT61 7QQ		
Date 07/08/2026 11:18 File P3953_PARNELL RD, BRAY ...	Designed by SineadMcCooey Checked by	
XP Solutions	Network 2020.1	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	450.00	Maximum Backdrop Height (m)	1.500
Persons per House	1.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	26.945	1.428	Open Manhole	1200	1.000	25.517	150				
2	26.975	1.628	Open Manhole	1200	1.001	25.347	150	1.000	25.350	150	3
3	26.910	1.682	Open Manhole	1200	1.002	25.228	150	1.001	25.228	150	
	26.800	1.641	Open Manhole	1200		OUTFALL		1.002	25.159	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	726196.100	718468.169	726196.100	718468.169	Required	
2	726171.730	718475.464	726171.730	718475.464	Required	
3	726165.941	718458.501	726165.941	718458.501	Required	
	726163.983	718448.321			No Entry	

PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	26.945	25.517	1.278	Open Manhole	1200
1.001	o	150	2	26.975	25.347	1.478	Open Manhole	1200
1.002	o	150	3	26.910	25.228	1.532	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.438	152.3	2	26.975	25.350	1.475	Open Manhole	1200
1.001	17.924	150.6	3	26.910	25.228	1.532	Open Manhole	1200
1.002	10.367	150.0		26.800	25.159	1.491	Open Manhole	1200

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		26.800	25.159	25.130	1200	0

STORM DESIGN 1 IN 1YR +20%

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	15.900	Add Flow / Climate Change (%)	0
Ratio R	0.275	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.055	4-8	0.019

Total Area Contributing (ha) = 0.074

Total Pipe Volume (m³) = 1.820

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.650	0.187	99.7	0.030	5.00	0.0	0.150	o	225	Pipe/Conduit	
2.000	7.182	0.072	99.8	0.030	5.00	0.0	0.150	o	150	Pipe/Conduit	
1.001	2.564	0.026	98.6	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.002	10.559	0.070	150.8	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.003	9.748	0.065	150.0	0.014	0.00	0.0	0.150	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.20	26.411	0.030	0.0	0.0	0.0	1.53	60.8	5.4
2.000	50.00	5.10	26.371	0.030	0.0	0.0	0.0	1.18	20.9	5.4
1.001	50.00	5.23	26.224	0.060	0.0	0.0	0.0	1.54	61.1	10.8
1.002	50.00	5.37	25.449	0.060	0.0	0.0	0.0	1.24	49.1	10.8
1.003	50.00	5.50	25.379	0.074	0.0	0.0	0.0	1.24	49.3	13.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	2.399	0.016	149.9	0.000	0.00	0.0	0.150	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	50.00	5.55	25.314	0.074	0.0	0.0	0.0	0.96	16.9	13.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backd (mm)
1	26.985	0.574	Open Manhole	900	1.000	26.411	225				
3	26.990	0.619	Open Manhole	600	2.000	26.371	150				
2	26.985	0.761	Open Manhole	900	1.001	26.224	225	1.000	26.224	225	
								2.000	26.299	150	
Storage	26.955	1.506	Open Manhole	1200	1.002	25.449	225	1.001	26.198	225	
4	26.835	1.456	Open Manhole	1200	1.003	25.379	225	1.002	25.379	225	
5	26.800	1.486	Open Manhole	1200	1.004	25.314	150	1.003	25.314	225	
6 Connection	26.800	1.502	Open Manhole	1200		OUTFALL		1.004	25.298	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	726197.442	718469.028	726196.050	718467.088	Required	
3	726172.826	718476.819	726172.826	718476.819	Required	
2	726179.559	718474.320	726179.559	718474.320	Required	
Storage	726178.806	718471.869	726178.806	718471.869	Required	
4	726168.375	718470.227	726168.375	718470.227	Required	
5	726165.616	718460.878	726165.616	718460.878	Required	
6 Connection	726165.941	718458.501			No Entry	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	6 Connection	26.800	25.298	25.018	1200	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 2.0

Unit Reference	MD-SHE-0114-6000-1100-6000
Design Head (m)	1.100
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	25.314
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	6.0
Flush-Flo™	0.325	6.0
Kick-Flo®	0.698	4.9
Mean Flow over Head Range	-	5.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	1.200	6.2	3.000	9.6	7.000	14.4
0.200	5.8	1.400	6.7	3.500	10.3	7.500	14.9
0.300	6.0	1.600	7.1	4.000	11.0	8.000	15.3
0.400	5.9	1.800	7.6	4.500	11.6	8.500	15.8
0.500	5.8	2.000	7.9	5.000	12.2	9.000	16.2
0.600	5.5	2.200	8.3	5.500	12.8	9.500	16.6
0.800	5.2	2.400	8.6	6.000	13.4		
1.000	5.7	2.600	9.0	6.500	13.9		

Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 25.449 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.801	0.0	36.8
0.800	20.0	36.8			

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.275
Region	Scotland and Ireland	Cv (Summer)	1.000
M5-60 (mm)	15.900	Cv (Winter)	1.000

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1
Climate Change (%)	20

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	1	+20%					26.457
2.000	3	15 Summer	1	+20%					26.427
1.001	2	1440 Summer	1	+20%					26.250
1.002	Storage	1440 Summer	1	+20%					25.473
1.003	4	15 Summer	1	+20%					25.413
1.004	5	15 Summer	1	+20%					25.376

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.179	0.000	0.09			4.9	OK	
2.000	3	-0.094	0.000	0.29			4.9	OK	
1.001	2	-0.199	0.000	0.03			0.9	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	Storage	-0.201	0.000	0.02			0.9	OK	
1.003	4	-0.191	0.000	0.05			1.9	OK	
1.004	5	-0.088	0.000	0.18			1.9	OK	

STORM DESIGN 1 IN 30YR +20%

McMahon Associates		Page 1
Consulting Engineers 50 Dobbin Street Armagh BT61 7QQ		Micro Drainage
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XP Solutions	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	15.900	Add Flow / Climate Change (%)	0
Ratio R	0.275	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.055	4-8	0.019

Total Area Contributing (ha) = 0.074

Total Pipe Volume (m³) = 1.820

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.650	0.187	99.7	0.030	5.00	0.0	0.150	o	225	Pipe/Conduit	
2.000	7.182	0.072	99.8	0.030	5.00	0.0	0.150	o	150	Pipe/Conduit	
1.001	2.564	0.026	98.6	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.002	10.559	0.070	150.8	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.003	9.748	0.065	150.0	0.014	0.00	0.0	0.150	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.20	26.411	0.030	0.0	0.0	0.0	1.53	60.8	5.4
2.000	50.00	5.10	26.371	0.030	0.0	0.0	0.0	1.18	20.9	5.4
1.001	50.00	5.23	26.224	0.060	0.0	0.0	0.0	1.54	61.1	10.8
1.002	50.00	5.37	25.449	0.060	0.0	0.0	0.0	1.24	49.1	10.8
1.003	50.00	5.50	25.379	0.074	0.0	0.0	0.0	1.24	49.3	13.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	2.399	0.016	149.9	0.000	0.00	0.0	0.150	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	50.00	5.55	25.314	0.074	0.0	0.0	0.0	0.96	16.9	13.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backd (mm)
1	26.985	0.574	Open Manhole	900	1.000	26.411	225				
3	26.990	0.619	Open Manhole	600	2.000	26.371	150				
2	26.985	0.761	Open Manhole	900	1.001	26.224	225	1.000	26.224	225	
								2.000	26.299	150	
Storage	26.955	1.506	Open Manhole	1200	1.002	25.449	225	1.001	26.198	225	
4	26.835	1.456	Open Manhole	1200	1.003	25.379	225	1.002	25.379	225	
5	26.800	1.486	Open Manhole	1200	1.004	25.314	150	1.003	25.314	225	
6 Connection	26.800	1.502	Open Manhole	1200		OUTFALL		1.004	25.298	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	726197.442	718469.028	726196.050	718467.088	Required	
3	726172.826	718476.819	726172.826	718476.819	Required	
2	726179.559	718474.320	726179.559	718474.320	Required	
Storage	726178.806	718471.869	726178.806	718471.869	Required	
4	726168.375	718470.227	726168.375	718470.227	Required	
5	726165.616	718460.878	726165.616	718460.878	Required	
6 Connection	726165.941	718458.501			No Entry	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	6 Connection	26.800	25.298	25.018	1200	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 2.0

Unit Reference	MD-SHE-0114-6000-1100-6000
Design Head (m)	1.100
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	25.314
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	6.0
Flush-Flo™	0.325	6.0
Kick-Flo®	0.698	4.9
Mean Flow over Head Range	-	5.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	1.200	6.2	3.000	9.6	7.000	14.4
0.200	5.8	1.400	6.7	3.500	10.3	7.500	14.9
0.300	6.0	1.600	7.1	4.000	11.0	8.000	15.3
0.400	5.9	1.800	7.6	4.500	11.6	8.500	15.8
0.500	5.8	2.000	7.9	5.000	12.2	9.000	16.2
0.600	5.5	2.200	8.3	5.500	12.8	9.500	16.6
0.800	5.2	2.400	8.6	6.000	13.4		
1.000	5.7	2.600	9.0	6.500	13.9		

Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 25.449 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.801	0.0	36.8
0.800	20.0	36.8			

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR Ratio R	0.275
Region	Scotland and Ireland	Cv (Summer)	1.000
M5-60 (mm)	15.900	Cv (Winter)	1.000

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

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

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+20%					26.481
2.000	3	15 Summer	30	+20%					26.460
1.001	2	180 Summer	30	+20%					26.295
1.002	Storage	240 Summer	30	+20%					25.557
1.003	4	240 Summer	30	+20%					25.551
1.004	5	240 Summer	30	+20%	30/120 Summer				25.544

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.155	0.000	0.21			11.0	OK	
2.000	3	-0.061	0.000	0.65			11.0	OK	
1.001	2	-0.154	0.000	0.22			6.5	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	Storage	-0.117	0.000	0.18			6.5	OK	
1.003	4	-0.053	0.000	0.20			7.1	OK	
1.004	5	0.080	0.000	0.54			5.8	SURCHARGED	

STORM DESIGN 1 IN 100YR +20%

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Consulting Engineers 50 Dobbin Street Armagh BT61 7QQ		
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XP Solutions	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	15.900	Add Flow / Climate Change (%)	0
Ratio R	0.275	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.055	4-8	0.019

Total Area Contributing (ha) = 0.074

Total Pipe Volume (m³) = 1.820

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	18.650	0.187	99.7	0.030	5.00	0.0	0.150	o	225	Pipe/Conduit	
2.000	7.182	0.072	99.8	0.030	5.00	0.0	0.150	o	150	Pipe/Conduit	
1.001	2.564	0.026	98.6	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.002	10.559	0.070	150.8	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
1.003	9.748	0.065	150.0	0.014	0.00	0.0	0.150	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.20	26.411	0.030	0.0	0.0	0.0	1.53	60.8	5.4
2.000	50.00	5.10	26.371	0.030	0.0	0.0	0.0	1.18	20.9	5.4
1.001	50.00	5.23	26.224	0.060	0.0	0.0	0.0	1.54	61.1	10.8
1.002	50.00	5.37	25.449	0.060	0.0	0.0	0.0	1.24	49.1	10.8
1.003	50.00	5.50	25.379	0.074	0.0	0.0	0.0	1.24	49.3	13.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.004	2.399	0.016	149.9	0.000	0.00	0.0	0.150	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.004	50.00	5.55	25.314	0.074	0.0	0.0	0.0	0.96	16.9	13.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backd (mm)
1	26.985	0.574	Open Manhole	900	1.000	26.411	225				
3	26.990	0.619	Open Manhole	600	2.000	26.371	150				
2	26.985	0.761	Open Manhole	900	1.001	26.224	225	1.000	26.224	225	
								2.000	26.299	150	
Storage	26.955	1.506	Open Manhole	1200	1.002	25.449	225	1.001	26.198	225	
4	26.835	1.456	Open Manhole	1200	1.003	25.379	225	1.002	25.379	225	
5	26.800	1.486	Open Manhole	1200	1.004	25.314	150	1.003	25.314	225	
6 Connection	26.800	1.502	Open Manhole	1200		OUTFALL		1.004	25.298	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	726197.442	718469.028	726196.050	718467.088	Required	
3	726172.826	718476.819	726172.826	718476.819	Required	
2	726179.559	718474.320	726179.559	718474.320	Required	
Storage	726178.806	718471.869	726178.806	718471.869	Required	
4	726168.375	718470.227	726168.375	718470.227	Required	
5	726165.616	718460.878	726165.616	718460.878	Required	
6 Connection	726165.941	718458.501			No Entry	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004	6 Connection	26.800	25.298	25.018	1200	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 2.0

Unit Reference	MD-SHE-0114-6000-1100-6000
Design Head (m)	1.100
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	25.314
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	6.0
Flush-Flo™	0.325	6.0
Kick-Flo®	0.698	4.9
Mean Flow over Head Range	-	5.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	1.200	6.2	3.000	9.6	7.000	14.4
0.200	5.8	1.400	6.7	3.500	10.3	7.500	14.9
0.300	6.0	1.600	7.1	4.000	11.0	8.000	15.3
0.400	5.9	1.800	7.6	4.500	11.6	8.500	15.8
0.500	5.8	2.000	7.9	5.000	12.2	9.000	16.2
0.600	5.5	2.200	8.3	5.500	12.8	9.500	16.6
0.800	5.2	2.400	8.6	6.000	13.4		
1.000	5.7	2.600	9.0	6.500	13.9		

Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 25.449 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.801	0.0	36.8
0.800	20.0	36.8			

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR Ratio R	0.275
Region	Scotland and Ireland	Cv (Summer)	1.000
M5-60 (mm)	15.900	Cv (Winter)	1.000

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

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

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+20%					26.491
2.000	3	15 Summer	100	+20%					26.478
1.001	2	180 Summer	100	+20%					26.433
1.002	Storage	180 Summer	100	+20%	100/60 Summer				26.430
1.003	4	180 Summer	100	+20%	100/60 Summer				26.424
1.004	5	180 Summer	100	+20%	100/15 Summer				26.417

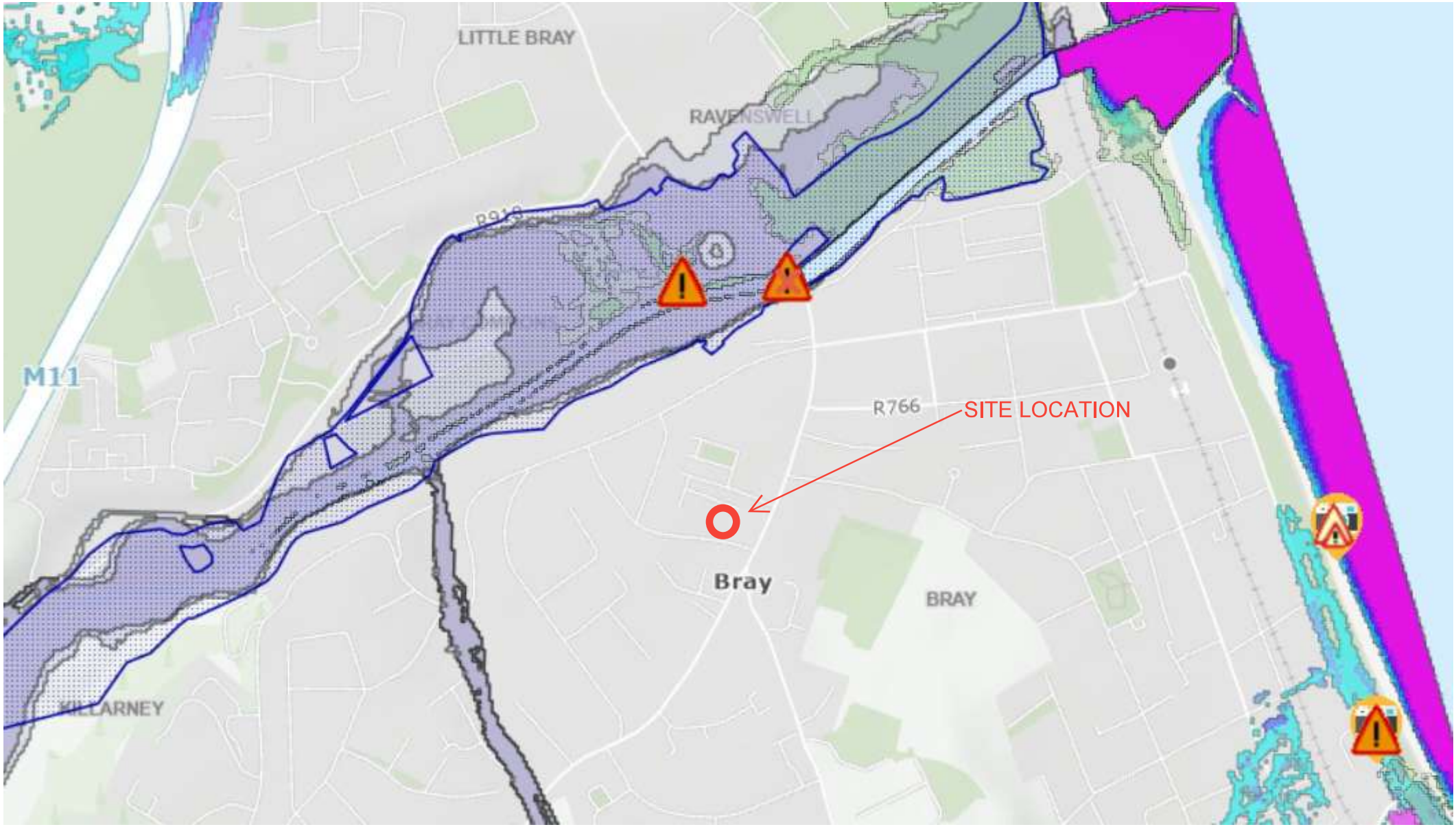
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.145	0.000	0.27			14.2	OK	
2.000	3	-0.043	0.000	0.85			14.2	OK	
1.001	2	-0.016	0.000	0.38			11.4	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.002	Storage	0.756	0.000	0.29			10.7	SURCHARGED	
1.003	4	0.820	0.000	0.26			9.2	SURCHARGED	
1.004	5	0.953	0.000	0.55			6.0	SURCHARGED	

Appendix D:

- OPW Flood Maps


LITTLE BRAY
RAVENSWELL
R918
M11
R766
SITE LOCATION
Bray
BRAY
KILLARNEY