

ENGINEERING DESIGN REPORT

**Residential Development
Lahardane / Ballincolly
Ballyvolane
Co. Cork
November 2019**





DOCUMENT CONTROL SHEET

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This report should be read in conjunction with the submitted Engineering and Architectural Design Drawings

1. INTRODUCTION

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

MHL Consulting Engineers have been engaged by Longview Estates Limited to provide design consultancy services for the civil engineering elements associated with a proposed development of 753 residential units, a 103 child creche and a local neighbour centre on a phased basis (a 10-year permission is being sought) and will be determined by way of the Strategic Infrastructure Application process to An Bord Pleanála. The location of the proposed site along Ballyhooly Road, Ballyvolane, is highlighted in Figure 1.1 below.

The proposed development is located within the area of the Cobh Municipal District Local Area Plan which was adopted in 2017. It is located in an area identified as the Cork City North Environs which includes part of a special policy area known as Ballyvolane Urban Expansion Area. The Northern Environs were identified in the Cork Area Strategic Plan update in 2008 as a significant growth location with Ballyvolane identified as the primary location to accommodate additional growth. The 2011 Blarney Electoral Area LAP required the preparation of a masterplan to guide development using a brief prepared by Cork County Council. A special policy area objective was identified which provides for a minimum of 2,337 and up to 3,600 dwellings through a phased programme of development. This Local Area Plan provides a framework for the development of the Ballyvolane Urban Expansion Area addressing the particular issues relevant to its future development.

The proposed development on our Client's site is consistent with the zoning which is comprised of zoning NE-R-08 and NE-R-09 for Medium B residential development, zoning NE-C-01 for proposed primary and secondary school campus with playing pitches and NE-O-04 for public recreation as an urban park.

The overall vision for the Cork City North Environs is to re-invigorate the northern suburbs of the city, within the County area, as a significant location for future residential development.

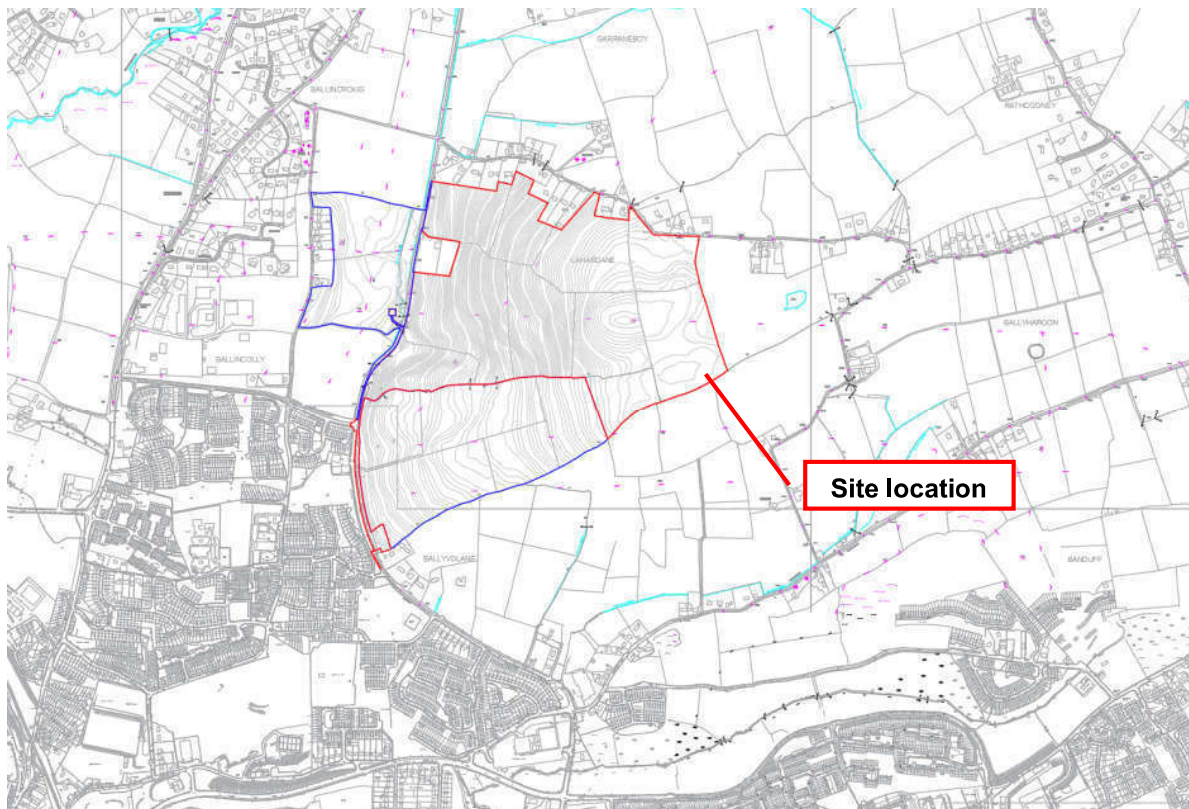


Figure 1.1: Site location

2. ROADS

Distributor Road

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

The distributor road (highlighted in figure 2.1 below) has been designed in accordance with the Design Manual for Urban Roads and Streets (DMRB). A design speed of 40km/h with minimum radii of 56m was agreed with Cork County Councils Traffic & Transportation Section.



Figure 2.1: Proposed Distributor Road

The parameters for a design speed of 40km/h were used to produce the horizontal alignment as required by Cork County Council and are outlined in Table 4.3, DMURS. The minimum value used for horizontal curvature is 56m. Table 4.3 is highlighted in figure 2.2 below.

| HORIZONTAL CURVATURE | | | | | | |
|--|----|----|----|----|-----|-----|
| Design Speed (km/h) | 10 | 20 | 30 | 40 | 50 | 60 |
| Minimum Radius with adverse camber of 2.5% | - | 11 | 26 | 56 | 104 | 178 |
| Minimum Radius with superelevation of 2.5% | - | - | - | 46 | 82 | 136 |

| VERTICAL CURVATURE | | | | | | |
|---------------------|-----|-----|-----|-----|-----|-----|
| Design Speed (km/h) | 10 | 20 | 30 | 40 | 50 | 60 |
| Crest Curve K Value | N/A | N/A | N/A | 2.6 | 4.7 | 8.2 |
| Sag Curve K Value | N/A | N/A | 2.3 | 4.1 | 6.4 | 9.2 |

Figure 2.2: Table 4.3 Carriageway geometry parameters for horizontal and vertical curvature.

To produce a robust design for the distributor road it is prudent to introduce elements of the *Design Manual for Roads and Bridges* and TII document *Rural Road Link Design – DN-GEO-03031*. As the horizontal radii are low and this road is likely to be used by heavy goods vehicle for rubbish collection or deliveries, table 3.2 in the TII document recommends lane widths are widened at curves to 4.5m for a 56m radii curve. In discussions with Cork County Council it was agreed that a relaxation to 3.6m widening at tight bends be used to enforce traffic calming on this route. With regards the vertical alignment, a minimum K-value of 6.5 was used, taken from table 1.3 of the TII document, refer to figure 2.3 below.

| Curve Radius (m) | Minimum Lane Width along curve (m) |
|------------------|------------------------------------|
| 500 | 3.35 |
| 400 | 3.50 |
| 350 | 3.50 |
| 300 | 3.50 |
| 250 | 3.50 |
| 200 | 3.65 |
| 180 | 3.65 |
| 160 | 3.65 |
| 140 | 3.75 |
| 120 | 3.80 |
| 100 | 3.95 |
| 90 | 4.00 |
| 80 | 4.10 |
| 70 | 4.25 |
| 60 | 4.40 |
| 50 | 4.65 |
| 40 | 5.00 |

Figure 2.3: Rural Road Link Design Table 3.2 Minmum lane widths on curves

| DESIGN SPEED (km/h) | 120 | 100 | 85 | 70 | 60 |
|---|-----|-----|----|----|-----|
| Vertical Curvature – Crest | | | | | |
| Desirable Minimum Crest K Value | 182 | 100 | 55 | 30 | 17 |
| One Step below Desirable Min Crest K Value | 100 | 55 | 30 | 17 | 10 |
| Two Steps below Desirable Min Crest K Value | 55 | 30 | 17 | 10 | 6.5 |
| Vertical Curvature – SAG | | | | | |
| Desirable Minimum Crest K Value | 53 | 37 | 26 | 20 | 13 |
| One Step below Desirable Min Crest K Value | 37 | 26 | 20 | 13 | 9 |
| Two Steps below Desirable Min Crest K Value | 26 | 20 | 13 | 9 | 6.5 |

Figure 2.4: Extract from table 1.3 Rural Road Link Design

The Distributor Road has been designed to encourage the use of alternative modes of transport which will contribute to achieving modal shift targets as set-out by Government Policy. The proposed distributor road will

comprise of two 3.0m carriageways, two 3.0m combined cycle/footpaths. In addition to widening at bends an allowance for the provision of two off-road bus stops is proposed which will facilitate any future public transport offering in the area.

In terms of gradient for the distributor road, to be compliant with the gradient requirements of DMURS, the maximum gradient allowed is 8.3%. Cork County Council required that if feasible the road should be designed using a maximum gradient of 5%. A number of options were assessed which involved accessing the site at different locations, winding the distributor road throughout the site and realigning the Ballyhooly Road into third party lands to achieve the 5% gradient. Each of these options resulted in similar depths of cut when compared to the proposed road but had the added disadvantage of significantly increasing the length of road whilst reducing the area of land available to achieve the required density of development to make the scheme economically viable.

The Rural Road Link Design document allows for cycle lanes to be a maximum 10% in gradient, while the National Cycle Manual states in section 1.2.5 *“Cycling infrastructure should be designed, built and maintained for ease of use and for comfort. This is particularly important for beginners, tourists and recreational cyclists...Gradients: Ensure gradients are not excessive”*. Table 4.3 of the Rural Road Link Design document is highlighted in figure 2.5 below.

| | Gradients |
|-----------------------------------|------------------|
| Desirable Maximum | 3% |
| One step below desirable maximum | 5% |
| Two steps below desirable maximum | 10% |

Figure 2.5: Table 4.3 Gradient Requirement for Cycle Facilities

As a consequence of the topography of the site and in order to maintain a 5% gradient along the proposed horizontal alignment as presented in Figure 2.1, levels of cut were reaching 14m below existing ground level. This was found to be excessive and unfeasible as it would adversely impact the layout of the rest of the scheme.

Using the recommendation in DMURS section 4.4.6. *“In hilly terrain, steeper gradients may be required but regard must be had to the maximum gradient that most wheelchair users can negotiate of 8.3%, although this should be limited to shorter distances a designer may need to consider mitigation measures, such as intermediate landings, to ensure that pedestrian routes are accessible”*, a vertical alignment incorporating 5% rest areas at junctions and restricting the maximum gradient of 8.3% to at most 100m in length was deemed an acceptable compromise.

It should be noted that all internal roads within the proposed estate have been designed using a maximum gradient of 5%. A number of at-grade pedestrian/cycle crossings of the Distributor Road will link the estate to the Park opposite, through which pedestrian and cycle paths will provide connectivity to the remainder of the SDZ and further afield.



Figure 2.6: Horizontal alignment Distributor Rd

| Curve | Radius | Curve length | Chainage |
|-------|--------|--------------|---------------|
| C1 | 56m | 38m | 15m – 53m |
| C2 | 56m | 65m | 132m – 197m |
| C3 | 56m | 108m | 272m – 380m |
| C4 | 56m | 37m | 588m – 625m |
| C5 | 75m | 159m | 692m – 851m |
| C6 | 90m | 84m | 955m – 1039m |
| C7 | 200m | 171m | 1084m – 1256m |
| C8 | 59m | 56m | 1265m – 1321m |
| C9 | 274m | 193m | 1343m – 1537m |

Reference Documents:

- Design Manual for Urban Roads and Streets 2013
- NRA Design Manual for Roads and Bridges – TD9/12 Road Link Design February 2012
- TII Rural Road Link Design DN-GEO-03031 June 2017

Table 2.1: Horizontal Design of Distributor Road

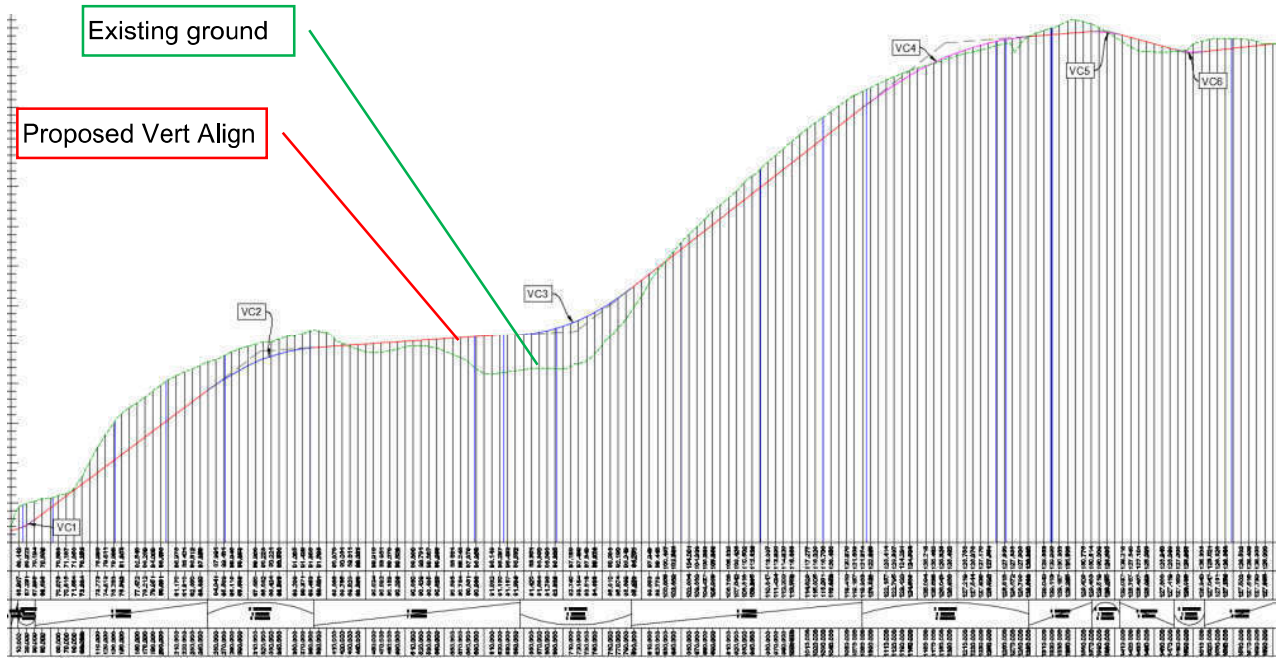


Figure 2.7: Vertical alignment Distributor Rd. (10x Exaggeration)

| Vertical Curve | Curve Radius | Curve length | VIP Chainage | K-Value | Curve Type | Gradient (in / out) | Length (in / out) |
|----------------|--------------|--------------|--------------|---------|------------|---------------------|-------------------|
| VC1 | 500m | 22m | 20m | 5.0 | Sag | 3% / 7.4% | 9m / 219m |
| VC2 | 2000m | 134m | 317m | 20.0 | Crest | 7.4% / 0.7% | 219m / 262m |
| VC3 | 2000m | 142m | 717m | 20.0 | Sag | 0.7% / 7.8% | 262m / 292m |
| VC4 | 3017m | 211m | 1185m | 30.1 | Crest | 7.8% / 0.7% | 292m / 80m |
| VC5 | 1000m | 34m | 1388m | 10.0 | Crest | 0.7% / -2.7% | 80m / 70m |
| VC6 | 1000m | 38m | 1495m | 10.0 | Sag | -2.7% / 1.1% | 70m / 90m |

Reference Documents:

- Design Manual for Urban Roads and Streets 2013
- NRA Design Manual for Roads and Bridges – TD9/12 Road Link Design February 2012
- TII Rural Road Link Design DN-GEO-03031 June 2017

Table 2.2: Vertical Design of Distributor Road

| Chainage | Depth of Cut / Fill | Width of corridor |
|----------|---------------------|-------------------|
| 0 | 0.36m cut | 12.45m |
| 100 | 2.148m cut | 19.15m |
| 200 | 5.004m cut | 29.38m |
| 300 | 2.468m cut | 21.07m |
| 400 | 1.964m cut | 19.75m |
| 500 | 0.665m fill | 16.12m |
| 600 | 4.700m fill | 22.68m |
| 700 | 5.524m fill | 25.89m |
| 800 | 1.966m fill | 20.53m |
| 900 | 1.691m cut | 17.71m |
| 1000 | 2.736m cut | 21.24m |
| 1100 | 1.491m cut | 16.93m |
| 1200 | 0.373m fill | 14.44m |
| 1300 | 0.395m cut | 13.37m |
| 1400 | 0.441m fill | 14.60m |
| 1500 | 1.092m cut | 16.14m |
| 1600 | 0.043m cut | 13.05m |
| 1604 | 0m | 12.45m |

Table 2.3: Depths of cut and fill on Distributor Rd

Internal Estate Roads

The internal estate roads have been designed in accordance with the Design Manual for Urban Roads and Streets as agreed with Cork County Council. A maximum gradient of 5% and minimum gradient of 0.5% was used for all internal estate roads.

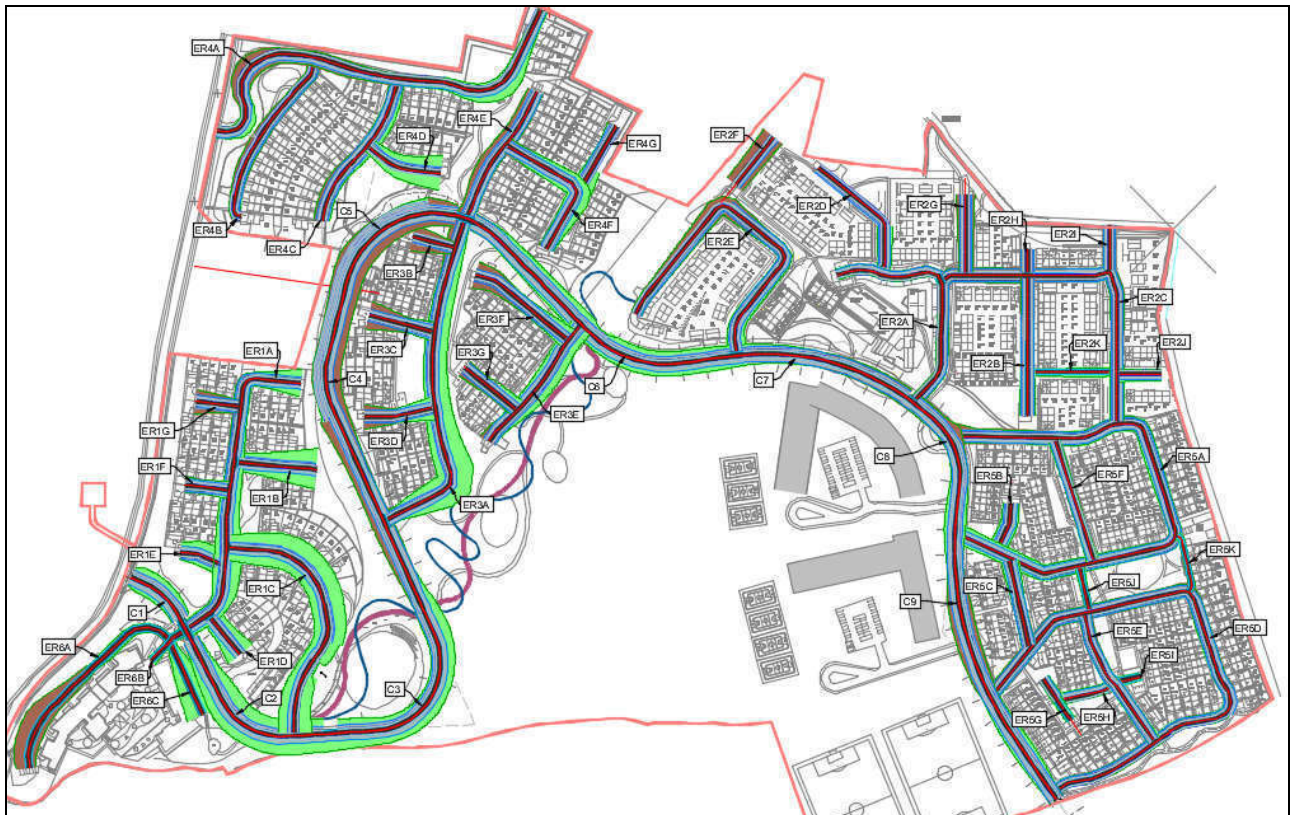


Figure 2.8: Overall proposed estate roads and distributor road with cut and fill lines

The parameters for a design speed of 20km/h were used to produce the horizontal and vertical alignments in accordance with the requirements of Cork County Council. Table 4.3 in DMURS outlines the minimum requirement for horizontal and vertical curvature for a 20km/h road. The minimum value used for horizontal curvature is 11m. To produce a robust design regarding the vertical alignment it is prudent to use K-values relating to a 40km/h road, 4.1 for a crest curve and 2.6 for a sag curve. Figure 3.1 below highlights each of the internal roads and corresponds with Table 2.4 which highlights the maximum and minimum design parameters used.

| Estate Roads Design | Max Gradient | Min Gradient | Max K | Min K | Junction Approach Gradient | Junction Approach Length |
|---------------------|--------------|--------------|-------|-------|----------------------------|--------------------------|
| Estate Road 1A | 5.0% | 3.0% | 5.0 | 2.0 | 3.0% | 17m |
| Estate Road 1B | 5.0% | 5.0% | - | - | 5.0% | 66m |
| Estate Road 1C | 4.6% | 1.9% | 64.0 | 23.0 | 4.6%/1.9% | 63m/47m |
| Estate Road 1D | 5.0% | 5.0% | - | - | 5.0% | 77m |
| Estate Road 1E | 2.5% | 2.5% | - | - | 2.5% | 36m |
| Estate Road 1F | 3.0% | 3.0% | - | - | 3.0% | 34m |
| Estate Road 1G | 3.0% | 3.0% | - | - | 3.0% | 35m |
| Estate Road 2A | 4.5% | 0.7% | 10.0 | 5.0 | 4.5% | 27m |
| Estate Road 2B | 2.6% | 0.5% | 10.0 | 10.0 | 2.6% | 75m |
| Estate Road 2C | 3.7% | 0.5% | 10.0 | 5.0 | 1.5% | 53m |
| Estate Road 2D | 4.0% | 4.0% | - | - | 4.0% | 111m |
| Estate Road 2E | 3.4% | 1.4% | - | - | 1.4% | 91m |
| Estate Road 2F | 0.5% | 0.5% | - | - | 0.5% | 69m |
| Estate Road 2G | 0.8% | 0.8% | - | - | 0.8% | 77m |
| Estate Road 2H | 0.5% | 0.5% | - | - | 0.5% | 18m |
| Estate Road 2I | 1.2% | 1.2% | - | - | 1.2% | 39m |
| Estate Road 2J | 1.3% | 1.3% | - | - | 1.3% | 34m |
| Estate Road 2K | 2.0% | 2.0% | - | - | 2.0% | 68m |
| Estate Road 3A | 5.0% | -0.8% | 15.0 | 10.0 | 3.0%/5.0% | 20m/50m |
| Estate Road 3B | 5.0% | 5.0% | - | - | 5.0% | 33m |
| Estate Road 3C | 5.0% | 5.0% | - | - | 5.0% | 53m |
| Estate Road 3D | 5.0% | 5.0% | - | - | 5.0% | 57m |
| Estate Road 3E | 5.0% | 5.0% | - | - | 5.0% | 125m |
| Estate Road 3F | 5.0% | 5.0% | - | - | 5.0% | 92m |

| | | | | | | |
|--|------|------|------|------|-----------|-----------|
| Estate Road 3G | 5.0% | 5.0% | - | - | 5.0% | 54m |
| Estate Road 4A | 7.7% | 0.5% | 5.0 | 5.0 | 3.0% | 29m |
| Estate Road 4B | 5.0% | 4.9% | 2.4 | 2.4 | 5.0% | 139m |
| Estate Road 4C | 4.9% | 1.6% | 10.0 | 10.0 | 1.6% | 57m |
| Estate Road 4D | 5.0% | 5.0% | - | - | 5.0% | 69m |
| Estate Road 4E | 4.6% | 0.9% | 10.0 | 10.0 | 0.9% | 74m |
| Estate Road 4F | 8.2% | 2.8% | 6.2 | 3.0 | 2.8% | 12m |
| Estate Road 4G | 2.5% | 2.5% | - | - | 2.5% | 61m |
| Estate Road 5A | 1.8% | 0.6% | 20.0 | 5.0 | 0.6%/1.8% | 120m/196m |
| Estate Road 5B | 1.3% | 1.3% | - | - | 1.3% | 59m |
| Estate Road 5C | 2.0% | 0.5% | 5.0 | 5.0 | 0.5%/2.0% | 44m/27m |
| Estate Road 5D | 2.9% | 0.5% | 5.0 | 2.5 | 0.6%/0.5% | 119m/87m |
| Estate Road 5E | 2.1% | 1.0% | 5.9 | 5.9 | 1.0%/2.1% | 57m/60m |
| Estate Road 5F | 4.7% | 2.0% | 5.0 | 5.0 | 2.0%/4.7% | 54m/48m |
| Estate Road 5G | 1.0% | 1.0% | - | - | - | - |
| Estate Road 5H | 0.9% | 0.9% | - | - | 0.9% | 43m |
| Estate Road 5I | 1.0% | 1.0% | - | - | 1.0% | 20m |
| Estate Road 5J | 1.7% | 1.7% | - | - | 1.7% | 33m |
| Estate Road 5K | 2.9% | 1.6% | 5.0 | 5.0 | 2.9%/1.6% | 13m/35m |
| Estate Road 6A | 5.0% | 1.7% | 8.7 | 5.7 | 4.2% | 48m |
| Estate Road 6B | 0.5% | 0.5% | - | - | 0.5% | 35m |
| Estate Road 6C | 5.0% | 5.0% | - | - | 5.0% | 63m |
| Reference Document: | | | | | | |
| ➤ Design Manual for Urban Roads and Streets 2013 | | | | | | |

Table 2.4: Internal Estate Roads Design

3. TRAFFIC AND PEDESTRIAN MANAGEMENT

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

Fig. 3.1 presents an overview of traffic calming and pedestrian connectivity throughout the site. Junction table-tops, 75mm high, are proposed at selected internal roads junctions. These will work in conjunction with colour contrasted surfaces as a reminder to motorists that they are in a low speed regime. Pedestrian crossings are included as part of these raised areas to facilitate the safe movement of pedestrians throughout the scheme. The reader is directed to the Architectural Design Statement and submitted site layout plan for further details.

Fig. 3.2 presents proposed improvement to the road junction between R614 & Kilbarry link road. For further detail on pedestrian connectivity, see drawing numbers LHD-PC-P01, LHD-PC-P02, LHD-PC-P03, LHD-PC-P04, LHD-PC-P05, LHD-PC-P06, and LHD-PC-P07.

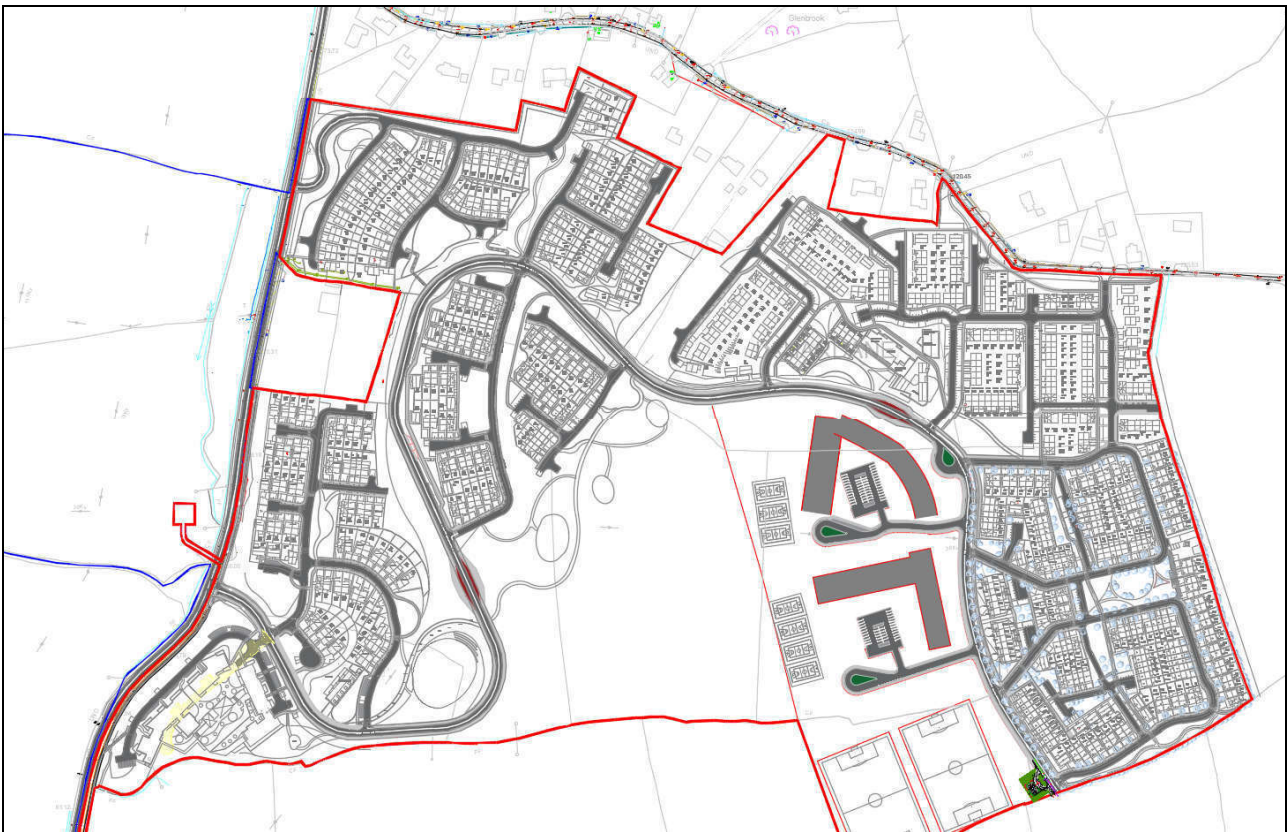


Figure 3.1: Traffic Calming & Pedestrian Connectivity



Figure 3.2: Improvement to R614/Kilbarry Link Road Junction

A separate Traffic & Transport Assessment (TTA) report has been included in the application package for review. The TTA assesses & quantifies how the proposed development will impact the surrounding roads network.

4. SITE INVESTIGATION

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

As part of the design for the proposed development, site investigations were carried out by Priority Geotechnical Ltd. on the green field site in 2017 & 2019. In total, site investigation consisted of 13 No. rotary core holes to measure the depth and strength of rock, 34 No. trial pits to measure the depth of soil and rock and 10 No. infiltration pits to measure the on-site infiltration rate. The investigation also included laboratory testing on samples taken from trial pits and core holes and crushing of rock samples taken from trial pits. The results of these tests indicate that the rock is ripable and can be reused on site.

Figure 4.1 below highlights the locations of the site investigation.

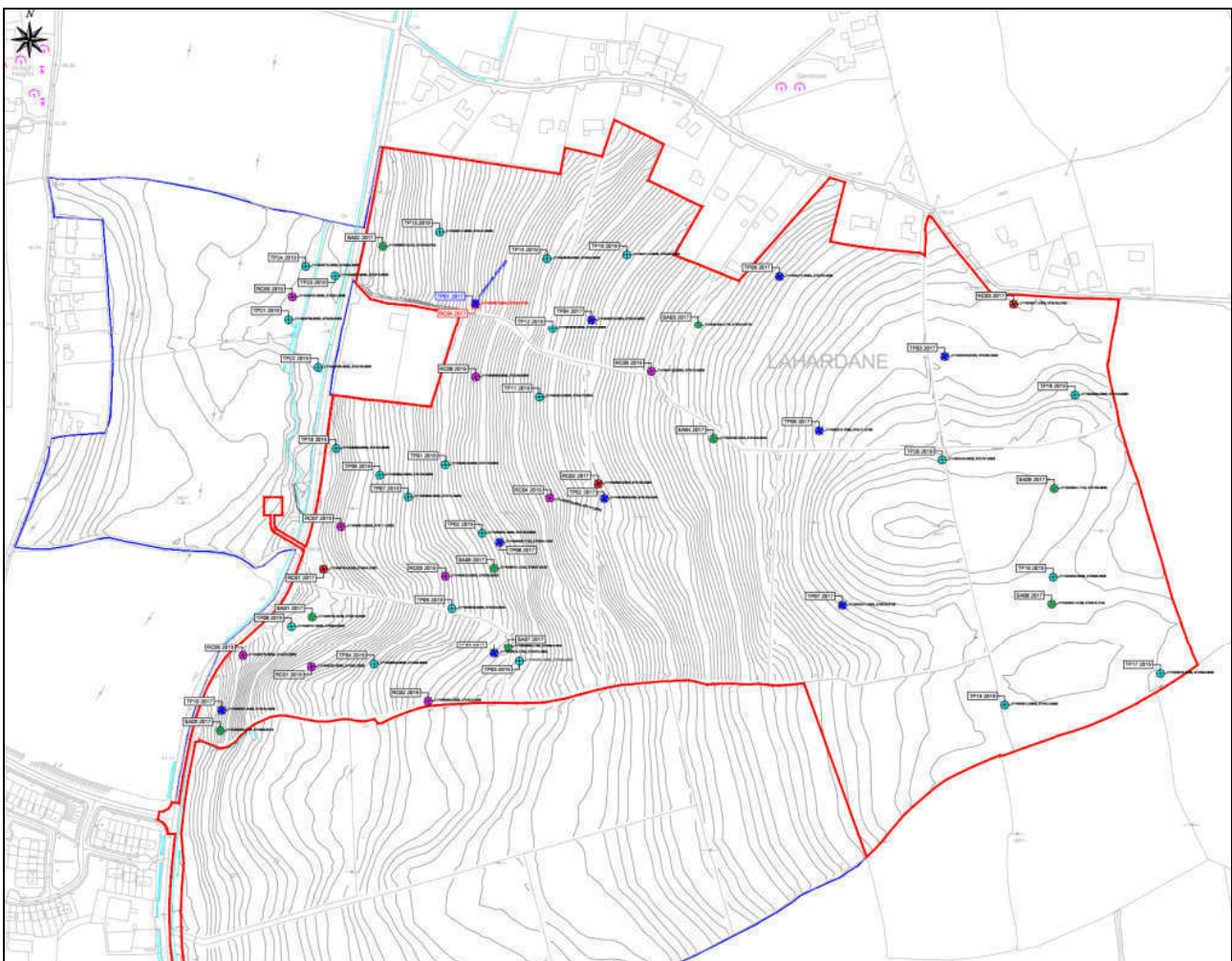


Figure 4.1: Site investigation locations

The complete results and logs of the site investigation are included in a Site Investigation Factual and Interpretative Report included as part of this application.

In addition to the site investigation, a Groundwater Seepage Assessment was conducted by JBA Consulting to provide an assessment of groundwater conditions on site and outline the potential for seepage to occur in areas of cut. JBA Consulting concluded that the nature of the substrate is not highly water-bearing and should be manageable by construction mitigation measures. Some areas of cut within the development will take the new ground level below the current groundwater table. Groundwater discharge rates may be expected to

range from 2 – 92m³/d in the south western part of the site, or 0.004 – 0.184m³/d (0.0004 – 0.002l/s) per unit length. The stormwater attenuation system has been designed to account for the inclusion of this groundwater. The JBA Consulting Ground Seepage Report is included as part of the application.

Site Investigation - Storm design

With regards the design of the storm water network, it was found that soil infiltration rates to the east of the site were high (IT3 and IT4) while infiltration rates to the west of the site were low (IT1/2/5/6/7). This result informed the design team that soakpits could be used for the storm water collection for the eastern portion of the proposed development while the remainder of the site needed to be positively drained off the site. Attenuation tanks have been designed to control the flow of storm water off the site to 5 litres per second per hectare of land (98.2l/s) which is below the existing green field runoff rate of 149.4l/s. Soakpits have been designed using the infiltration rates from the site investigation (1.88x10⁻⁴m/s). Both designs are illustrated in detail in Section 5 of this report. See extract from infiltration test results in Figure 4.2 below. The infiltration tests were carried out in accordance with BRE Digest 365.

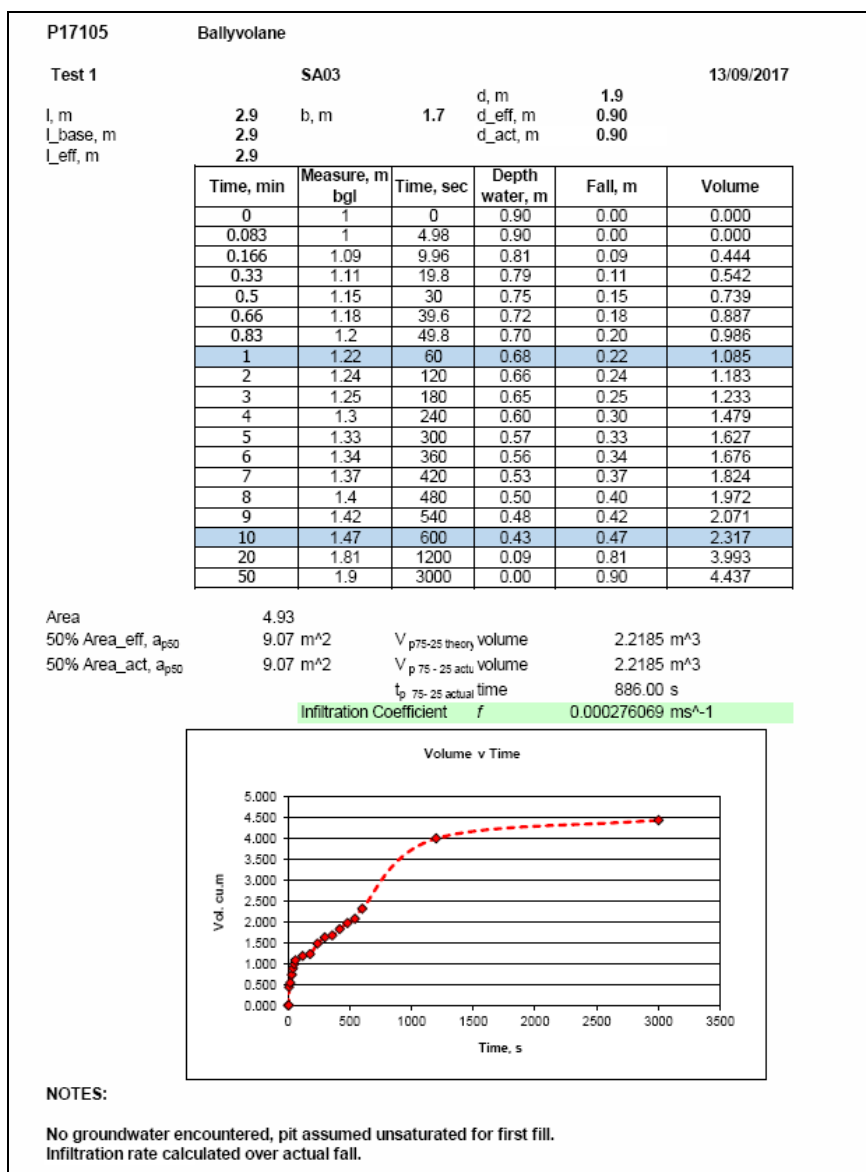


Figure 4.2: Infiltration test results – SA03

Site Investigation - Road design

The site investigation cores and trial pits have informed the design team of the depth and strength of rock and subsoil throughout the site. From this information an approximate volume of cut and fill needed to construct the proposed development has been determined. The samples taken from each pit and corehole also went through a series of lab testing to examine the re-usability of the rock and subsoil. The results of these tests are contained in Appendix D to this report.

In summary, it was found that the volume of rock to be excavated is approx. 50,900m³ while the volume of subsoil is approx. 90,400m³. Table 4.1 below presents the estimated quantities of material to be generated per phase of development. It was also found that the rock varied from that of a moderately strong sandstone to a weak siltstone and that much of the rock and subsoil could be used for general fill across the site which amounts to approx 91,350m³. Finally, there were several soil samples taken from the trial pits and assessed to determine its grading capability. It was found that there appears to be two distinct strata with target moistures 10% and 15% to achieve an MCV8 or more and a minimum design CBR 15%. The upper 1.5m was more plastic and had higher fines contents (>20%), while a more-gravelly deposit was encountered below. A reduction in moisture content of -5% to -6% is required for re-use of any excavated deposits. These deposits will be compacted dry to the optimum moisture content achieving 95% compaction and a CBR 15% minimum. This may be achieved with the addition of lime alone or the addition of lime and subsequent addition of OPC. The latter will provide a stiffer material where the deposits are more granular (<20% fines).

| Summary | | | Cut Breakdown | | |
|-----------------------|-----------------|-----------------|---------------|----------|----------|
| Description | Cut (m3) | Fill (m3) | Topsoil | Subsoil | Rock |
| Main Distributor Road | 33025.15 | 28830.26 | 6758.158 | 17621.66 | 8645.337 |
| Neighbourhood 1 | 58223.55 | 12171.37 | 7448.902 | 30180.86 | 20593.79 |
| Neighbourhood 2 | 12923.79 | 33821.76 | 5843.401 | 6305.963 | 774.425 |
| Neighbourhood 3 | 17088.67 | 38556.4 | 4220.603 | 8655.356 | 4212.708 |
| Neighbourhood 4 | 31270.01 | 22554.65 | 7708.464 | 15569.45 | 7992.096 |
| Neighbourhood 5 | 16701 | 11741.69 | 10940.72 | 5755.966 | 4.312 |
| Neighbourhood 6 | 17600.46 | 4760.655 | 2695.258 | 6229.607 | 8675.59 |
| Subtotal | 186832.6 | 152436.8 | 45615.51 | 90318.86 | 50898.26 |

Table 4.1 Breakdown of Materials to be generated per Neighbourhood

Extracts from trial pit and corehole logs generated by Priority Geotechnical Ltd. are highlighted in figure 4.3 below. The full site investigation report provided by Priority Geotechnical Ltd. is included in this planning submission for reference.

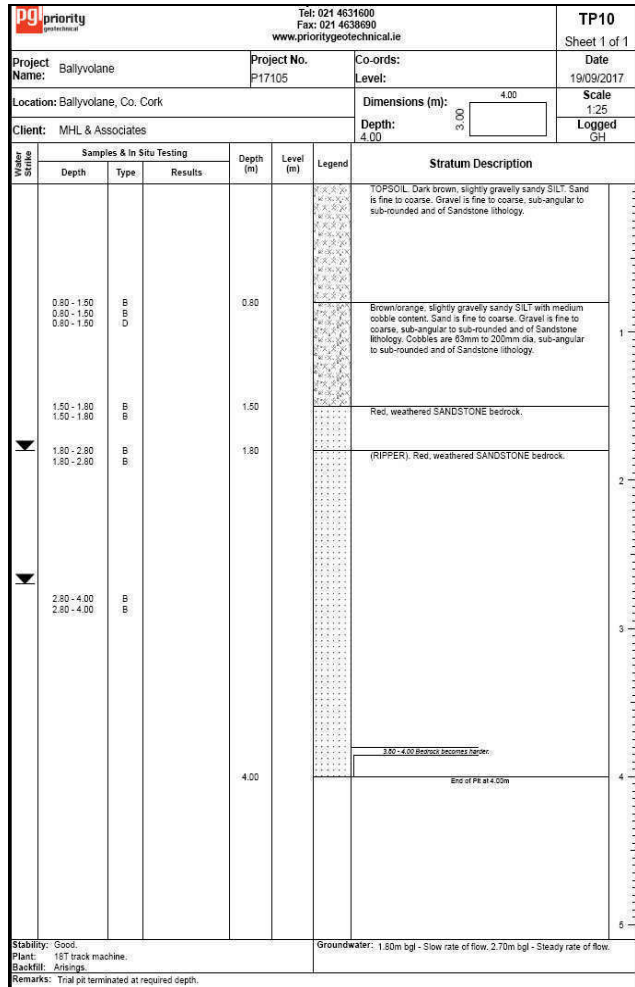
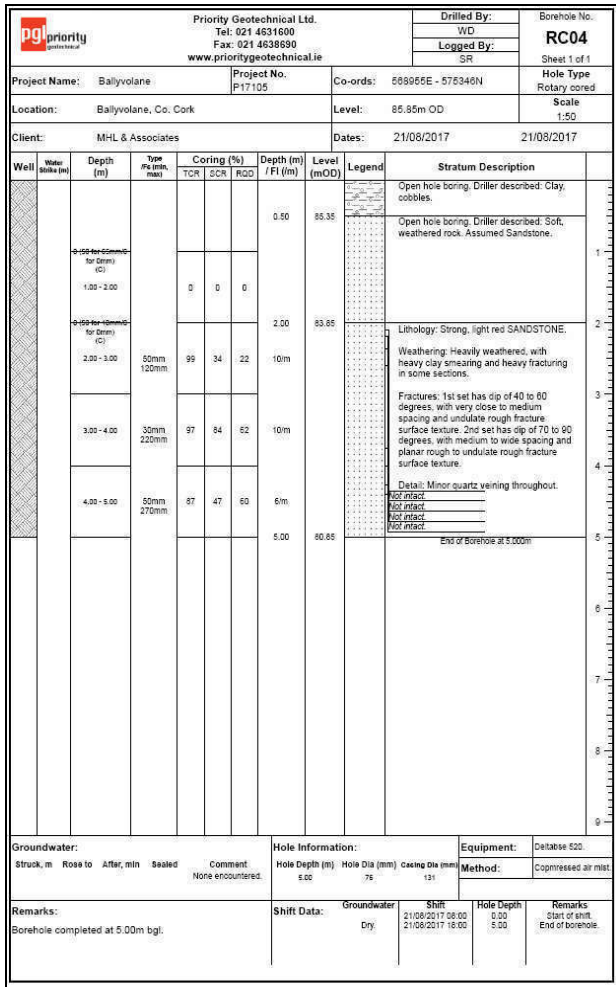


Figure 4.3: Rotary Corehole 04 and Trial Pit 10 logs (2017)

5. STORM WATER NETWORK

Storm design: (Return Period 1:100 with a 20% Climate Change Factor)

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

The proposed surface water drainage system is in accordance with Sustainable Urban Drainage Systems (SUDS) principles and divides the site into seventeen (17) drainage catchments; eight (8) catchments being proposed for infiltration, and nine (9) catchments proposed for attenuation utilising Stormtech Underground Chamber systems with a controlled average greenfield run-off rate of 5.0 l/s/ha (Qbar for the site). The attenuated systems will ultimately discharge into the stream located on the west side of Ballyhooly Road at two locations.

To ensure a thorough design, JBA Consulting Ltd. were invited to produce a Groundwater Seepage Assessment for inclusion in the stormwater network capacity calculations (refer to appendix F for report). The report concluded that a groundwater discharge rate of 0.004 - 0.184 m³/d (0.00004 - 0.002 l/s) per unit length (per m) could be expected in areas of cut below the current groundwater table. This rate has been included in the stormwater network design calculations for sizing proposed pipelines and attenuation tanks in impacted zones.

The calculated storm sewer pipe diameters to provide adequate capacity for the development is shown in the table below. The minimum gradient in the development storm sewer network is 1/150. The maximum gradient in the development storm sewer network is 1/7.

The storm-runs (Design Details provided in Table 5.1) generally flow in a south-westerly direction to several proposed attenuation tanks and soakpits. The design of the soakpits was informed by infiltration tests carried out on the site, as highlighted in section 4 above. Each soakpit was designed using BRE Digest 365 with an infiltration rate of 1.88×10^{-4} m/s. The design of the attenuation tanks was informed by an actual greenfield run-off rate of 233.64 l/s using HR Wallingford Methodology IH124. However, in order to produce a robust design, the greenfield run-off rate has been restricted to 5 litres per second per hectare (170.80 l/s). Details of the attenuation tanks and soakpit design and sizes are included in tables 5.2 and 5.3 below. Attenuation tanks and soakpits have been designed for a storm return period of 1 in 100 year and with a 20% climate change factor.

There are three proposed outfalls to the Ballyhooly Rd, where a proposed 600mm storm line will be constructed, running south along the extents of the development to outfall to the existing watercourse running west of Ballyhooly Rd.

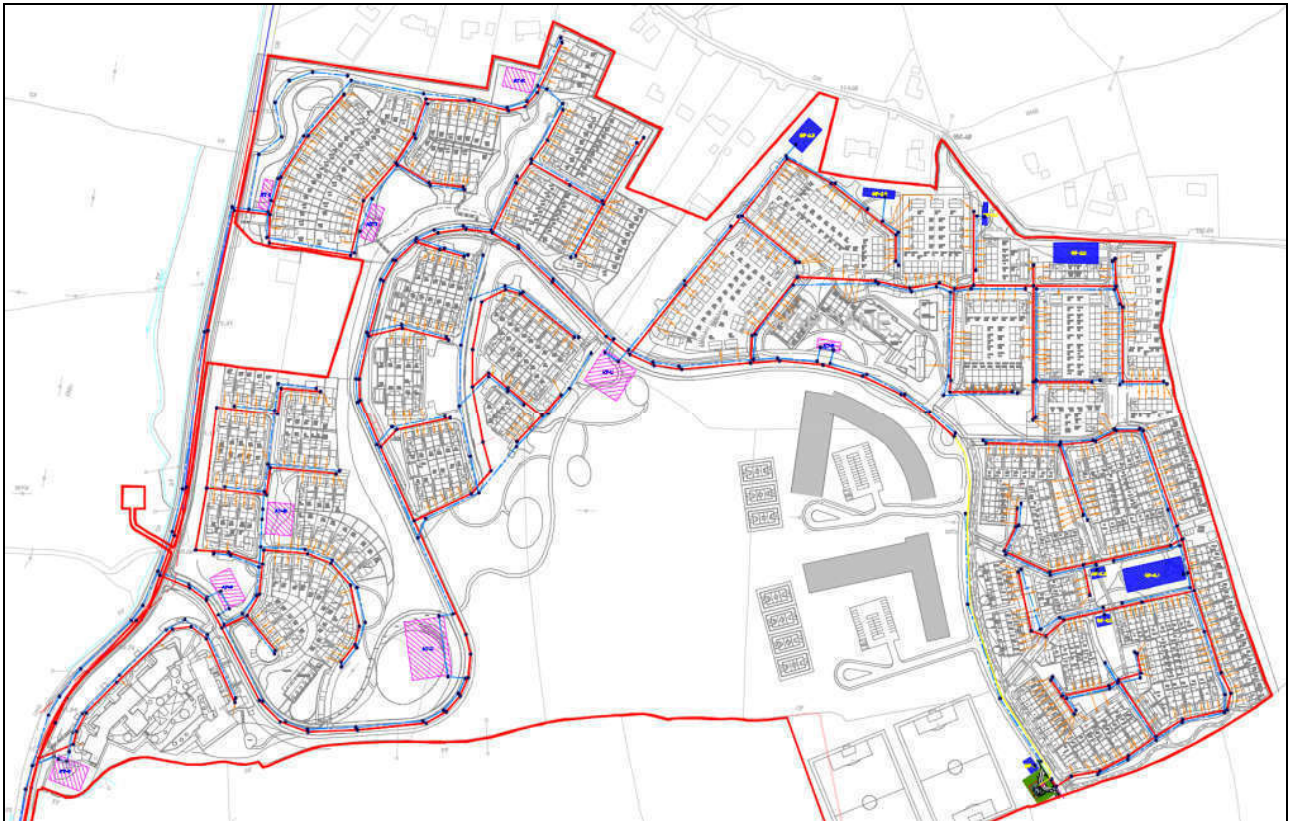


Figure 5.1: Proposed storm/foul lines, attenuation tank, and soakpit locations

Full details of the stormwater design can be found in drawings LHD-S1-P01, LHD-S2-P01, LHD-S2-P02, LHD-S3-P01, LHD-S4-P01, LHD-S5-P01, LHD-S5-P02, and LHD-S6-P01. Longsections of the stormwater network are presented in drawings LHD-SLS-P01, LHD-SLS-P02, LHD-SLS-P03, LHD-SLS-P04, LHD-SLS-P05, LHD-SLS-P06, and LHD-SLS-P07.

The construction of the storm sewer pipe network shall be in accordance with BS EN 752:2008 - drain and sewer systems outside buildings.

| Pipe Name | Upstream MH ID | Downstream MH ID | Length (m) | Dia (mm) | Vel (m/s) | Flow (l/s) | Σ Area (ha) |
|-----------|----------------|------------------|------------|----------|-----------|------------|-------------|
| 11.000 | S11.000 | S11.001 | 28.101 | 225 | 2.464 | 0 | 0 |
| 11.001 | S11.001 | S11.002 | 16.565 | 225 | 2.209 | 15 | 0.111 |
| 11.002 | S11.002 | S11.003 | 20.812 | 300 | 1.214 | 26.7 | 0.197 |
| 12.000 | S12.000 | S12.001 | 35.169 | 225 | 2.577 | 0 | 0 |
| 12.001 | S12.001 | S12.002 | 48.343 | 225 | 1.934 | 11.7 | 0.086 |
| 12.002 | S12.002 | S12.003 | 12.934 | 375 | 1.913 | 63.8 | 0.471 |
| 13.000 | S13.000 | S13.001 | 62.815 | 225 | 2.416 | 0 | 0 |
| 13.001 | S13.001 | S12.002 | 65.898 | 300 | 0.751 | 47.6 | 0.351 |
| 14.000 | S14.000 | S14.001 | 60.989 | 225 | 2.265 | 0 | 0 |
| 14.001 | S14.001 | S7.011 | 76.036 | 225 | 2.634 | 11.3 | 0.129 |
| 16.000 | S16.000 | S16.001 | 55.316 | 225 | 2.767 | 0 | 0 |
| 16.001 | S16.001 | S16.002 | 70.597 | 300 | 2.993 | 61.3 | 0.452 |
| 16.002 | S16.002 | S16.003 | 54.529 | 300 | 1.210 | 69.7 | 0.514 |
| 16.003 | S16.003 | S16.004 | 18.266 | 300 | 3.000 | 88 | 0.649 |
| 16.004 | S16.004 | S16.005 | 8.302 | 300 | 1.706 | 88 | 0.649 |

| | | | | | | | |
|--------|---------|---------|--------|-----|-------|-------|-------|
| 16.005 | S16.005 | S16.006 | 15.828 | 375 | 1.367 | 103 | 0.76 |
| 16.006 | S16.006 | S16.007 | 17.756 | 375 | 2.414 | 104.9 | 0.774 |
| 16.007 | S16.007 | S16.008 | 29.336 | 375 | 3.000 | 108.1 | 0.798 |
| 16.008 | S16.008 | S16.009 | 43.524 | 375 | 3.000 | 118 | 0.871 |
| 16.009 | S16.009 | S16.010 | 62.862 | 375 | 3.000 | 130.5 | 0.963 |
| 16.010 | S16.010 | S16.011 | 62.362 | 375 | 3.000 | 137.7 | 1.016 |
| 16.011 | S16.011 | S16.012 | 42.365 | 375 | 3.000 | 158.3 | 1.168 |
| 16.012 | S16.012 | S16.013 | 19.957 | 375 | 3.000 | 170.2 | 1.256 |
| 17.000 | S17.000 | S16.001 | 57.365 | 225 | 1.972 | 0 | 0 |
| 18.000 | S18.000 | S27.002 | 34.718 | 225 | 0.871 | 6 | 0 |
| 2.000 | S2.000 | S2.001 | 72.628 | 375 | 2.956 | 139.9 | 2.02 |
| 2.001 | S2.001 | S2.002 | 41.479 | 375 | 2.992 | 145.7 | 2.122 |
| 2.002 | S2.002 | S2.003 | 26.915 | 375 | 2.841 | 148.2 | 2.171 |
| 2.003 | S2.003 | S2.004 | 23.84 | 375 | 2.936 | 158.4 | 2.333 |
| 2.004 | S2.004 | S2.005 | 24.896 | 375 | 2.995 | 159.6 | 2.363 |
| 2.005 | S2.005 | S2.006 | 21.86 | 375 | 2.966 | 160.9 | 2.392 |
| 2.006 | S2.006 | S2.007 | 22.251 | 375 | 2.788 | 169.5 | 2.533 |
| 2.007 | S2.007 | S2.008 | 19.625 | 375 | 2.944 | 170.6 | 2.56 |
| 2.008 | S2.008 | S2.009 | 46.566 | 375 | 2.766 | 170.4 | 2.583 |
| 2.009 | S2.009 | S2.010 | 40.847 | 450 | 1.718 | 188.5 | 2.896 |
| 2.010 | S2.010 | S2.011 | 20.059 | 450 | 1.623 | 190.4 | 2.947 |
| 2.011 | S2.011 | S2.012 | 48.174 | 450 | 1.558 | 188.7 | 2.971 |
| 2.012 | S2.012 | S2.013 | 79.655 | 450 | 1.373 | 200.1 | 3.252 |
| 2.013 | S2.013 | S2.014 | 71.708 | 525 | 1.522 | 250.3 | 4.166 |
| 2.014 | S2.014 | S2.015 | 12.353 | 525 | 1.522 | 258.6 | 4.322 |
| 2.015 | S2.015 | S2.016 | 52.465 | 600 | 0.916 | 251.5 | 4.322 |
| 20.000 | S20.000 | S16.005 | 45.687 | 225 | 0.543 | 0 | 0 |
| 21.000 | S21.000 | S21.001 | 38.955 | 300 | 2.859 | 0 | 0 |
| 21.001 | S21.001 | S21.002 | 40.257 | 300 | 1.748 | 21.7 | 0.25 |
| 21.002 | S21.002 | S21.003 | 51.605 | 300 | 1.650 | 24.3 | 0.288 |
| 21.003 | S21.003 | S21.004 | 45.429 | 300 | 2.900 | 32.3 | 0.388 |
| 21.004 | S21.004 | S21.005 | 32.037 | 300 | 3.185 | 35.3 | 0.428 |
| 21.005 | S21.005 | S21.006 | 50.577 | 300 | 3.160 | 56.1 | 0.69 |
| 21.006 | S21.006 | S2.013 | 17.779 | 300 | 1.894 | 65.9 | 0.817 |
| 22.000 | S22.000 | S22.001 | 35.088 | 225 | 2.748 | 0 | 0 |
| 22.001 | S22.001 | S22.002 | 29.082 | 225 | 2.732 | 7.1 | 0.078 |
| 22.002 | S22.002 | S22.003 | 39.534 | 225 | 2.745 | 11.4 | 0.128 |
| 22.003 | S22.003 | S21.005 | 50.815 | 225 | 3.000 | 20.3 | 0.232 |
| 23.000 | S23.000 | S23.001 | 20.857 | 225 | 3.000 | 0 | 0 |
| 23.001 | S23.001 | S2.006 | 28.651 | 225 | 2.435 | 7.4 | 0.081 |
| 24.000 | S24.000 | S24.001 | 39.667 | 225 | 3.000 | 0 | 0 |
| 24.001 | S24.001 | S2.009 | 30.292 | 225 | 2.834 | 18.1 | 0.2 |
| 25.000 | S25.000 | S25.001 | 40.474 | 225 | 3.000 | 0 | 0 |
| 25.001 | S25.001 | S2.012 | 28.591 | 225 | 3.000 | 17.3 | 0.19 |
| 27.000 | S27.000 | S27.001 | 32.718 | 225 | 2.736 | 5.7 | 0 |

| | | | | | | | |
|--------|---------|---------|--------|-----|-------|-------|-------|
| 27.001 | S27.001 | S27.002 | 23.234 | 225 | 2.298 | 15.9 | 0 |
| 27.002 | S27.002 | S27.003 | 47.455 | 300 | 1.048 | 44.9 | 0 |
| 27.003 | S27.003 | S27.004 | 23.632 | 300 | 2.315 | 80.8 | 0 |
| 27.004 | S27.004 | S27.005 | 15.088 | 600 | 1.013 | 108.6 | 0 |
| 27.005 | S27.005 | S27.006 | 8.679 | 375 | 1.011 | 108.7 | 0 |
| 27.006 | S27.006 | S27.007 | 23.511 | 375 | 2.719 | 110 | 0 |
| 27.007 | S27.007 | S27.008 | 17.361 | 375 | 2.719 | 186.8 | 0 |
| 27.008 | S27.008 | S27.009 | 24.199 | 375 | 2.719 | 199.9 | 0 |
| 27.009 | S27.009 | S27.010 | 19.571 | 375 | 2.719 | 204.4 | 0 |
| 27.010 | S27.010 | S44.001 | 18.23 | 375 | 3.000 | 219.4 | 0 |
| 28.000 | S28.000 | S28.001 | 20.848 | 225 | 2.075 | 10.8 | 0 |
| 28.001 | S28.001 | S28.002 | 22.664 | 225 | 1.923 | 15 | 0 |
| 28.002 | S28.002 | S28.003 | 30.573 | 225 | 2.168 | 21.4 | 0 |
| 28.003 | S28.003 | S28.004 | 31.53 | 225 | 2.168 | 27.1 | 0 |
| 28.004 | S28.004 | S28.005 | 24.895 | 225 | 2.488 | 46.2 | 0 |
| 28.005 | S28.005 | S27.007 | 38.105 | 225 | 2.139 | 62.1 | 0 |
| 3.000 | S3.000 | S3.002 | 33.355 | 300 | 2.407 | 0 | 0 |
| 3.001 | S3.002 | S3.003 | 77.63 | 300 | 1.854 | 26 | 0.192 |
| 3.002 | S3.003 | S4.002 | 66.581 | 375 | 1.183 | 80.2 | 0.592 |
| 30.000 | S30.000 | S27.003 | 61.295 | 225 | 2.556 | 0 | 0 |
| 31.000 | S31.000 | S31.001 | 59.327 | 225 | 2.476 | 98.4 | 0 |
| 31.001 | S31.001 | S31.002 | 23.425 | 225 | 0.979 | 38.9 | 0.191 |
| 31.002 | S31.002 | S31.003 | 18.013 | 225 | 2.868 | 114 | 0.215 |
| 31.003 | S31.003 | S31.004 | 55.579 | 225 | 1.363 | 54.2 | 0.238 |
| 31.004 | S31.004 | S31.005 | 45.825 | 300 | 1.469 | 103.8 | 0.364 |
| 31.005 | S31.005 | S31.006 | 18.036 | 300 | 3.000 | 231.4 | 0.474 |
| 31.006 | S31.006 | S31.007 | 16.46 | 300 | 3.000 | 370.6 | 0.503 |
| 31.007 | S31.007 | S31.009 | 11.12 | 300 | 2.393 | 169.2 | 0.556 |
| 31.008 | S31.008 | S31.009 | 5.962 | 225 | 2.393 | 169.2 | 0 |
| 31.009 | S31.009 | S31.010 | 16.118 | 300 | 2.393 | 169.2 | 0 |
| 32.000 | S32.000 | S37.001 | 70.363 | 225 | 1.001 | 0 | 0 |
| 33.000 | S33.000 | S33.001 | 18.43 | 225 | 1.869 | 0 | 0 |
| 33.001 | S33.001 | S33.002 | 27.575 | 225 | 1.378 | 7.2 | 0.053 |
| 33.002 | S33.002 | S33.003 | 42.079 | 225 | 1.589 | 15 | 0.111 |
| 33.003 | S33.003 | S33.004 | 39.986 | 225 | 1.619 | 23 | 0.17 |
| 34.000 | S34.000 | MH622 | 28.631 | 225 | 0.865 | 0 | 0 |
| 34.001 | MH622 | S34.001 | 29.24 | 225 | 1.002 | 17.1 | 0.126 |
| 34.002 | S34.001 | S34.002 | 26.909 | 375 | 1.000 | 77.8 | 0.574 |
| 34.003 | S34.002 | S34.003 | 37.027 | 375 | 1.003 | 82.9 | 0.612 |
| 34.004 | S34.003 | S34.004 | 15.527 | 375 | 1.005 | 95.1 | 0.702 |
| 34.005 | S34.004 | S34.005 | 56.229 | 375 | 1.002 | 102.1 | 0.753 |
| 34.006 | S34.005 | S34.006 | 39.585 | 600 | 2.596 | 130.8 | 0.965 |
| 34.007 | S34.006 | S34.007 | 12.689 | 600 | 3.000 | 170.9 | 1.261 |
| 34.008 | S34.007 | S34.008 | 13.101 | 600 | 1.664 | 325.8 | 2.404 |
| 35.000 | S35.000 | S35.001 | 65.08 | 300 | 1.653 | 0 | 0 |

| | | | | | | | |
|--------|---------|---------|--------|-----|-------|-------|-------|
| 35.001 | S35.001 | S35.002 | 28.838 | 375 | 1.320 | 37.8 | 0.279 |
| 35.002 | S35.002 | S35.003 | 38.366 | 375 | 1.272 | 43.4 | 0.32 |
| 35.003 | S35.003 | S35.004 | 6.172 | 375 | 1.384 | 56.6 | 0.418 |
| 36.000 | S36.000 | S36.001 | 20.285 | 225 | 2.736 | 0 | 0 |
| 36.001 | S36.001 | S34.001 | 58.52 | 300 | 1.048 | 37 | 0.273 |
| 37.000 | S37.000 | S37.001 | 66.408 | 300 | 1.048 | 0 | 0 |
| 37.001 | S37.001 | S37.002 | 27.595 | 300 | 1.001 | 65.3 | 0.482 |
| 37.002 | S37.002 | S37.003 | 20.572 | 375 | 2.138 | 72.9 | 0.538 |
| 37.003 | S37.003 | S37.004 | 21.754 | 375 | 2.273 | 81.5 | 0.601 |
| 37.004 | S37.004 | S37.005 | 73.234 | 600 | 3.000 | 88.2 | 0.651 |
| 37.005 | S37.005 | S37.006 | 32.288 | 600 | 1.095 | 123.6 | 0.912 |
| 37.006 | S37.006 | S34.007 | 24.009 | 600 | 1.007 | 154.9 | 1.143 |
| 38.000 | S38.000 | S38.001 | 77.268 | 225 | 0.880 | 0 | 0 |
| 38.001 | S38.001 | S38.002 | 84.994 | 225 | 1.631 | 0 | 0 |
| 38.002 | S38.002 | S38.003 | 63.878 | 225 | 0.893 | 0 | 0 |
| 39.000 | S39.000 | S39.001 | 28.905 | 225 | 1.577 | 0 | 0 |
| 39.001 | S39.001 | S39.002 | 26.255 | 225 | 1.998 | 12.6 | 0.14 |
| 39.002 | S39.002 | S39.003 | 37.072 | 225 | 2.210 | 15 | 0.17 |
| 39.003 | S39.003 | S39.004 | 32.638 | 225 | 2.649 | 18.9 | 0.217 |
| 39.004 | S39.004 | S39.005 | 11.659 | 225 | 0.583 | 22.8 | 0.267 |
| 39.005 | S39.005 | S39.006 | 11.451 | 225 | 1.957 | 22.7 | 0.267 |
| 39.006 | S39.006 | S39.007 | 12.101 | 225 | 1.894 | 22.5 | 0.267 |
| 39.007 | S39.007 | S39.008 | 33.978 | 225 | 2.592 | 22.3 | 0.267 |
| 39.008 | S39.008 | S7.008 | 20.519 | 225 | 2.736 | 26.4 | 0.319 |
| 4.000 | S4.000 | S4.001 | 68.57 | 375 | 2.040 | 19.4 | 0.143 |
| 4.001 | S4.001 | S4.002 | 13.235 | 375 | 1.418 | 52.3 | 0.386 |
| 4.002 | S4.002 | S4.003 | 24.298 | 600 | 1.001 | 159.9 | 1.18 |
| 40.000 | S40.000 | S2.003 | 50.817 | 225 | 1.267 | 0 | 0 |
| 41.000 | S41.000 | S27.004 | 33.851 | 300 | 1.048 | 6.2 | 0 |
| 42.000 | S42.000 | S42.001 | 14.719 | 225 | 0.957 | 1.9 | 0 |
| 42.001 | S42.001 | S27.008 | 26.095 | 225 | 1.002 | 5.7 | 0 |
| 43.000 | S43.000 | S4.000 | 40.455 | 225 | 1.001 | 3.1 | 0.023 |
| 44.000 | S44.000 | S44.001 | 73.231 | 600 | 1.824 | 23.9 | 19 |
| 44.001 | S44.001 | S44.002 | 9.384 | 600 | 3.000 | 256.4 | 19 |
| 44.002 | S44.002 | S44.003 | 10.674 | 600 | 1.018 | 259.3 | 19 |
| 44.003 | S44.003 | S44.004 | 16.547 | 600 | 3.000 | 259.3 | 19 |
| 44.004 | S44.004 | S44.005 | 12.789 | 600 | 3.000 | 259.3 | 19 |
| 44.005 | S44.005 | S44.006 | 18.894 | 600 | 3.000 | 259.3 | 19 |
| 45.000 | S45.000 | S3.002 | 54.6 | 225 | 1.764 | 0 | 0 |
| 46.000 | S46.000 | S46.001 | 61.103 | 225 | 2.736 | 0 | 0 |
| 46.001 | S46.001 | S46.002 | 16.619 | 225 | 2.736 | 14.9 | 0.166 |
| 46.002 | S46.002 | S21.001 | 31.487 | 225 | 2.736 | 17.6 | 0.198 |
| 47.000 | S47.000 | S47.001 | 17.914 | 225 | 1.934 | 0 | 0 |
| 47.001 | S47.001 | S47.002 | 20.616 | 225 | 1.934 | 5 | 0.055 |
| 47.002 | S47.002 | S21.003 | 35.525 | 225 | 1.934 | 5.9 | 0.066 |

| | | | | | | | |
|--------|---------|---------|--------|-----|-------|-------|-------|
| 48.000 | S48.000 | S48.001 | 12.9 | 225 | 0.865 | 0 | 0 |
| 48.001 | S48.001 | S48.002 | 37.634 | 225 | 1.034 | 10.8 | 0.08 |
| 48.002 | S48.002 | S36.001 | 8.221 | 225 | 1.001 | 20.9 | 0.154 |
| 49.000 | S49.000 | S48.001 | 21.941 | 225 | 1.001 | 0 | 0 |
| 50.000 | S50.000 | S50.001 | 22.611 | 225 | 0.928 | 0 | 0 |
| 50.001 | S50.001 | S36.001 | 19.804 | 225 | 1.003 | 9.2 | 0.068 |
| 51.000 | S51.000 | S34.006 | 60 | 225 | 1.668 | 0 | 0 |
| 52.000 | S52.000 | S37.006 | 58.109 | 225 | 1.617 | 0 | 0 |
| 7.000 | S7.000 | S7.001 | 46.4 | 300 | 1.088 | 0 | 0 |
| 7.001 | S7.001 | S7.002 | 17.732 | 300 | 1.167 | 10.3 | 0.118 |
| 7.002 | S7.002 | S7.003 | 12.901 | 300 | 1.048 | 36.9 | 0.456 |
| 7.003 | S7.003 | S7.004 | 21.875 | 300 | 1.048 | 39 | 0.49 |
| 7.004 | S7.004 | S7.005 | 29.178 | 300 | 1.048 | 43.3 | 0.557 |
| 7.005 | S7.005 | S7.006 | 75.509 | 300 | 2.224 | 47.4 | 0.626 |
| 7.006 | S7.006 | S7.007 | 48.824 | 300 | 1.406 | 69 | 0.934 |
| 7.007 | S7.007 | S7.008 | 21.567 | 300 | 1.657 | 84.9 | 1.16 |
| 7.008 | S7.008 | S7.009 | 63.852 | 300 | 2.933 | 110.1 | 1.528 |
| 7.009 | S7.009 | S7.010 | 22.793 | 300 | 2.895 | 117.4 | 1.638 |
| 7.010 | S7.010 | S7.011 | 23.211 | 300 | 2.918 | 119.4 | 1.675 |
| 7.011 | S7.011 | S7.012 | 12.907 | 375 | 1.479 | 143.2 | 2.02 |
| 7.012 | S7.012 | S7.013 | 13.729 | 375 | 2.916 | 142.7 | 2.02 |
| 7.013 | S7.013 | S2.000 | 13.764 | 375 | 2.412 | 142.2 | 2.02 |
| 8.000 | S8.000 | S8.001 | 65.341 | 225 | 0.895 | 0 | 0 |
| 8.001 | S8.001 | S8.002 | 15.455 | 225 | 0.984 | 9.4 | 0.111 |
| 8.002 | S8.002 | S7.002 | 71.717 | 225 | 1.816 | 23.6 | 0.288 |
| 9.000 | S9.000 | S9.001 | 46.019 | 225 | 1.112 | 0 | 0 |
| 9.001 | S9.001 | S9.002 | 6.134 | 225 | 1.000 | 21.7 | 0.16 |

Table 5.1: Storm Sewer design output

| Attenuation tank | Area drained from | Runoff area | | Storage volume required m ³ |
|------------------|----------------------|----------------------------------|----------------------------|---|
| | | Impervious area (100% runoff) | Green Area (10% runoff) | |
| AT-K | N4 | 7118 | 0 | 538 |
| AT-L | N4 | 5680 | 0 | 353 |
| AT-M | N1 | 13294 | 0 | 994 |
| AT-N | N6 | 10469 | 345 | 782 |
| AT-P | N1 and Main Dist. | 5985 | 750 | 155 |
| AT-T | N4 | 4354 | 0 | 330 |

| | | | | |
|---|-------------------|-------|-------|------|
| AT-U | N2 and Main Dist. | 18297 | 2235 | 1374 |
| AT-Z | N3 and Main Dist. | 22376 | 14976 | 1509 |
| Reference Document: | | | | |
| ➤ <i>CIRIA C697 2007: The Suds Manual</i> | | | | |

Table 5.2: Storm water attenuation tank design and sizing

| Soakpit | Area drained from | Runoff area | Storage volume required |
|----------------------------|-------------------------|----------------------------------|-------------------------|
| | | Impervious area (100% runoff) | m ³ |
| SP-Houses | Individual housing unit | 290 | 11 |
| SP-2.0 | N2 | 6537 | 185 |
| SP-2.1 | N2 | 1991 | 84 |
| SP-2.2 | N2 | 3301 | 168 |
| SP-2.3 | N2 | 5935 | 363 |
| SP-5.1 | N5 | 16760 | 1156 |
| SP-5.2 | N5 | 2100 | 100 |
| SP-5.3 | N5 | 2230 | 109 |
| SP-5.4 | Main Distributor | 1992 | 95 |
| Reference Document: | | | |
| ➤ <i>BRE Digest 365</i> | | | |

Table 5.3: Storm water soak-pits design and sizing

Refer to appendices C & D respectively for attenuation tank and soakpit design sheets.

MHL Consulting Engineers was instructed by Longview Estates Ltd to prepare a SuDS (Sustainable Urban Drainage Systems) Strategy Report in support of this planning application. Further information pertaining to the sizing and selection of the storm water system proposed for this development is provided in the SuDS Strategy Report included with this application.

6. FOUL WATER NETWORK

Foul design

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

Each person is assumed to consume 200 litres of water per day.

Dry Weather Flow (DWF) = 600 l/house/day

Design for 6 X DWF = 3,600 litres/house/day (to account for surges in the consumption at peak times leading to surcharges in the pipe network).

For each pipe run the accumulative number of households contributing to that section of pipework is used to calculate the design flow.

The calculated foul pipe diameters to provide adequate capacity for the development is shown in table 6.1 below.

Per discussions with Irish Water, the existing foul network has sufficient capacity to cater for Phase 1 only. A new strategic pumping station is required along Ballyhooly Road to cater for the remainder of the development. Upon completion of the strategic pumping station, phase 1 will be transferred over from the existing network to feed into the new station.

An additional, internal pumping station is required to allow connection between the foul network of neighbourhood 5 (phase 5) and the rest for the network. This pumping station is proposed at a location adjacent to neighbourhood 5 and will output to a point where it can connect to the overall development foul network.

Full details of the foul design can be found in drawings LHD-F1-P01, LHD-F2-P01, LHD-F2-P02, LHD-F3-P01, LHD-F4-P01, LHD-F5-P01, LHD-F5-P02, LHD-F6-P01, and table 6.1 below. Longsections of the foul network are presented in drawings LHD-FLS-P01, LHD-FLS-P02, LHD-FLS-P03, LHD-FLS-P04, LHD-FLS-P05, LHD-FLS-P06, LHD-FLS-P07, LHD-FLS-P08, LHD-FLS-P09. and LHD-FLS-P10.

Refer to Appendix B included in this report for Irish Water statement of design acceptance letter received.

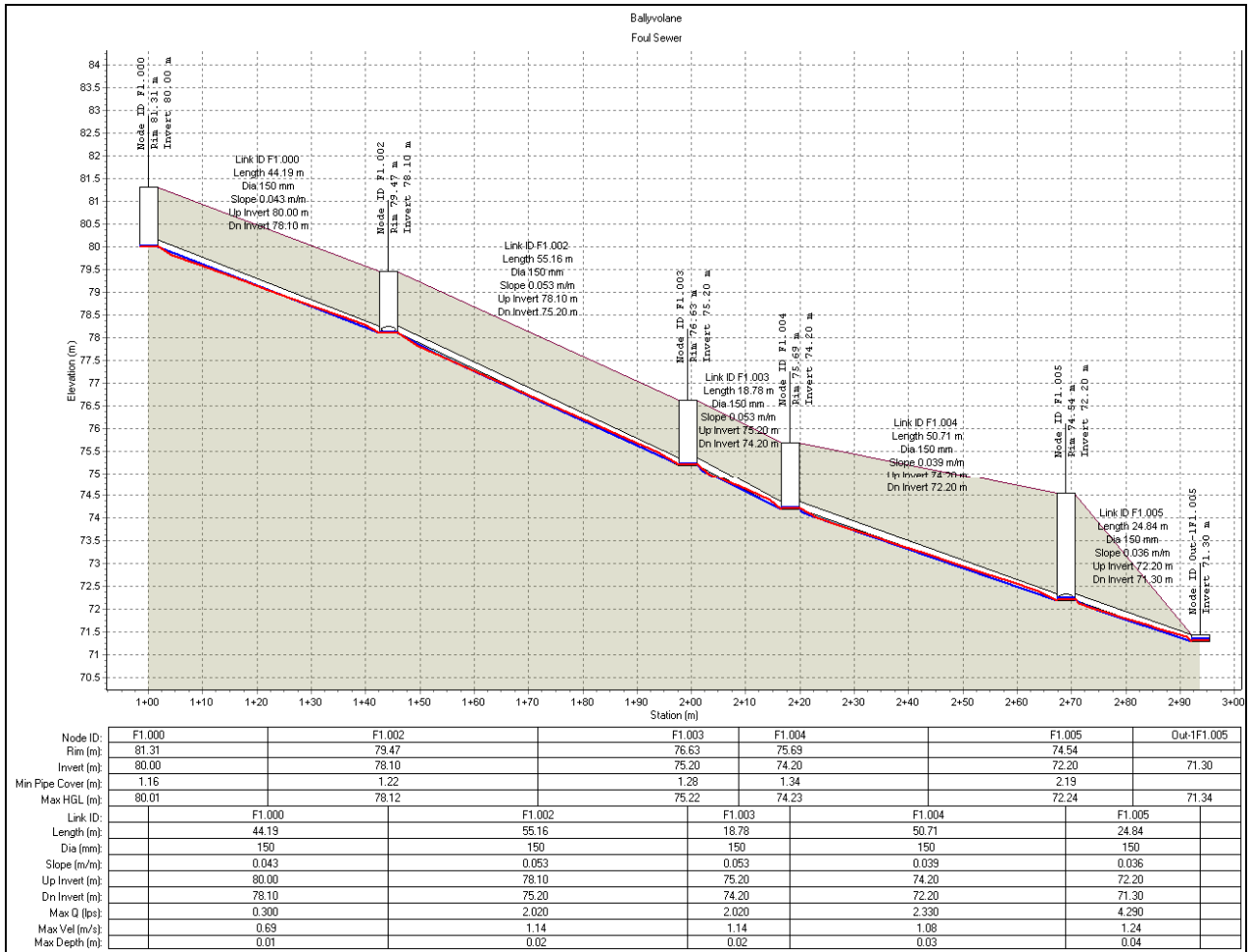


Figure 6.1: Typical Output profile plot of F1.000 – F1.006 from foul sewer analysis package

The construction of the foul sewer pipe network shall be in accordance with Irish Water Code of Practice for Wastewater Infrastructure Doc IW-CDS-5030-03.

| Pipe ID | Upstream MH ID | Downstream MH ID | Length (m) | Dia (mm) | Vel (m/s) | Flow (l/s) |
|---------|----------------|------------------|------------|----------|-----------|------------|
| 1.000 | F1.000 | F1.001 | 32.473 | 300 | 1.98 | 80.000 |
| 1.001 | F1.001 | F1.002 | 26.668 | 300 | 2.44 | 80.000 |
| 1.002 | F1.002 | F1.003 | 36.258 | 300 | 2.89 | 80.000 |
| 1.003 | F1.003 | F1.004 | 35.238 | 300 | 3.00 | 80.000 |
| 1.004 | F1.004 | F1.005 | 37.048 | 300 | 3.00 | 80.000 |
| 1.005 | F1.005 | F1.006 | 25.204 | 300 | 3.00 | 80.000 |
| 1.006 | F1.006 | F1.007 | 59.077 | 300 | 3.00 | 100.300 |
| 1.007 | F1.007 | F1.008 | 23.977 | 300 | 3.00 | 100.400 |
| 1.008 | F1.008 | F1.009 | 20.897 | 300 | 3.00 | 100.400 |
| 1.009 | F1.009 | F1.010 | 27.197 | 300 | 3.00 | 104.200 |
| 1.010 | F1.010 | F1.011 | 65.308 | 300 | 3.00 | 104.200 |
| 1.011 | F1.011 | F1.012 | 40.607 | 300 | 3.00 | 104.200 |
| 1.012 | F1.012 | F1.013 | 26.139 | 300 | 3.00 | 104.200 |
| 1.013 | F1.013 | F1.014 | 22.648 | 450 | 0.91 | 106.400 |
| 1.014 | F1.014 | F1.015 | 24.041 | 450 | 3.00 | 106.400 |

| | | | | | | |
|--------|---------|---------|---------|-----|------|---------|
| 1.015 | F1.015 | F1.016 | 27.06 | 450 | 3.00 | 106.400 |
| 1.016 | F1.016 | F1.017 | 16.855 | 450 | 3.00 | 106.800 |
| 1.017 | F1.017 | F1.018 | 20.554 | 450 | 4.00 | 106.800 |
| 1.018 | F1.018 | F1.019 | 48.551 | 450 | 3.00 | 106.800 |
| 1.019 | F1.019 | F1.020 | 37.654 | 375 | 1.48 | 107.500 |
| 1.020 | F1.020 | F1.021 | 17.906 | 375 | 1.47 | 107.500 |
| 1.021 | F1.021 | F1.022 | 51.476 | 375 | 1.46 | 107.500 |
| 1.022 | F1.022 | F1.023 | 62.836 | 375 | 1.44 | 108.200 |
| 1.023 | F1.023 | F1.024 | 106.445 | 375 | 1.42 | 109.800 |
| 1.024 | F1.024 | F1.025 | 17.418 | 375 | 1.49 | 109.800 |
| 1.025 | F1.025 | F1.026 | 20.128 | 375 | 1.96 | 109.800 |
| 1.026 | F1.026 | F1.027 | 17.198 | 375 | 3.00 | 109.800 |
| 1.027 | F1.027 | F1.028 | 17.675 | 375 | 3.00 | 109.800 |
| 1.028 | F1.028 | F1.029 | 19.921 | 375 | 3.00 | 109.800 |
| 1.029 | F1.029 | F1.030 | 58.805 | 375 | 3.00 | 109.800 |
| 1.030 | F1.030 | F1.031 | 42.314 | 375 | 3.00 | 109.800 |
| 1.031 | F1.031 | F1.032 | 25.487 | 375 | 3.00 | 109.800 |
| 1.032 | F1.032 | F1.033 | 25.5 | 375 | 3.00 | 109.800 |
| 1.033 | F1.033 | F1.034 | 69.597 | 375 | 3.00 | 109.800 |
| 1.034 | F1.034 | F1.035 | 26.982 | 375 | 3.00 | 113.300 |
| 1.035 | F1.035 | F1.036 | 17.662 | 375 | 3.00 | 113.300 |
| 1.036 | F1.036 | F15.004 | 27.65 | 375 | 2.87 | 113.300 |
| 10.000 | F10.000 | F2.000 | 34.818 | 150 | 0.76 | 2.600 |
| 11.000 | F11.000 | F11.001 | 49.886 | 150 | 2.09 | 1.900 |
| 11.001 | F11.001 | F11.002 | 32.889 | 150 | 2.65 | 5.300 |
| 11.002 | F11.002 | F11.003 | 38.33 | 150 | 1.71 | 9.100 |
| 11.003 | F11.003 | F11.004 | 21.392 | 150 | 0.99 | 9.500 |
| 11.004 | F11.004 | F1.013 | 47.181 | 150 | 0.98 | 9.800 |
| 12.000 | F12.000 | F11.002 | 62.177 | 150 | 1.20 | 1.900 |
| 13.000 | F13.000 | F11.002 | 48.349 | 150 | 1.85 | 1.900 |
| 14.000 | F14.000 | F14.001 | 47.6 | 150 | 1.22 | 0.000 |
| 14.001 | F14.001 | F14.002 | 16.155 | 150 | 1.25 | 0.000 |
| 14.002 | F14.002 | F14.003 | 14.375 | 150 | 1.26 | 3.700 |
| 14.003 | F14.003 | F14.004 | 33.208 | 150 | 2.58 | 3.700 |
| 14.004 | F14.004 | F14.005 | 38.391 | 150 | 2.11 | 3.700 |
| 14.005 | F14.005 | F14.006 | 31.475 | 150 | 1.03 | 5.300 |
| 14.006 | F14.006 | F14.007 | 28.883 | 150 | 1.69 | 6.200 |
| 14.007 | F14.007 | F14.008 | 42.695 | 150 | 1.96 | 6.900 |
| 14.008 | F14.008 | F14.009 | 42.864 | 150 | 3.00 | 8.100 |
| 14.009 | F14.009 | F14.010 | 67.085 | 150 | 2.10 | 9.500 |
| 14.010 | F14.010 | F14.011 | 17.943 | 150 | 0.94 | 10.300 |
| 14.011 | F14.011 | F15.000 | 31.004 | 150 | 2.08 | 12.300 |
| 15.000 | F15.000 | F15.001 | 104.891 | 375 | 2.37 | 12.300 |
| 15.001 | F15.001 | F15.002 | 136.224 | 375 | 2.05 | 12.300 |
| 15.002 | F15.002 | F15.003 | 42.785 | 375 | 2.37 | 12.300 |

| | | | | | | |
|--------|---------|---------|--------|-----|------|---------|
| 15.003 | F15.003 | F15.004 | 35.959 | 375 | 3.00 | 12.300 |
| 15.004 | F15.004 | F15.005 | 27.781 | 450 | 0.88 | 115.500 |
| 15.005 | F15.005 | F15.006 | 15.948 | 450 | 0.88 | 115.500 |
| 15.006 | F15.006 | F15.007 | 59.944 | 450 | 3.00 | 115.500 |
| 15.007 | F15.007 | F15.008 | 28.905 | 450 | 3.00 | 115.500 |
| 15.008 | F15.008 | F15.009 | 24.25 | 450 | 2.46 | 115.500 |
| 15.009 | F15.009 | F15.010 | 19.025 | 450 | 2.27 | 115.500 |
| 15.010 | F15.010 | F15.011 | 40.552 | 450 | 0.88 | 115.500 |
| 15.011 | F15.011 | F15.012 | 80.183 | 450 | 0.88 | 115.500 |
| 15.012 | F15.012 | F15.013 | 61.897 | 450 | 0.88 | 115.500 |
| 15.013 | F15.013 | F15.014 | 55.498 | 450 | 0.88 | 115.500 |
| 15.014 | F15.014 | F15.015 | 80.593 | 450 | 0.88 | 115.500 |
| 15.015 | F15.015 | F15.016 | 77.631 | 450 | 2.19 | 115.500 |
| 15.016 | F15.016 | F15.017 | 56.928 | 450 | 1.96 | 115.500 |
| 16.000 | F16.000 | F16.001 | 47.022 | 150 | 2.09 | 1.900 |
| 16.001 | F16.001 | F16.002 | 41.958 | 150 | 2.11 | 4.900 |
| 16.002 | F16.002 | F14.011 | 33.549 | 150 | 2.66 | 6.700 |
| 17.000 | F17.000 | F17.001 | 29.5 | 150 | 2.10 | 0.000 |
| 17.001 | F17.001 | F14.007 | 32.563 | 150 | 2.15 | 0.000 |
| 18.000 | F18.000 | F18.001 | 29 | 150 | 1.24 | 0.000 |
| 18.001 | F18.001 | F11.003 | 24.138 | 150 | 1.20 | 0.000 |
| 19.000 | F19.000 | F19.001 | 41.704 | 150 | 1.23 | 5.600 |
| 19.001 | F19.001 | F19.002 | 42.057 | 150 | 1.23 | 5.600 |
| 19.002 | F19.002 | MH610 | 47.891 | 150 | 1.54 | 8.700 |
| 19.003 | MH610 | F19.003 | 24.475 | 150 | 2.11 | 8.700 |
| 19.004 | F19.003 | F19.004 | 13.935 | 150 | 2.03 | 8.700 |
| 19.005 | F19.004 | F1.023 | 54.137 | 150 | 1.88 | 8.900 |
| 2.000 | F2.000 | F2.001 | 63.653 | 150 | 1.44 | 6.200 |
| 2.001 | F2.001 | F2.002 | 18.364 | 150 | 1.94 | 9.500 |
| 2.002 | F2.002 | F2.003 | 70.707 | 150 | 0.78 | 10.700 |
| 2.003 | F2.003 | F2.004 | 51.252 | 225 | 1.15 | 14.900 |
| 2.004 | F2.004 | F2.005 | 16.683 | 225 | 1.10 | 16.600 |
| 2.005 | F2.005 | F2.006 | 13.608 | 225 | 1.06 | 17.900 |
| 2.006 | F2.006 | F2.007 | 25.849 | 225 | 1.06 | 18.100 |
| 2.007 | F2.007 | F2.008 | 29.71 | 225 | 1.05 | 18.500 |
| 2.008 | F2.008 | F2.009 | 74.412 | 225 | 1.14 | 18.600 |
| 2.009 | F2.009 | F2.010 | 52.829 | 225 | 1.42 | 19.200 |
| 2.010 | F2.010 | F1.006 | 23.497 | 225 | 1.93 | 20.300 |
| 20.000 | F20.000 | F20.001 | 24.881 | 150 | 3.00 | 1.900 |
| 20.001 | F20.001 | F20.002 | 38.31 | 150 | 1.35 | 4.500 |
| 20.002 | F20.002 | F20.003 | 20.881 | 150 | 1.20 | 5.900 |
| 20.003 | F20.003 | F19.002 | 32.512 | 150 | 3.00 | 6.400 |
| 21.000 | F21.000 | F21.001 | 21.641 | 150 | 2.90 | 1.900 |
| 21.001 | F21.001 | F1.016 | 25.425 | 150 | 2.02 | 3.700 |
| 22.000 | F22.000 | F22.001 | 40.916 | 150 | 2.76 | 0.000 |

| | | | | | | |
|--------|---------|---------|--------|-----|------|--------|
| 22.001 | F22.001 | F1.019 | 29.416 | 150 | 1.77 | 5.600 |
| 23.000 | F23.000 | F23.001 | 42.582 | 150 | 2.70 | 0.000 |
| 23.001 | F23.001 | F1.022 | 28.035 | 150 | 1.70 | 5.600 |
| 24.000 | F24.000 | F24.001 | 59.334 | 150 | 2.78 | 1.900 |
| 24.001 | F24.001 | F24.002 | 13.052 | 150 | 3.00 | 4.900 |
| 24.002 | F24.002 | F19.000 | 30.416 | 150 | 2.19 | 5.600 |
| 25.000 | F25.000 | F25.001 | 45.137 | 375 | 1.70 | 16.100 |
| 25.001 | F25.001 | F25.002 | 73.67 | 375 | 1.59 | 19.000 |
| 25.002 | F25.002 | F25.003 | 19.348 | 375 | 1.54 | 20.400 |
| 25.003 | F25.003 | F25.004 | 14.443 | 375 | 1.54 | 20.700 |
| 25.004 | F25.004 | F25.005 | 38.658 | 375 | 1.53 | 20.800 |
| 25.005 | F25.005 | F25.006 | 26.955 | 375 | 1.52 | 21.200 |
| 25.006 | F25.006 | F25.007 | 28.791 | 375 | 1.46 | 23.300 |
| 25.007 | F25.007 | F25.008 | 27.735 | 375 | 1.46 | 23.500 |
| 25.008 | F25.008 | F25.009 | 24.876 | 375 | 1.45 | 23.800 |
| 25.009 | F25.009 | F25.010 | 15.332 | 375 | 1.44 | 23.900 |
| 25.010 | F25.010 | F25.011 | 7.347 | 375 | 1.45 | 23.900 |
| 26.000 | F26.000 | F26.001 | 56.51 | 150 | 2.13 | 1.900 |
| 26.001 | F26.001 | F26.002 | 23.44 | 150 | 1.64 | 6.200 |
| 26.002 | F26.002 | F26.003 | 51.416 | 150 | 1.52 | 6.200 |
| 26.003 | F26.003 | F26.004 | 52.432 | 225 | 1.87 | 11.100 |
| 26.004 | F26.004 | F26.005 | 25.092 | 225 | 1.29 | 11.100 |
| 26.005 | F26.005 | F26.006 | 30.829 | 225 | 1.28 | 11.400 |
| 26.006 | F26.006 | F26.007 | 25.744 | 225 | 1.16 | 14.300 |
| 26.007 | F26.007 | F26.008 | 20.775 | 225 | 2.41 | 14.300 |
| 26.008 | F26.008 | F1.034 | 24.371 | 225 | 1.65 | 14.900 |
| 27.000 | F27.000 | F27.001 | 62.893 | 225 | 1.60 | 0.000 |
| 27.001 | F27.001 | F27.002 | 31.02 | 225 | 1.05 | 8.500 |
| 27.002 | F27.002 | F27.003 | 19.867 | 225 | 1.06 | 9.100 |
| 27.003 | F27.003 | F27.004 | 22.753 | 225 | 1.06 | 10.000 |
| 27.004 | F27.004 | F27.005 | 86.284 | 225 | 1.51 | 10.500 |
| 27.005 | F27.005 | F25.000 | 12.235 | 225 | 1.22 | 12.900 |
| 28.000 | F28.000 | F27.001 | 63.043 | 150 | 1.33 | 2.600 |
| 29.000 | F29.000 | F29.001 | 33.524 | 150 | 2.10 | 2.600 |
| 29.001 | F29.001 | F29.002 | 23.018 | 150 | 1.89 | 4.200 |
| 29.002 | F29.002 | F29.003 | 52.43 | 150 | 1.85 | 4.200 |
| 29.003 | F29.003 | F26.003 | 70.554 | 225 | 1.86 | 7.200 |
| 3.000 | F3.000 | F3.002 | 33.557 | 150 | 1.78 | 2.600 |
| 3.001 | F3.002 | F2.003 | 81.862 | 150 | 1.20 | 5.900 |
| 30.000 | F30.000 | F30.001 | 19.292 | 150 | 1.53 | 1.900 |
| 30.001 | F30.001 | F30.002 | 15.984 | 150 | 1.60 | 3.200 |
| 30.002 | F30.002 | F30.003 | 35.576 | 150 | 1.43 | 3.700 |
| 30.003 | F30.003 | F30.004 | 24.916 | 150 | 1.72 | 4.500 |
| 30.004 | F30.004 | F30.005 | 21.677 | 150 | 1.97 | 6.200 |
| 30.005 | F30.005 | F30.006 | 37.553 | 150 | 2.00 | 7.700 |

| | | | | | | |
|--------|---------|---------|--------|-----|------|--------|
| 30.006 | F30.006 | F26.006 | 12.15 | 150 | 1.97 | 8.300 |
| 31.000 | F31.000 | F26.008 | 38.462 | 150 | 2.12 | 1.900 |
| 32.000 | F32.000 | F32.001 | 15.757 | 225 | 2.18 | 3.700 |
| 32.001 | F32.001 | F32.002 | 22.849 | 225 | 1.62 | 4.900 |
| 32.002 | F32.002 | F32.003 | 42.829 | 225 | 1.44 | 4.900 |
| 32.003 | F32.003 | F32.004 | 29.583 | 225 | 2.02 | 5.600 |
| 32.004 | F32.004 | F32.005 | 76.449 | 225 | 1.50 | 7.900 |
| 32.005 | F32.005 | F25.000 | 11.477 | 225 | 1.37 | 9.700 |
| 33.000 | F33.000 | F33.001 | 59.664 | 150 | 2.09 | 0.000 |
| 33.001 | F33.001 | F33.002 | 16.241 | 150 | 1.25 | 0.000 |
| 33.002 | F33.002 | F33.003 | 16.169 | 150 | 1.93 | 0.000 |
| 33.003 | F33.003 | F33.004 | 65.823 | 150 | 1.57 | 0.000 |
| 33.004 | F33.004 | F33.005 | 36.863 | 150 | 1.48 | 0.000 |
| 33.005 | F33.005 | F33.006 | 17.874 | 150 | 3.00 | 0.000 |
| 33.006 | F33.006 | F33.007 | 11.44 | 150 | 3.00 | 0.000 |
| 33.007 | F33.007 | F15.010 | 25.712 | 150 | 3.00 | 0.000 |
| 34.000 | F34.000 | F34.001 | 68.994 | 150 | 0.99 | 2.600 |
| 34.001 | F34.001 | F34.002 | 32.32 | 150 | 0.81 | 6.900 |
| 34.002 | F34.002 | F34.003 | 72.153 | 150 | 0.78 | 7.400 |
| 34.003 | F34.003 | F25.001 | 45.967 | 150 | 1.04 | 8.300 |
| 35 | F35.000 | F32.004 | 26.269 | 150 | 1.98 | 1.900 |
| 36.000 | F36.000 | F36.001 | 16.977 | 150 | 1.20 | 0.000 |
| 36.001 | F36.001 | F36.002 | 20.22 | 150 | 1.30 | 1.900 |
| 36.002 | F36.002 | F25.006 | 57.953 | 150 | 1.01 | 9.100 |
| 37.002 | F37.002 | F36.002 | 9.554 | 150 | 1.07 | 7.900 |
| 37.000 | F37.000 | F37.001 | 18.607 | 150 | 1.95 | 3.700 |
| 37.001 | F37.001 | F37.002 | 41.186 | 150 | 1.18 | 6.200 |
| 38 | F38.000 | F37.001 | 16.691 | 150 | 1.68 | 2.600 |
| 39 | F39.000 | F20.001 | 31.222 | 150 | 1.97 | 1.900 |
| 4.000 | F4.000 | F4.001 | 57.517 | 150 | 1.22 | 0.000 |
| 4.001 | F4.001 | F4.002 | 11.282 | 150 | 1.27 | 4.900 |
| 4.002 | F4.002 | F2.005 | 76.862 | 150 | 1.65 | 4.900 |
| 40 | F40.000 | F3.002 | 50.087 | 150 | 1.97 | 1.900 |
| 5.000 | F5.000 | F2.002 | 23.533 | 150 | 2.29 | 1.900 |
| 6.000 | F6.000 | F2.003 | 17.752 | 150 | 1.55 | 1.900 |
| 7.000 | F7.000 | F2.004 | 62.934 | 150 | 1.31 | 1.900 |
| 8.000 | F8.000 | F8.001 | 22.541 | 150 | 1.90 | 1.900 |
| 8.001 | F8.001 | F8.002 | 70.448 | 150 | 1.85 | 4.900 |
| 8.002 | F8.002 | F8.003 | 43.34 | 150 | 1.00 | 7.900 |
| 8.003 | F8.003 | F8.004 | 61.846 | 150 | 0.81 | 7.900 |
| 8.004 | F8.004 | F8.005 | 76.272 | 150 | 1.96 | 11.400 |
| 8.005 | F8.005 | F1.009 | 75.955 | 150 | 2.30 | 12.300 |
| 9.000 | F9.000 | F8.004 | 62.817 | 150 | 1.77 | 3.200 |

Table 6.1: Foul design output

Pumping Station design

Two (2) foul pumping stations are required to accommodate the entirety of the wastewater network serving the development.

As per the pre-connection enquiry, in accordance with Irish Water, a new strategic pump station is required to accommodate the new development and future developments in surrounding zoned lands. The proposed site for the new pumping station is to the south of the development lands along Ballyhooley Road.

Proposed fenced in boundary for this station includes room for future expansion by Irish Water. Figure 6.2 below depicts proposed site location and layout.

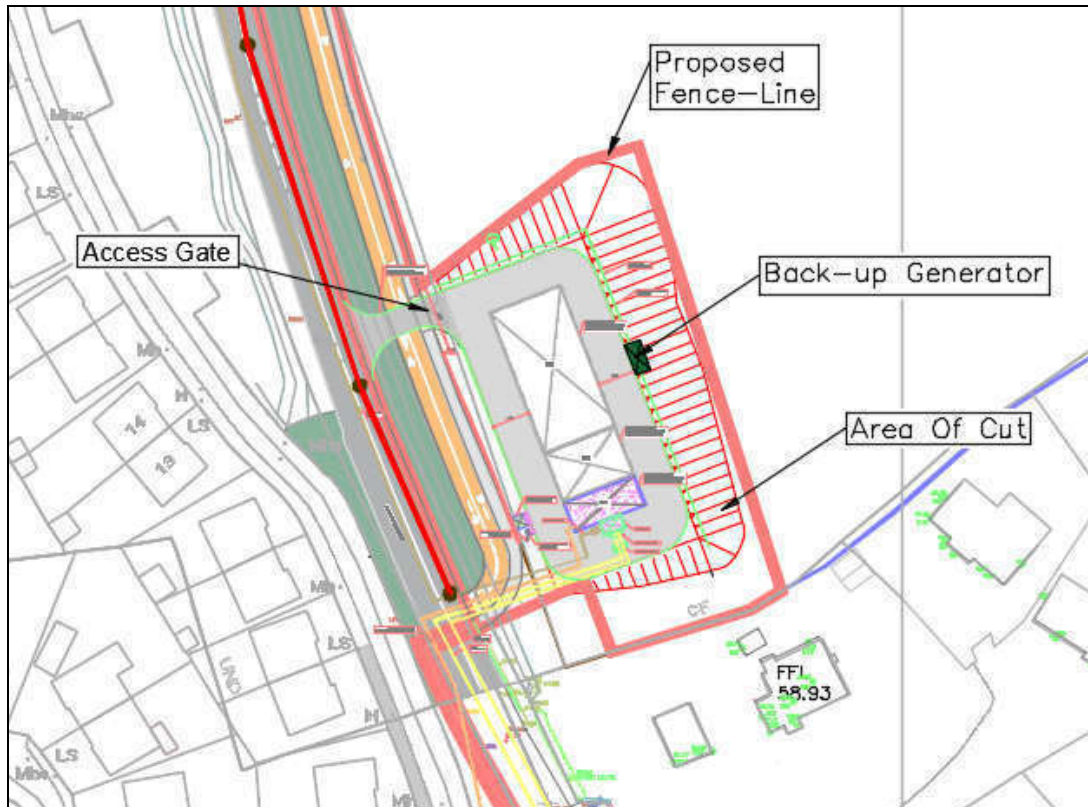


Fig 6.2: Ballyhooley Road Pumping station detail (For full details refer to drawing LHD-IWPS-P01)

Refer to drawing LHD-PC-P01 and LHD-PC-P07 for further detail of site location.

Refer to drawing LHD-PSXS-P01 and LHS-PSXS-P02 for cross section details of proposed pumping station.

A secondary pumping station, internal to the development, is proposed to accommodate the wastewater network of neighbourhood 5 (phase 5). This pumping station is required to connect neighbourhood 5 with the remainder of the development wastewater network due to site topography. Pumping station design as per Irish Water Detail STD-WW-26. Figure 6.3 below depicts proposed site location and layout.

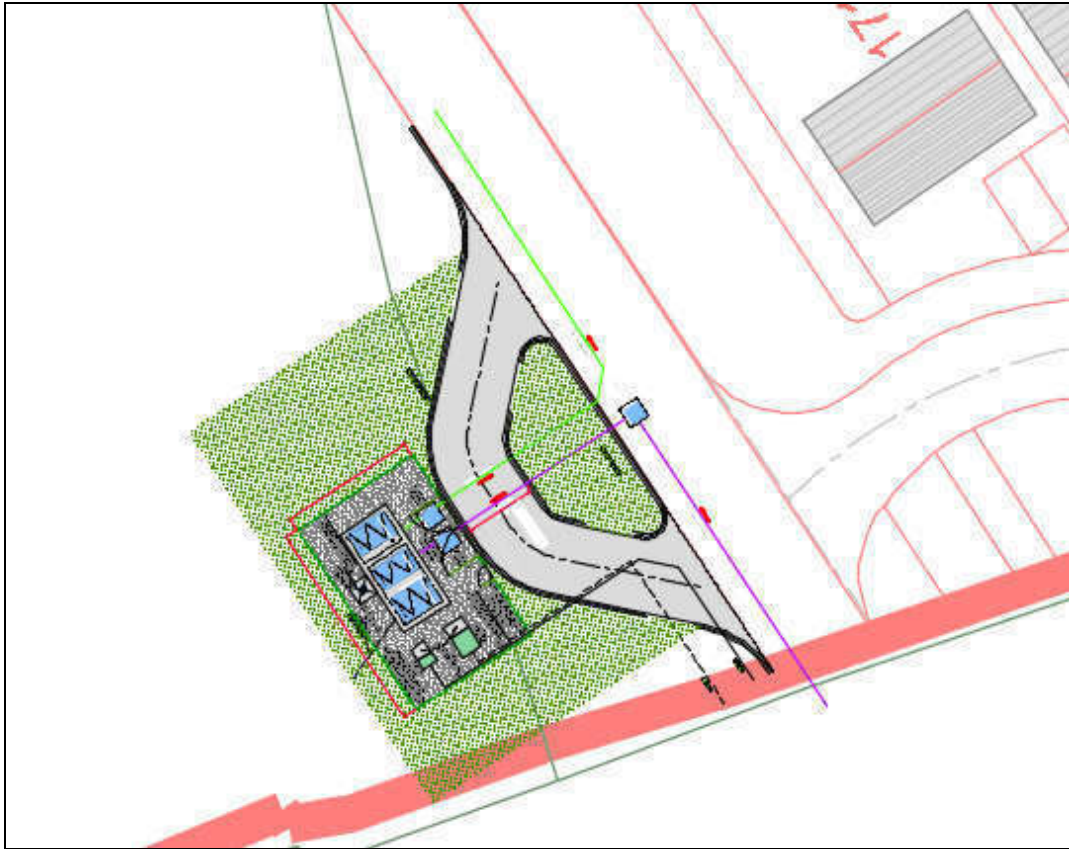


Fig 6.3: Neighbourhood 5 Pumping station detail (For full details refer to drawing LHD-IPS-P01)

7. SERVICES

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

To accommodate the proposed development, a diversion of the existing 38kV overhead electricity line is required. The newly proposed route will be grounded and installed in accordance with the ESB Standard Specification for ESB 38kV Networks Ducting/Cabling. A proposed cable route has been discussed and agreed upon with ESB engineering representatives.

Figure 7.1 below depicts existing 38kV route and proposed diversion. The new route will extend from a connection point on the east side of the development and continue west along the southern boundary of the development before connecting back into the existing overhead network on the west side of Ballyhooly Road. Full detail of the proposed diversion can be found in drawings LHD-ESBD-P01, LHD-ESBD-P02, LHD-ESBD-P03, and LHD-ESBD-P04 included in this application.

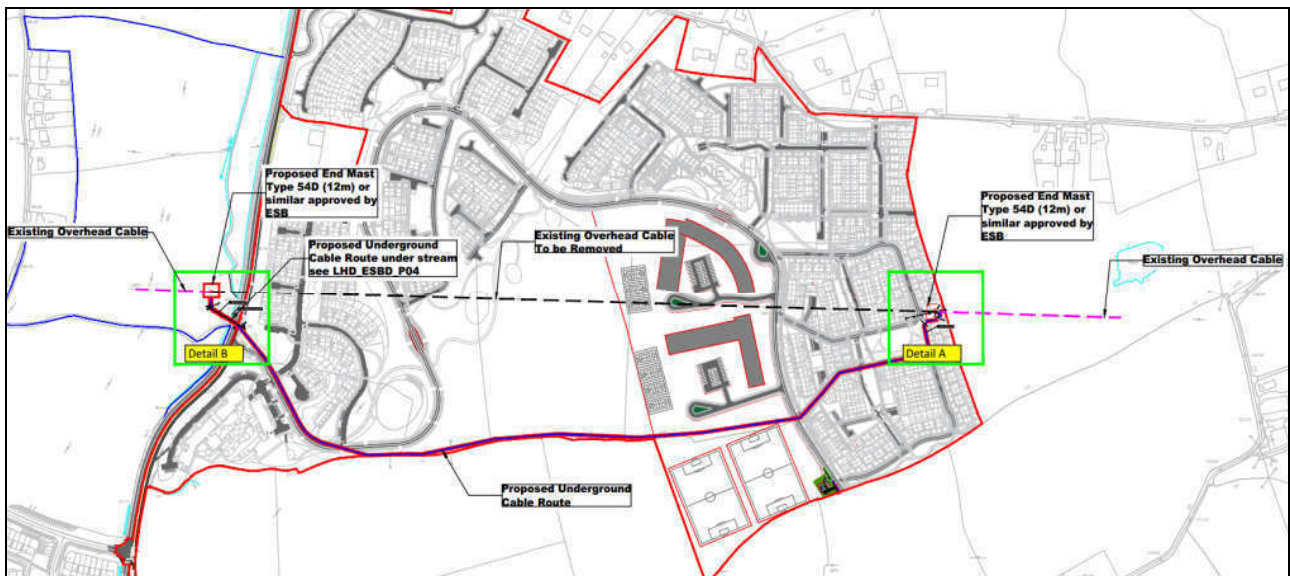


Fig 7.1: Proposed ESB 38kV diversion

The new underground 38kV cable will be required to cross the existing watercourse on the west side of Ballyhooly Road. Installation of the cable underneath the watercourse is proposed via directional drilling. Refer to figure 7.2 below showing the proposed installation under the watercourse.

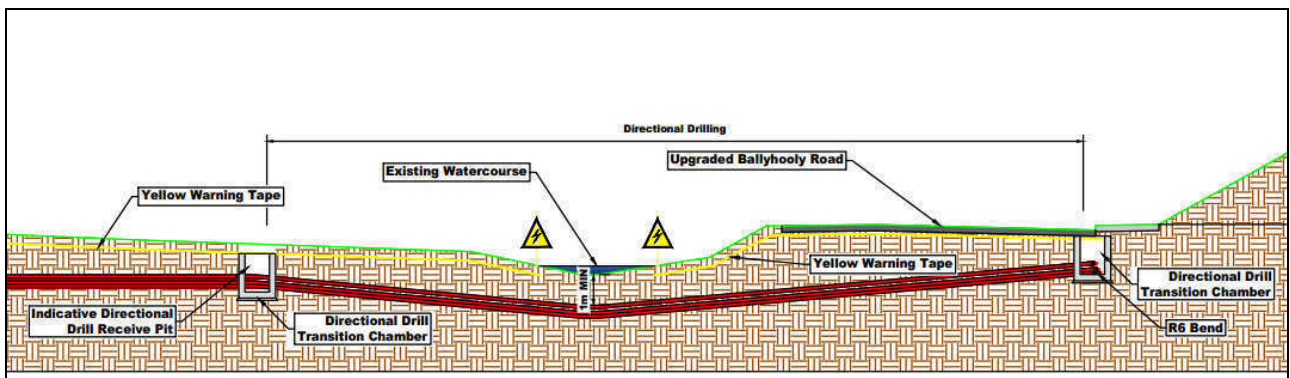


Fig 7.2: Proposed directional drill of ESB cabling under watercourse

Full detail of the proposed installation under the watercourse can be found in drawing LHD-ESBD-P03.

The existing 110kV overhead powerlines running north-east to south-west through the development will not be interfered with. Per discussions held with ESB representative for conflicts during design, all construction work performed around and under the existing electricity poles/powerlines will be conducted in adherence to ESB Code of Practice documentation.

Currently there are no gas or fibre broadband cables in the vicinity of the proposed development.

A fibre optic broadband cable and ducting will be extended to the site. The broadband ducting and cable line will be constructed as per ENET construction guidelines.

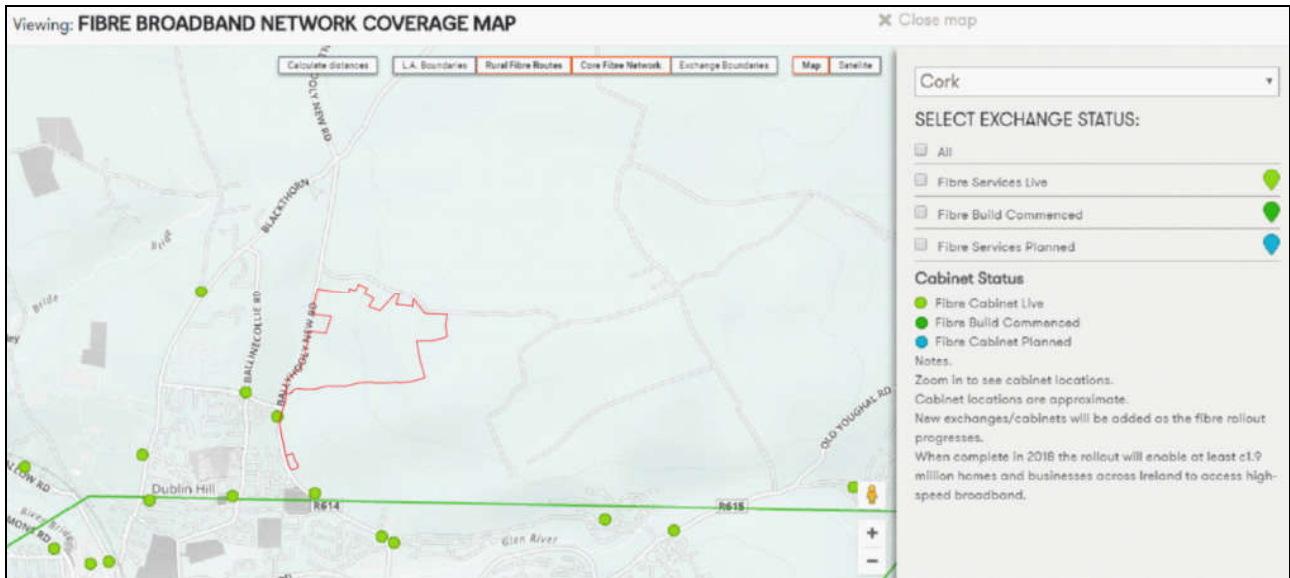


Figure 7.1: Fibre broadband coverage map

There is no gas pipeline extension proposed as a part of this development.

8. WATERMAIN NETWORK

Water design

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

A 200mm diameter HDPE watermain is proposed to supply potable water to all units and fire hydrants within the development. The proposed pipe network has no dead ends with loops serving a minimum of 4 units in accordance with Irish Water Code of Practice for Water Infrastructure Doc IW-CDS-5020-03.

The 200mm mains will be connected to the existing mainline present on Ballyhooly Road as agreed with Irish Water.

The construction of the water supply pipe network shall be in accordance with Irish Water Code of Practice for Water Infrastructure Doc IW-CDS-5020-03. Service layout distances to comply with Irish Water Detail STD-W-11. A Statement of Design Acceptance from Irish Water has been received and included in Appendix B for the proposed design.

A Pre-Connection Enquiry Form has been submitted to Irish Water to progress connection details. The response from Irish Water is included in Appendix A of this report.

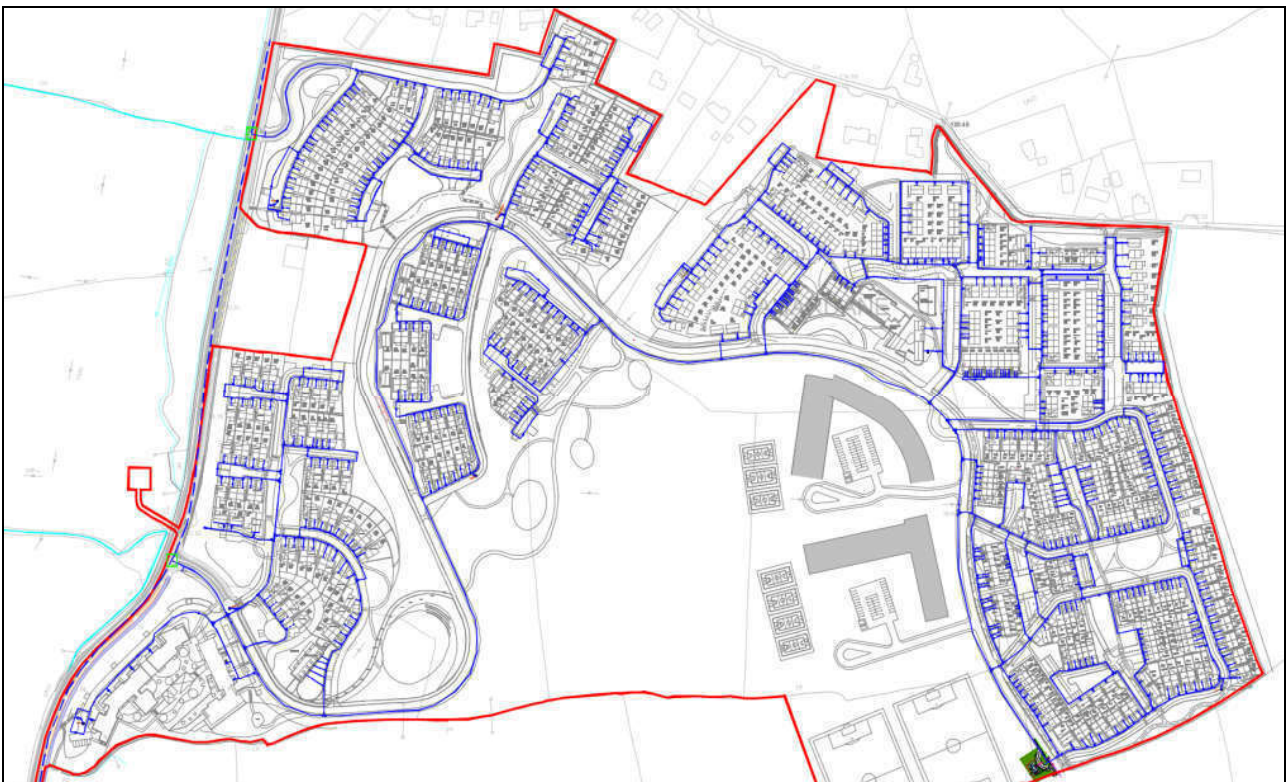


Fig 8.1: Watermains plan (For full details of all neighbourhoods refer to drawings LHD-PWM-P01, LHD-PWM-P02, LHD-PWM-P03, LHD-PWM-P04, LHD-PWM-P05, LHD-PWM-P06, and LHD-PWM-P07.

9. PUBLIC LIGHTING

PUBLIC LIGHTING DESIGN

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

The Public Road Lighting has been designed to EN 13201 and British Standard BS 5489. The “Lighting Reality Pro” software package was used to choose an appropriate lantern type and to optimise the lighting design. An appropriate lantern in the Philips range of products was found to be the Philips BGP615 DM10 3.8klm LED for the internal estate roads, the Philips BGP623 DM12 10.0klm LED for the distributor road, and Philips BGP623 DM12 11.0klm LED for Ballyhooly Road, which are designed and manufactured to comply with EN 13201 and IP65 optic and gear housing 10 joules shock resistant.

The 6m wide internal roads with 1.8m footpaths will require 8m mounting height columns with post top fixings at 30m maximum centres when using a Philips BGP615 DM10 3.8klm LED as shown on drawings LHD-PL-P01, LHD-PL-P02, LHD-PL-P03, LHD-PL-P04, LHD-PL-P05, LHD-PL-P06, LHD-PL-P07, and in the design report attached to this report. The 10m wide distributor road outside the development will require 10m mounting height columns with post top fixings at maximum 30m centres when using a Philips BGP623 DM12 10.0klm LED as shown on drawings LHD-PL-P01, LHD-PL-P02, LHD-PL-P03, LHD-PL-P04, LHD-PL-P05, LHD-PL-P06, and LHD-PL-P07. The lighting here is designed to EN 13201 and BS5489 Parts 2, 3 and 10. The existing Ballyhooly Road will require 8m mounting height columns with post top fixings at maximum 30m centres when using a Philips BGP623 DM12 11.0klm LED as shown on drawing LHD-PL-P08.

Site specific public lighting design reports are included in Appendix F of this report.

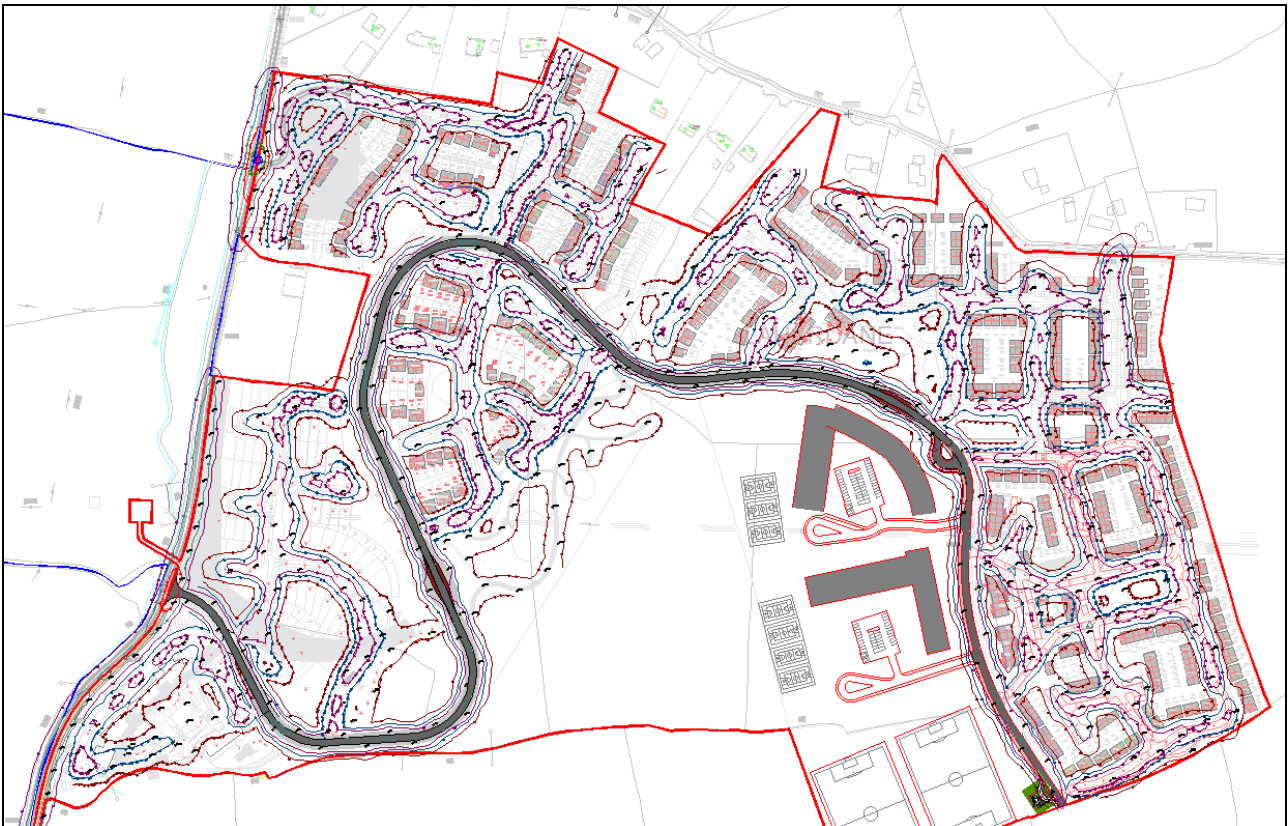


Fig 9.1: Public lighting plan (For full details of all neighbourhoods refer to drawings LHD-PL-P01, LHD-PL-P02, LHD-PL-P03, LHD-PL-P04, LHD-PL-P05, LHD-PL-P06, LHD-PL-P07, and LHD-PL-P08)

10. FLOOD RISK ASSESSMENT

PROJECT: LONGVIEW ESTATES HOUSING DEVELOPMENT, BALLYHOOLY RD, BALLYVOLANE

CLIENT: Longview Estates Ltd

PROPOSED DEVELOPMENT: 753 Residential units and a creche

Planning guidelines on flood risk and development have been published by the OPW and Department of Environment, Heritage and Local Government (DoEHLG). The below sections summarise how the developments design will be assessed in accordance with the main principals of the guidelines.

SEQUENTIAL APPROACH

The sequential approach makes use of flood zones for river and coastal flooding, as described below:

Zone A –High probability. This zone defines areas with the highest risk of flooding from of flooding. For river flooding it is defined as more than 1% probability or more than 1 in 100 year, and for coastal flooding it is defined as 0.5% probability or more than 1 in 200 year.

Zone B Moderate probability. This zone defines areas with a moderate risk of flooding. For river flooding it is defined as 0.1% to 1% probability or between 1 in 100 and 1 in 1000 years, and for coastal flooding 0.1% and 0.5% probability or between 1 in 200 and 1 in 1000 years.

Zone C Low probability. This zone defines areas with a low risk of flooding less than 0.1% probability or less than 1 in 1000.

The flood zones are then to be looked at with the vulnerability of the building proposed;

- Highly Vulnerable Hospitals, Garda stations, homes, motorways etc.
- Less Vulnerable commercial, retail, offices etc.
- Water Compatible Marina's, green areas

A sequential approach is then taken to assess the most favourable location for the development based on its vulnerability.

Zone A Water Compatible or Justification Test

Zone B Less Vulnerable if no other lands are available or highly vulnerable with Justification Test

Zone C Any development

DEVELOPMENT SEQUENTIAL TEST

Coastal Flood Risk

Coastal flooding results from sea levels which are higher than normal and result in sea water overflowing onto the land. Coastal flooding is influenced by the following three factors which often work in combination: high tide level, storm surges and wave action.

There is no risk associated with coastal flooding for this site as general ground levels for the site (circa 70.00m – 120.00m OD) are much higher than expected extreme coastal flood levels.

Fluvial Flood Risk

Fluvial flooding is the result of a river exceeding its capacity and excess water spilling out onto the adjacent floodplain.

Myplan.ie map incorporates many different sets of spatial information, including OPW Flood Mapping data (fluvial, pluvial, coastal flooding data and groundwater flood extents).

Figure 10.1 is an extract from www.myplan.ie and indicates that there is no fluvial flooding threat to the site of the proposed development.

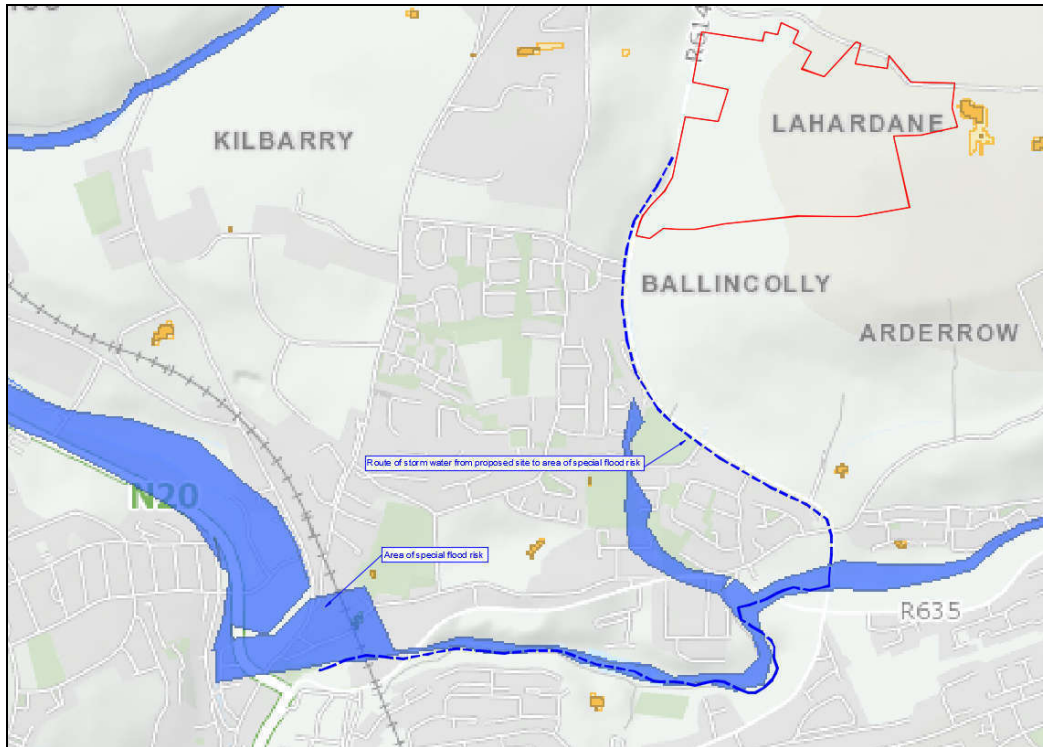


Figure 10.1: Fluvial flood map in the vicinity of the proposed site

Pluvial Flooding

The OPW Flood Hazard Mapping Website is a record of historic flood events and this database indicates that there was one reported incident of flooding in the area further downhill in Glounthaune, see Figure 10.2 below.

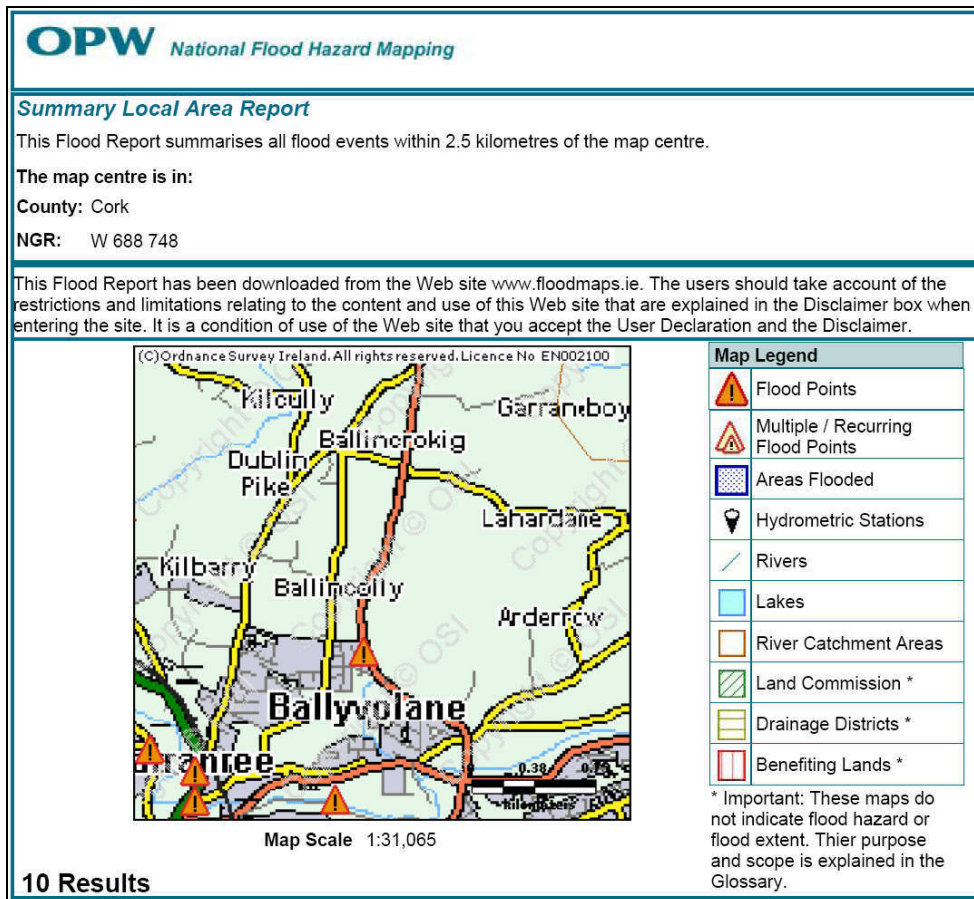


Figure 10.2: Historical flood events in Ballyvolane

Nine of the ten flood events occurred in the Blackpool area of the city. The flooding on the Ballyhooly Rd was from the Glen Stream in 1988. Flooding occurred due to blocked gullies.

It is noted the site of the proposed development was not affected by the flooding.

Development Drainage

The proposed surface water drainage design proposes to discharge at QBAR for all rainfall events up to and including the 1 in 100-year storm event plus 20% climate change as per the requirements of Cork City Council. This exceeds the climate change factor of 10% required as part of GDSDS. As is evident in the accompanying SuDS Strategy Report, the proposed discharge rate of QBAR is considerably lower than the 30-year and 100-year greenfield runoff rates and represents a substantial reduction in the peak run-off rates from the site. Furthermore, additional SuDS elements (open swales, permeable paving and partial infiltration solutions) are proposed in areas where the designed layout and topography allow, which have not been included when sizing of the attenuation tanks. When the overall site area is included, the resulting reduction in QBAR used in the design is considerable, 233.64 l/s to 170.80 l/s, implying that current peak fluvial flows from the site entering the watercourse are lower. The result is that the proposed control is very conservative and should result in a reduced flood risk downstream in particular in Blackpool which An Bord Pleanála have specifically referred to in their Opinion on Pre Application Consultations.

Flood Risk Assessment Conclusions

The site has been assessed in accordance with the Flood Risk Management Guidelines. As part of the sequential test, the OPW flood hazard maps have been consulted, as have the draft Preliminary Catchment Flood Risk Assessment Maps produced by the OPW.

Other sources of flood risk have been investigated including development drainage. In all cases it was found that the development is at low risk of flooding and the development is deemed appropriate in the proposed site location.

Appendices**APPENDIX A – Irish Water Pre-connection response**

Letter Ref: CDSCOF2 - CDSCOF5

David Watson,
Longview Estates Ltd,
Unit 74,
Penrose Wharf,
Cork



Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

18th April 2019

Dear Sir/Madam,

CUST17453 pre-connection enquiry – Subject to contract | Contract denied
Re: [Proposed 757 No. House development at Lahardane, Ballyvolane Co. Cork]

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at Lahardane, Ballyvolane Co. Cork. Based upon the details you have provided with your pre-connection enquiry and on the capacity currently available 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 can be facilitated.

In order to complete the proposed connection at the Premises, the Irish Water water and wastewater network will have to be extended, and a new strategic pump station is required to cater for this development and future developments in zoned lands in the area (Details outlined below). The costs of the network extensions and pump station will be borne by the developer. To date, a conceptual design for the works has been completed. The water main and foul sewer extensions will be located in the public space and will not require any statutory approval or third party consent. As agreed, the proposed strategic pump station will be located on your lands and will form part of your planning submission.

Water Supply:

Presently there is sufficient capacity in the IW water network to supply your proposed development. The existing network is located approximately 780m to the West of your site, please refer to the attached drawing "Connection Points". In order to facilitate the connection of your development the network will have to be extended to your site. Please note the confirmation of feasibility does not extend to your fire flow requirements.

Wastewater:

The existing foul sewer infrastructure in the area, has the capacity to accommodate the initial phase of the development. Future phases of the development will require construction of a gravity sewer network, a pump station and a rising main to pump the discharge to the existing IW wastewater network located approximately 3,000m to the South/East of your site, please refer to the attached drawing "Connection Points".

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

A. In advance of submitting your full application to An Bord Pleanála for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

B. 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 and appropriate connection fee paid 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 Energy Regulation.

If you have any further questions, please contact Maurice Feehan from the design team on 022-52284 or email maufeehan@water.ie. For further information, visit www.water.ie/connections

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Stiúrthóirí / Directors: Mike Quinn (Chairman), Eamon Gallen, Cathal Marley, Brendan Murphy, Michael G. O'Sullivan

Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin 1, D01 NP86

Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.

Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363

APPENDIX B: - Irish Water Statement of Design Acceptance

MHL & Associates Ltd.
 Carraig Mor House,
 10 High Street,
 Douglas Road,
 Cork.

19 November 2019

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

**Re: SHD Development at Lahardane, Ballyvolane, Co. Cork (the "Development")
 (the "Design Submission") / Connection Reference No: CUST17453**

Dear Gerard,

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: Alvaro Soriano
 Phone: 022 54613
 Email: agarcia@water.ie

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

Appendix A**Document Title & Revision**


- LHD-FLS-P01 Rev A Long sections Foul
- LHD-FLS-P02 Rev A Long sections Foul
- LHD-FLS-P03 Rev B Long sections Foul
- LHD-FLS-P04 Rev A Long sections Foul
- LHD-FLS-P05 Rev A Long sections Foul
- LHD-FLS-P06 Rev B Long sections Foul
- LHD-FLS-P07 Rev A Long sections Foul
- LHD-FLS-P08 Rev A Long sections Foul
- LHD-FLS-P09 Rev A Long sections Foul
- LHD-FLS-P10 Rev A Long sections Foul
- LHD-SF1-P01 Rev G Neighbourhood 1 – Stormwater/foul
- LHD-SF2-P01 Rev G Neighbourhood 2 – Stormwater/foul
- LHD-SF2-P02 Rev G Neighbourhood 2 – Stormwater/foul
- LHD-SF3-P01 Rev G Neighbourhood 3 – Stormwater/foul
- LHD-SF4-P01 Rev G Neighbourhood 4 – Stormwater/foul
- LHD-SF5-P01 Rev D Neighbourhood 5 – Stormwater/foul
- LHD-SF5-P02 Rev B Neighbourhood 5 – Stormwater/foul
- LHD-SF6-P02 Rev F Neighbourhood 6 – Stormwater/foul
- LHD-PWM-P02 Rev G Proposed watermain layout Neighbourhood 6
- LHD-PWM-P03 Rev G Proposed watermain layout Neighbourhood 1
- LHD-PWM-P04 Rev G Proposed watermain layout Neighbourhood 4
- LHD-PWM-P05 Rev G Proposed watermain layout Neighbourhood 3
- LHD-PWM-P06 Rev G Proposed watermain layout Neighbourhood 2
- LHD-PWM-P07 Rev G Proposed watermain layout Neighbourhood 5

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.

APPENDIX C – Attenuation tank design sheets

Please see following Micro Drainage design sheets for proposed attenuation tanks


| | | |
|--|------------------------------------|---|
| Microstrain Ltd | | Page 1 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-K 3.56l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1488 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|-----------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|--------|
| 15 min Winter | 0.271 | 0.271 | 0.0 | 2.6 | 2.6 | 142.2 | O K |
| 30 min Winter | 0.375 | 0.375 | 0.0 | 2.6 | 2.6 | 197.0 | O K |
| 60 min Winter | 0.487 | 0.487 | 0.0 | 2.6 | 2.6 | 255.7 | O K |
| 120 min Winter | 0.611 | 0.611 | 0.0 | 2.7 | 2.7 | 320.8 | O K |
| 180 min Winter | 0.689 | 0.689 | 0.0 | 2.9 | 2.9 | 361.6 | O K |
| 240 min Winter | 0.745 | 0.745 | 0.0 | 3.0 | 3.0 | 391.0 | O K |
| 360 min Winter | 0.823 | 0.823 | 0.0 | 3.2 | 3.2 | 432.3 | O K |
| 480 min Winter | 0.877 | 0.877 | 0.0 | 3.3 | 3.3 | 460.3 | O K |
| 600 min Winter | 0.916 | 0.916 | 0.0 | 3.3 | 3.3 | 480.6 | O K |
| 720 min Winter | 0.944 | 0.944 | 0.0 | 3.4 | 3.4 | 495.8 | O K |
| 960 min Winter | 0.983 | 0.983 | 0.0 | 3.4 | 3.4 | 516.0 | O K |
| 1440 min Winter | 1.014 | 1.014 | 0.0 | 3.5 | 3.5 | 532.2 | O K |
| 2160 min Winter | 1.024 | 1.024 | 0.0 | 3.5 | 3.5 | 537.8 | O K |
| 2880 min Winter | 1.017 | 1.017 | 0.0 | 3.5 | 3.5 | 533.7 | O K |
| 4320 min Winter | 0.972 | 0.972 | 0.0 | 3.4 | 3.4 | 510.5 | O K |
| 5760 min Winter | 0.916 | 0.916 | 0.0 | 3.3 | 3.3 | 480.8 | O K |
| 7200 min Winter | 0.858 | 0.858 | 0.0 | 3.2 | 3.2 | 450.2 | O K |
| 8640 min Winter | 0.800 | 0.800 | 0.0 | 3.1 | 3.1 | 420.3 | O K |


| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|-----------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 132.8 | 19 |
| 30 min Winter | 66.979 | 0.0 | 179.5 | 33 |
| 60 min Winter | 43.888 | 0.0 | 256.6 | 64 |
| 120 min Winter | 28.007 | 0.0 | 325.6 | 122 |
| 180 min Winter | 21.389 | 0.0 | 369.7 | 180 |
| 240 min Winter | 17.621 | 0.0 | 401.0 | 240 |
| 360 min Winter | 13.379 | 0.0 | 437.0 | 356 |
| 480 min Winter | 10.992 | 0.0 | 447.3 | 472 |
| 600 min Winter | 9.434 | 0.0 | 451.9 | 586 |
| 720 min Winter | 8.326 | 0.0 | 456.7 | 700 |
| 960 min Winter | 6.836 | 0.0 | 466.1 | 924 |
| 1440 min Winter | 5.168 | 0.0 | 475.8 | 1340 |
| 2160 min Winter | 3.900 | 0.0 | 827.8 | 1668 |
| 2880 min Winter | 3.191 | 0.0 | 883.3 | 2136 |
| 4320 min Winter | 2.402 | 0.0 | 860.2 | 3068 |
| 5760 min Winter | 1.964 | 0.0 | 1125.9 | 3976 |
| 7200 min Winter | 1.680 | 0.0 | 1203.5 | 4832 |
| 8640 min Winter | 1.479 | 0.0 | 1270.4 | 5704 |

| | | |
|--|------------------------------------|---|
| Microstrain Ltd | | Page 2 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-K 3.56l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E (l/s) | Max Outflow (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------|------------------------------|--------|
| 10080 min Winter | 0.746 | 0.746 | 0.0 | 3.0 | 3.0 | 3.0 | 391.6 | 0 K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------------------------|------------------|
| 10080 min Winter | 1.329 | 0.0 | 1327.7 | 6552 |

| | | |
|--|------------------------------------|---|
| Microstrain Ltd | | Page 3 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-K 3.56l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |


Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 0.712

| Time (mins) | Area |
|-------------|---------|
| From: To: | (ha) |
| 0 | 4 0.712 |

| | | |
|--|------------------------------------|---|
| Microstrain Ltd | | Page 4 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-K 3.56l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 875.0 | 875.0 | 1.200 | 0.0 | 1007.0 |
| 1.100 | 875.0 | 1007.0 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 3.6 Diameter (mm) 78

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 2.1 | 1.200 | 3.8 | 3.000 | 6.0 | 7.000 | 9.2 |
| 0.200 | 2.5 | 1.400 | 4.1 | 3.500 | 6.5 | 7.500 | 9.5 |
| 0.300 | 2.4 | 1.600 | 4.4 | 4.000 | 6.9 | 8.000 | 9.8 |
| 0.400 | 2.4 | 1.800 | 4.7 | 4.500 | 7.4 | 8.500 | 10.1 |
| 0.500 | 2.5 | 2.000 | 4.9 | 5.000 | 7.8 | 9.000 | 10.4 |
| 0.600 | 2.7 | 2.200 | 5.1 | 5.500 | 8.1 | 9.500 | 10.7 |
| 0.800 | 3.1 | 2.400 | 5.4 | 6.000 | 8.5 | | |
| 1.000 | 3.5 | 2.600 | 5.6 | 6.500 | 8.8 | | |

| | |
|--|--------------------------------|
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |
|--|--------------------------------|



| | |
|------------------------|------------------------------------|
| Date 20NOV2019 File | Designed by SC740 Checked by JM |
|------------------------|------------------------------------|


XP Solutions Source Control 2015.1

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 384 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ (l/s) | Max Outflow Volume (m³) | Status |
|------------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------------|------------|
| 15 min Winter | 0.325 | 0.325 | 0.0 | 7.5 | 7.5 | 108.0 | O K |
| 30 min Winter | 0.448 | 0.448 | 0.0 | 7.5 | 7.5 | 148.9 | O K |
| 60 min Winter | 0.571 | 0.571 | 0.0 | 7.5 | 7.5 | 189.9 | O K |
| 120 min Winter | 0.689 | 0.689 | 0.0 | 7.5 | 7.5 | 229.2 | O K |
| 180 min Winter | 0.748 | 0.748 | 0.0 | 7.5 | 7.5 | 248.6 | O K |
| 240 min Winter | 0.780 | 0.780 | 0.0 | 7.5 | 7.5 | 259.2 | O K |
| 360 min Winter | 0.808 | 0.808 | 0.0 | 7.5 | 7.5 | 268.4 | O K |
| 480 min Winter | 0.818 | 0.818 | 0.0 | 7.6 | 7.6 | 272.0 | O K |
| 600 min Winter | 0.826 | 0.826 | 0.0 | 7.6 | 7.6 | 274.7 | O K |
| 720 min Winter | 0.832 | 0.832 | 0.0 | 7.6 | 7.6 | 276.6 | O K |
| 960 min Winter | 0.843 | 0.843 | 0.0 | 7.7 | 7.7 | 280.1 | O K |
| 1440 min Winter | 0.866 | 0.866 | 0.0 | 7.8 | 7.8 | 287.9 | O K |
| 2160 min Winter | 0.905 | 0.905 | 0.0 | 7.9 | 7.9 | 300.9 | O K |
| 2880 min Winter | 0.927 | 0.927 | 0.0 | 8.0 | 8.0 | 308.1 | O K |
| 4320 min Winter | 0.906 | 0.906 | 0.0 | 7.9 | 7.9 | 301.3 | O K |
| 5760 min Winter | 0.986 | 0.986 | 0.0 | 8.2 | 8.2 | 327.6 | O K |
| 7200 min Winter | 1.054 | 1.054 | 0.0 | 8.5 | 8.5 | 350.4 | O K |
| 8640 min Winter | 1.060 | 1.060 | 0.0 | 8.5 | 8.5 | 352.4 | O K |
| 10080 min Winter | 0.984 | 0.984 | 0.0 | 8.2 | 8.2 | 327.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 237.1 | 25 |
| 30 min Winter | 66.979 | 0.0 | 282.1 | 39 |
| 60 min Winter | 43.888 | 0.0 | 665.5 | 66 |
| 120 min Winter | 28.007 | 0.0 | 723.3 | 124 |
| 180 min Winter | 21.389 | 0.0 | 762.2 | 180 |
| 240 min Winter | 17.621 | 0.0 | 792.4 | 236 |
| 360 min Winter | 13.379 | 0.0 | 839.1 | 342 |
| 480 min Winter | 10.992 | 0.0 | 875.6 | 392 |
| 600 min Winter | 9.434 | 0.0 | 906.2 | 472 |
| 720 min Winter | 8.326 | 0.0 | 932.8 | 556 |
| 960 min Winter | 6.836 | 0.0 | 977.9 | 724 |
| 1440 min Winter | 5.168 | 0.0 | 1047.3 | 1058 |
| 2160 min Winter | 3.900 | 0.0 | 2072.9 | 1560 |
| 2880 min Winter | 3.191 | 0.0 | 2133.8 | 1992 |
| 4320 min Winter | 2.402 | 0.0 | 2147.6 | 3032 |
| 5760 min Winter | 1.964 | 0.0 | 2347.8 | 3992 |
| 7200 min Winter | 1.680 | 0.0 | 2410.1 | 4760 |
| 8640 min Winter | 1.479 | 0.0 | 2464.5 | 5448 |
| 10080 min Winter | 1.329 | 0.0 | 2512.9 | 5760 |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |  |
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| Date 20NOV2019 | Designed by SC740 | |
| File | Checked by JM | |

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| XP Solutions | Source Control 2015.1 |
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Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 0.568

| Time (mins) | Area | Time (mins) | Area | Time (mins) | Area |
|-------------|---------|-------------|---------|-------------|----------|
| From: To: | (ha) | From: To: | (ha) | From: To: | (ha) |
| 0 | 4 0.189 | 4 | 8 0.189 | 8 | 12 0.189 |

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| Unit B3 | Ballyvolane |
| Metropoint Business Park | AT- L |
| Swords Co. Dublin | 8.6l/s |



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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure


Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 554.0 | 554.0 | 1.200 | 0.0 | 658.9 |
| 1.100 | 554.0 | 658.9 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 8.6 Diameter (mm) 120

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 3.8 | 1.200 | 9.0 | 3.000 | 14.2 | 7.000 | 21.7 |
| 0.200 | 7.2 | 1.400 | 9.7 | 3.500 | 15.4 | 7.500 | 22.5 |
| 0.300 | 7.5 | 1.600 | 10.4 | 4.000 | 16.4 | 8.000 | 23.2 |
| 0.400 | 7.1 | 1.800 | 11.0 | 4.500 | 17.4 | 8.500 | 24.0 |
| 0.500 | 6.9 | 2.000 | 11.6 | 5.000 | 18.4 | 9.000 | 24.6 |
| 0.600 | 7.0 | 2.200 | 12.2 | 5.500 | 19.3 | 9.500 | 25.3 |
| 0.800 | 7.5 | 2.400 | 12.7 | 6.000 | 20.1 | | |
| 1.000 | 8.3 | 2.600 | 13.2 | 6.500 | 20.9 | | |


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |  |
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| Date 20NOV2019 | Designed by SC740 |
| File | Checked by JM |

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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 10 | 0.0 | 510 | 0.6 | 1010 | 1.6 | 1510 | 2.4 | 2010 | 2.5 | 2510 | 2.5 |
| 20 | 0.0 | 520 | 0.7 | 1020 | 1.7 | 1520 | 2.4 | 2020 | 2.5 | 2520 | 2.5 |
| 30 | 0.0 | 530 | 0.7 | 1030 | 1.7 | 1530 | 2.4 | 2030 | 2.5 | 2530 | 2.5 |
| 40 | 0.0 | 540 | 0.7 | 1040 | 1.7 | 1540 | 2.4 | 2040 | 2.5 | 2540 | 2.5 |
| 50 | 0.0 | 550 | 0.7 | 1050 | 1.7 | 1550 | 2.4 | 2050 | 2.5 | 2550 | 2.5 |
| 60 | 0.0 | 560 | 0.8 | 1060 | 1.7 | 1560 | 2.4 | 2060 | 2.5 | 2560 | 2.5 |
| 70 | 0.0 | 570 | 0.8 | 1070 | 1.7 | 1570 | 2.4 | 2070 | 2.5 | 2570 | 2.5 |
| 80 | 0.0 | 580 | 0.8 | 1080 | 1.7 | 1580 | 2.5 | 2080 | 2.4 | 2580 | 2.5 |
| 90 | 0.0 | 590 | 0.8 | 1090 | 1.8 | 1590 | 2.5 | 2090 | 2.4 | 2590 | 2.6 |
| 100 | 0.0 | 600 | 0.9 | 1100 | 1.8 | 1600 | 2.5 | 2100 | 2.4 | 2600 | 2.6 |
| 110 | 0.0 | 610 | 0.9 | 1110 | 1.8 | 1610 | 2.5 | 2110 | 2.4 | 2610 | 2.6 |
| 120 | 0.0 | 620 | 0.9 | 1120 | 1.8 | 1620 | 2.5 | 2120 | 2.4 | 2620 | 2.6 |
| 130 | 0.0 | 630 | 0.9 | 1130 | 1.8 | 1630 | 2.5 | 2130 | 2.4 | 2630 | 2.6 |
| 140 | 0.0 | 640 | 0.9 | 1140 | 1.8 | 1640 | 2.5 | 2140 | 2.4 | 2640 | 2.6 |
| 150 | 0.0 | 650 | 1.0 | 1150 | 1.8 | 1650 | 2.5 | 2150 | 2.4 | 2650 | 2.6 |
| 160 | 0.0 | 660 | 1.0 | 1160 | 1.9 | 1660 | 2.5 | 2160 | 2.4 | 2660 | 2.6 |
| 170 | 0.0 | 670 | 1.0 | 1170 | 1.9 | 1670 | 2.5 | 2170 | 2.4 | 2670 | 2.6 |
| 180 | 0.0 | 680 | 1.0 | 1180 | 1.9 | 1680 | 2.5 | 2180 | 2.4 | 2680 | 2.7 |
| 190 | 0.0 | 690 | 1.1 | 1190 | 1.9 | 1690 | 2.5 | 2190 | 2.4 | 2690 | 2.7 |
| 200 | 0.0 | 700 | 1.1 | 1200 | 1.9 | 1700 | 2.5 | 2200 | 2.4 | 2700 | 2.7 |
| 210 | 0.1 | 710 | 1.1 | 1210 | 1.9 | 1710 | 2.5 | 2210 | 2.4 | 2710 | 2.7 |
| 220 | 0.1 | 720 | 1.1 | 1220 | 1.9 | 1720 | 2.5 | 2220 | 2.4 | 2720 | 2.7 |
| 230 | 0.1 | 730 | 1.1 | 1230 | 2.0 | 1730 | 2.5 | 2230 | 2.4 | 2730 | 2.7 |
| 240 | 0.1 | 740 | 1.2 | 1240 | 2.0 | 1740 | 2.5 | 2240 | 2.4 | 2740 | 2.7 |
| 250 | 0.1 | 750 | 1.2 | 1250 | 2.0 | 1750 | 2.6 | 2250 | 2.4 | 2750 | 2.7 |
| 260 | 0.1 | 760 | 1.2 | 1260 | 2.0 | 1760 | 2.6 | 2260 | 2.4 | 2760 | 2.8 |
| 270 | 0.1 | 770 | 1.2 | 1270 | 2.0 | 1770 | 2.6 | 2270 | 2.4 | 2770 | 2.8 |
| 280 | 0.1 | 780 | 1.2 | 1280 | 2.0 | 1780 | 2.6 | 2280 | 2.4 | 2780 | 2.8 |
| 290 | 0.2 | 790 | 1.3 | 1290 | 2.0 | 1790 | 2.6 | 2290 | 2.4 | 2790 | 2.8 |
| 300 | 0.2 | 800 | 1.3 | 1300 | 2.1 | 1800 | 2.6 | 2300 | 2.4 | 2800 | 2.8 |
| 310 | 0.2 | 810 | 1.3 | 1310 | 2.1 | 1810 | 2.6 | 2310 | 2.4 | 2810 | 2.8 |
| 320 | 0.2 | 820 | 1.3 | 1320 | 2.1 | 1820 | 2.6 | 2320 | 2.4 | 2820 | 2.8 |
| 330 | 0.2 | 830 | 1.3 | 1330 | 2.1 | 1830 | 2.6 | 2330 | 2.4 | 2830 | 2.8 |
| 340 | 0.3 | 840 | 1.4 | 1340 | 2.1 | 1840 | 2.6 | 2340 | 2.4 | 2840 | 2.9 |
| 350 | 0.3 | 850 | 1.4 | 1350 | 2.1 | 1850 | 2.6 | 2350 | 2.4 | 2850 | 2.9 |
| 360 | 0.3 | 860 | 1.4 | 1360 | 2.1 | 1860 | 2.6 | 2360 | 2.4 | 2860 | 2.9 |
| 370 | 0.3 | 870 | 1.4 | 1370 | 2.2 | 1870 | 2.6 | 2370 | 2.4 | 2870 | 2.9 |
| 380 | 0.3 | 880 | 1.4 | 1380 | 2.2 | 1880 | 2.6 | 2380 | 2.4 | 2880 | 2.9 |
| 390 | 0.4 | 890 | 1.5 | 1390 | 2.2 | 1890 | 2.6 | 2390 | 2.4 | 2890 | 2.9 |
| 400 | 0.4 | 900 | 1.5 | 1400 | 2.2 | 1900 | 2.6 | 2400 | 2.4 | 2900 | 2.9 |
| 410 | 0.4 | 910 | 1.5 | 1410 | 2.2 | 1910 | 2.5 | 2410 | 2.4 | 2910 | 2.9 |
| 420 | 0.4 | 920 | 1.5 | 1420 | 2.2 | 1920 | 2.5 | 2420 | 2.4 | 2920 | 2.9 |
| 430 | 0.4 | 930 | 1.5 | 1430 | 2.3 | 1930 | 2.5 | 2430 | 2.4 | 2930 | 3.0 |
| 440 | 0.5 | 940 | 1.5 | 1440 | 2.3 | 1940 | 2.5 | 2440 | 2.4 | 2940 | 3.0 |
| 450 | 0.5 | 950 | 1.5 | 1450 | 2.3 | 1950 | 2.5 | 2450 | 2.4 | 2950 | 3.0 |
| 460 | 0.5 | 960 | 1.6 | 1460 | 2.3 | 1960 | 2.5 | 2460 | 2.4 | 2960 | 3.0 |
| 470 | 0.5 | 970 | 1.6 | 1470 | 2.3 | 1970 | 2.5 | 2470 | 2.4 | 2970 | 3.0 |
| 480 | 0.6 | 980 | 1.6 | 1480 | 2.3 | 1980 | 2.5 | 2480 | 2.4 | 2980 | 3.0 |
| 490 | 0.6 | 990 | 1.6 | 1490 | 2.3 | 1990 | 2.5 | 2490 | 2.5 | 2990 | 3.0 |
| 500 | 0.6 | 1000 | 1.6 | 1500 | 2.4 | 2000 | 2.5 | 2500 | 2.5 | 3000 | 3.0 |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |  |
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| Date 20NOV2019 | Designed by SC740 | |
| File | Checked by JM | |

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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 3010 | 3.0 | 3470 | 3.4 | 3930 | 3.5 | 4390 | 3.5 | 4850 | 3.5 | 5310 | 3.4 |
| 3020 | 3.1 | 3480 | 3.4 | 3940 | 3.5 | 4400 | 3.5 | 4860 | 3.5 | 5320 | 3.4 |
| 3030 | 3.1 | 3490 | 3.4 | 3950 | 3.5 | 4410 | 3.5 | 4870 | 3.5 | 5330 | 3.4 |
| 3040 | 3.1 | 3500 | 3.4 | 3960 | 3.5 | 4420 | 3.5 | 4880 | 3.5 | 5340 | 3.4 |
| 3050 | 3.1 | 3510 | 3.4 | 3970 | 3.5 | 4430 | 3.5 | 4890 | 3.5 | 5350 | 3.4 |
| 3060 | 3.1 | 3520 | 3.4 | 3980 | 3.5 | 4440 | 3.5 | 4900 | 3.5 | 5360 | 3.4 |
| 3070 | 3.1 | 3530 | 3.4 | 3990 | 3.5 | 4450 | 3.5 | 4910 | 3.5 | 5370 | 3.4 |
| 3080 | 3.1 | 3540 | 3.4 | 4000 | 3.5 | 4460 | 3.5 | 4920 | 3.5 | 5380 | 3.4 |
| 3090 | 3.1 | 3550 | 3.4 | 4010 | 3.5 | 4470 | 3.5 | 4930 | 3.5 | 5390 | 3.4 |
| 3100 | 3.1 | 3560 | 3.4 | 4020 | 3.5 | 4480 | 3.5 | 4940 | 3.5 | 5400 | 3.4 |
| 3110 | 3.1 | 3570 | 3.4 | 4030 | 3.5 | 4490 | 3.5 | 4950 | 3.5 | 5410 | 3.4 |
| 3120 | 3.1 | 3580 | 3.4 | 4040 | 3.5 | 4500 | 3.5 | 4960 | 3.5 | 5420 | 3.4 |
| 3130 | 3.2 | 3590 | 3.4 | 4050 | 3.5 | 4510 | 3.5 | 4970 | 3.5 | 5430 | 3.4 |
| 3140 | 3.2 | 3600 | 3.4 | 4060 | 3.5 | 4520 | 3.5 | 4980 | 3.5 | 5440 | 3.4 |
| 3150 | 3.2 | 3610 | 3.4 | 4070 | 3.5 | 4530 | 3.5 | 4990 | 3.5 | 5450 | 3.4 |
| 3160 | 3.2 | 3620 | 3.4 | 4080 | 3.5 | 4540 | 3.5 | 5000 | 3.5 | 5460 | 3.4 |
| 3170 | 3.2 | 3630 | 3.4 | 4090 | 3.5 | 4550 | 3.5 | 5010 | 3.5 | 5470 | 3.4 |
| 3180 | 3.2 | 3640 | 3.4 | 4100 | 3.5 | 4560 | 3.5 | 5020 | 3.5 | 5480 | 3.4 |
| 3190 | 3.2 | 3650 | 3.4 | 4110 | 3.5 | 4570 | 3.5 | 5030 | 3.5 | 5490 | 3.4 |
| 3200 | 3.2 | 3660 | 3.5 | 4120 | 3.5 | 4580 | 3.5 | 5040 | 3.5 | 5500 | 3.4 |
| 3210 | 3.2 | 3670 | 3.5 | 4130 | 3.5 | 4590 | 3.5 | 5050 | 3.5 | 5510 | 3.4 |
| 3220 | 3.2 | 3680 | 3.5 | 4140 | 3.5 | 4600 | 3.5 | 5060 | 3.5 | 5520 | 3.4 |
| 3230 | 3.2 | 3690 | 3.5 | 4150 | 3.5 | 4610 | 3.5 | 5070 | 3.5 | 5530 | 3.4 |
| 3240 | 3.2 | 3700 | 3.5 | 4160 | 3.5 | 4620 | 3.5 | 5080 | 3.5 | 5540 | 3.4 |
| 3250 | 3.2 | 3710 | 3.5 | 4170 | 3.5 | 4630 | 3.5 | 5090 | 3.5 | 5550 | 3.4 |
| 3260 | 3.3 | 3720 | 3.5 | 4180 | 3.5 | 4640 | 3.5 | 5100 | 3.5 | 5560 | 3.4 |
| 3270 | 3.3 | 3730 | 3.5 | 4190 | 3.5 | 4650 | 3.5 | 5110 | 3.5 | 5570 | 3.4 |
| 3280 | 3.3 | 3740 | 3.5 | 4200 | 3.5 | 4660 | 3.5 | 5120 | 3.5 | 5580 | 3.4 |
| 3290 | 3.3 | 3750 | 3.5 | 4210 | 3.5 | 4670 | 3.5 | 5130 | 3.5 | 5590 | 3.4 |
| 3300 | 3.3 | 3760 | 3.5 | 4220 | 3.5 | 4680 | 3.5 | 5140 | 3.5 | 5600 | 3.4 |
| 3310 | 3.3 | 3770 | 3.5 | 4230 | 3.5 | 4690 | 3.5 | 5150 | 3.5 | 5610 | 3.4 |
| 3320 | 3.3 | 3780 | 3.5 | 4240 | 3.5 | 4700 | 3.5 | 5160 | 3.5 | 5620 | 3.4 |
| 3330 | 3.3 | 3790 | 3.5 | 4250 | 3.5 | 4710 | 3.5 | 5170 | 3.5 | 5630 | 3.4 |
| 3340 | 3.3 | 3800 | 3.5 | 4260 | 3.5 | 4720 | 3.5 | 5180 | 3.5 | 5640 | 3.4 |
| 3350 | 3.3 | 3810 | 3.5 | 4270 | 3.5 | 4730 | 3.5 | 5190 | 3.5 | 5650 | 3.4 |
| 3360 | 3.3 | 3820 | 3.5 | 4280 | 3.5 | 4740 | 3.5 | 5200 | 3.5 | 5660 | 3.4 |
| 3370 | 3.3 | 3830 | 3.5 | 4290 | 3.5 | 4750 | 3.5 | 5210 | 3.5 | 5670 | 3.3 |
| 3380 | 3.3 | 3840 | 3.5 | 4300 | 3.5 | 4760 | 3.5 | 5220 | 3.5 | 5680 | 3.3 |
| 3390 | 3.3 | 3850 | 3.5 | 4310 | 3.5 | 4770 | 3.5 | 5230 | 3.5 | 5690 | 3.3 |
| 3400 | 3.3 | 3860 | 3.5 | 4320 | 3.5 | 4780 | 3.5 | 5240 | 3.5 | 5700 | 3.3 |
| 3410 | 3.3 | 3870 | 3.5 | 4330 | 3.5 | 4790 | 3.5 | 5250 | 3.5 | 5710 | 3.3 |
| 3420 | 3.4 | 3880 | 3.5 | 4340 | 3.5 | 4800 | 3.5 | 5260 | 3.5 | 5720 | 3.3 |
| 3430 | 3.4 | 3890 | 3.5 | 4350 | 3.5 | 4810 | 3.5 | 5270 | 3.5 | 5730 | 3.3 |
| 3440 | 3.4 | 3900 | 3.5 | 4360 | 3.5 | 4820 | 3.5 | 5280 | 3.4 | 5740 | 3.3 |
| 3450 | 3.4 | 3910 | 3.5 | 4370 | 3.5 | 4830 | 3.5 | 5290 | 3.4 | 5750 | 3.3 |
| 3460 | 3.4 | 3920 | 3.5 | 4380 | 3.5 | 4840 | 3.5 | 5300 | 3.4 | 5760 | 3.3 |

Additional Hydrograph #2


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |  |
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| Date 20NOV2019 | Designed by SC740 |
| File | Checked by JM |

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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #2

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 10 | 0.0 | 510 | 0.5 | 1010 | 1.1 | 1510 | 1.4 | 2010 | 1.3 | 2510 | 1.5 |
| 20 | 0.0 | 520 | 0.5 | 1020 | 1.1 | 1520 | 1.4 | 2020 | 1.3 | 2520 | 1.5 |
| 30 | 0.0 | 530 | 0.5 | 1030 | 1.1 | 1530 | 1.4 | 2030 | 1.3 | 2530 | 1.5 |
| 40 | 0.0 | 540 | 0.5 | 1040 | 1.1 | 1540 | 1.4 | 2040 | 1.3 | 2540 | 1.5 |
| 50 | 0.0 | 550 | 0.6 | 1050 | 1.1 | 1550 | 1.4 | 2050 | 1.3 | 2550 | 1.5 |
| 60 | 0.0 | 560 | 0.6 | 1060 | 1.1 | 1560 | 1.4 | 2060 | 1.3 | 2560 | 1.5 |
| 70 | 0.0 | 570 | 0.6 | 1070 | 1.1 | 1570 | 1.4 | 2070 | 1.3 | 2570 | 1.5 |
| 80 | 0.0 | 580 | 0.6 | 1080 | 1.1 | 1580 | 1.4 | 2080 | 1.3 | 2580 | 1.5 |
| 90 | 0.0 | 590 | 0.6 | 1090 | 1.1 | 1590 | 1.4 | 2090 | 1.3 | 2590 | 1.6 |
| 100 | 0.0 | 600 | 0.6 | 1100 | 1.2 | 1600 | 1.4 | 2100 | 1.3 | 2600 | 1.6 |
| 110 | 0.0 | 610 | 0.6 | 1110 | 1.2 | 1610 | 1.4 | 2110 | 1.3 | 2610 | 1.6 |
| 120 | 0.0 | 620 | 0.7 | 1120 | 1.2 | 1620 | 1.4 | 2120 | 1.3 | 2620 | 1.6 |
| 130 | 0.0 | 630 | 0.7 | 1130 | 1.2 | 1630 | 1.4 | 2130 | 1.3 | 2630 | 1.6 |
| 140 | 0.0 | 640 | 0.7 | 1140 | 1.2 | 1640 | 1.4 | 2140 | 1.3 | 2640 | 1.6 |
| 150 | 0.0 | 650 | 0.7 | 1150 | 1.2 | 1650 | 1.4 | 2150 | 1.3 | 2650 | 1.6 |
| 160 | 0.0 | 660 | 0.7 | 1160 | 1.2 | 1660 | 1.4 | 2160 | 1.3 | 2660 | 1.6 |
| 170 | 0.0 | 670 | 0.7 | 1170 | 1.2 | 1670 | 1.4 | 2170 | 1.3 | 2670 | 1.6 |
| 180 | 0.0 | 680 | 0.8 | 1180 | 1.2 | 1680 | 1.4 | 2180 | 1.3 | 2680 | 1.6 |
| 190 | 0.0 | 690 | 0.8 | 1190 | 1.2 | 1690 | 1.4 | 2190 | 1.3 | 2690 | 1.6 |
| 200 | 0.0 | 700 | 0.8 | 1200 | 1.2 | 1700 | 1.4 | 2200 | 1.3 | 2700 | 1.6 |
| 210 | 0.0 | 710 | 0.8 | 1210 | 1.2 | 1710 | 1.4 | 2210 | 1.3 | 2710 | 1.7 |
| 220 | 0.1 | 720 | 0.8 | 1220 | 1.2 | 1720 | 1.4 | 2220 | 1.3 | 2720 | 1.7 |
| 230 | 0.1 | 730 | 0.8 | 1230 | 1.2 | 1730 | 1.4 | 2230 | 1.3 | 2730 | 1.7 |
| 240 | 0.1 | 740 | 0.8 | 1240 | 1.2 | 1740 | 1.4 | 2240 | 1.3 | 2740 | 1.7 |
| 250 | 0.1 | 750 | 0.8 | 1250 | 1.3 | 1750 | 1.4 | 2250 | 1.3 | 2750 | 1.7 |
| 260 | 0.1 | 760 | 0.9 | 1260 | 1.3 | 1760 | 1.4 | 2260 | 1.3 | 2760 | 1.7 |
| 270 | 0.1 | 770 | 0.9 | 1270 | 1.3 | 1770 | 1.4 | 2270 | 1.3 | 2770 | 1.7 |
| 280 | 0.1 | 780 | 0.9 | 1280 | 1.3 | 1780 | 1.4 | 2280 | 1.3 | 2780 | 1.7 |
| 290 | 0.1 | 790 | 0.9 | 1290 | 1.3 | 1790 | 1.4 | 2290 | 1.3 | 2790 | 1.7 |
| 300 | 0.1 | 800 | 0.9 | 1300 | 1.3 | 1800 | 1.4 | 2300 | 1.3 | 2800 | 1.7 |
| 310 | 0.2 | 810 | 0.9 | 1310 | 1.3 | 1810 | 1.4 | 2310 | 1.3 | 2810 | 1.7 |
| 320 | 0.2 | 820 | 0.9 | 1320 | 1.3 | 1820 | 1.4 | 2320 | 1.3 | 2820 | 1.7 |
| 330 | 0.2 | 830 | 0.9 | 1330 | 1.3 | 1830 | 1.4 | 2330 | 1.4 | 2830 | 1.8 |
| 340 | 0.2 | 840 | 0.9 | 1340 | 1.3 | 1840 | 1.3 | 2340 | 1.4 | 2840 | 1.8 |
| 350 | 0.2 | 850 | 0.9 | 1350 | 1.3 | 1850 | 1.3 | 2350 | 1.4 | 2850 | 1.8 |
| 360 | 0.2 | 860 | 1.0 | 1360 | 1.3 | 1860 | 1.3 | 2360 | 1.4 | 2860 | 1.8 |
| 370 | 0.2 | 870 | 1.0 | 1370 | 1.3 | 1870 | 1.3 | 2370 | 1.4 | 2870 | 1.8 |
| 380 | 0.3 | 880 | 1.0 | 1380 | 1.3 | 1880 | 1.3 | 2380 | 1.4 | 2880 | 1.8 |
| 390 | 0.3 | 890 | 1.0 | 1390 | 1.3 | 1890 | 1.3 | 2390 | 1.4 | 2890 | 1.8 |
| 400 | 0.3 | 900 | 1.0 | 1400 | 1.3 | 1900 | 1.3 | 2400 | 1.4 | 2900 | 1.8 |
| 410 | 0.3 | 910 | 1.0 | 1410 | 1.3 | 1910 | 1.3 | 2410 | 1.4 | 2910 | 1.8 |
| 420 | 0.3 | 920 | 1.0 | 1420 | 1.3 | 1920 | 1.3 | 2420 | 1.4 | 2920 | 1.8 |
| 430 | 0.3 | 930 | 1.0 | 1430 | 1.3 | 1930 | 1.3 | 2430 | 1.4 | 2930 | 1.8 |
| 440 | 0.4 | 940 | 1.0 | 1440 | 1.3 | 1940 | 1.3 | 2440 | 1.4 | 2940 | 1.8 |
| 450 | 0.4 | 950 | 1.0 | 1450 | 1.4 | 1950 | 1.3 | 2450 | 1.4 | 2950 | 1.8 |
| 460 | 0.4 | 960 | 1.0 | 1460 | 1.4 | 1960 | 1.3 | 2460 | 1.4 | 2960 | 1.8 |
| 470 | 0.4 | 970 | 1.1 | 1470 | 1.4 | 1970 | 1.3 | 2470 | 1.5 | 2970 | 1.9 |
| 480 | 0.4 | 980 | 1.1 | 1480 | 1.4 | 1980 | 1.3 | 2480 | 1.5 | 2980 | 1.9 |
| 490 | 0.5 | 990 | 1.1 | 1490 | 1.4 | 1990 | 1.3 | 2490 | 1.5 | 2990 | 1.9 |
| 500 | 0.5 | 1000 | 1.1 | 1500 | 1.4 | 2000 | 1.3 | 2500 | 1.5 | 3000 | 1.9 |


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- L 8.6l/s |  |
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| Date 20NOV2019 | Designed by SC740 | |
| File | Checked by JM | |

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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #2

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 3010 | 1.9 | 3470 | 2.1 | 3930 | 2.2 | 4390 | 2.2 | 4850 | 2.2 | 5310 | 2.1 |
| 3020 | 1.9 | 3480 | 2.1 | 3940 | 2.2 | 4400 | 2.2 | 4860 | 2.2 | 5320 | 2.1 |
| 3030 | 1.9 | 3490 | 2.1 | 3950 | 2.2 | 4410 | 2.2 | 4870 | 2.2 | 5330 | 2.1 |
| 3040 | 1.9 | 3500 | 2.1 | 3960 | 2.2 | 4420 | 2.2 | 4880 | 2.2 | 5340 | 2.1 |
| 3050 | 1.9 | 3510 | 2.1 | 3970 | 2.2 | 4430 | 2.2 | 4890 | 2.2 | 5350 | 2.1 |
| 3060 | 1.9 | 3520 | 2.1 | 3980 | 2.2 | 4440 | 2.2 | 4900 | 2.2 | 5360 | 2.1 |
| 3070 | 1.9 | 3530 | 2.1 | 3990 | 2.2 | 4450 | 2.2 | 4910 | 2.2 | 5370 | 2.1 |
| 3080 | 1.9 | 3540 | 2.1 | 4000 | 2.2 | 4460 | 2.2 | 4920 | 2.2 | 5380 | 2.1 |
| 3090 | 1.9 | 3550 | 2.1 | 4010 | 2.2 | 4470 | 2.2 | 4930 | 2.2 | 5390 | 2.1 |
| 3100 | 1.9 | 3560 | 2.1 | 4020 | 2.2 | 4480 | 2.2 | 4940 | 2.2 | 5400 | 2.1 |
| 3110 | 1.9 | 3570 | 2.1 | 4030 | 2.2 | 4490 | 2.2 | 4950 | 2.2 | 5410 | 2.1 |
| 3120 | 1.9 | 3580 | 2.1 | 4040 | 2.2 | 4500 | 2.2 | 4960 | 2.1 | 5420 | 2.1 |
| 3130 | 2.0 | 3590 | 2.1 | 4050 | 2.2 | 4510 | 2.2 | 4970 | 2.1 | 5430 | 2.1 |
| 3140 | 2.0 | 3600 | 2.1 | 4060 | 2.2 | 4520 | 2.2 | 4980 | 2.1 | 5440 | 2.1 |
| 3150 | 2.0 | 3610 | 2.1 | 4070 | 2.2 | 4530 | 2.2 | 4990 | 2.1 | 5450 | 2.1 |
| 3160 | 2.0 | 3620 | 2.1 | 4080 | 2.2 | 4540 | 2.2 | 5000 | 2.1 | 5460 | 2.1 |
| 3170 | 2.0 | 3630 | 2.1 | 4090 | 2.2 | 4550 | 2.2 | 5010 | 2.1 | 5470 | 2.1 |
| 3180 | 2.0 | 3640 | 2.1 | 4100 | 2.2 | 4560 | 2.2 | 5020 | 2.1 | 5480 | 2.1 |
| 3190 | 2.0 | 3650 | 2.1 | 4110 | 2.2 | 4570 | 2.2 | 5030 | 2.1 | 5490 | 2.1 |
| 3200 | 2.0 | 3660 | 2.1 | 4120 | 2.2 | 4580 | 2.2 | 5040 | 2.1 | 5500 | 2.1 |
| 3210 | 2.0 | 3670 | 2.1 | 4130 | 2.2 | 4590 | 2.2 | 5050 | 2.1 | 5510 | 2.1 |
| 3220 | 2.0 | 3680 | 2.1 | 4140 | 2.2 | 4600 | 2.2 | 5060 | 2.1 | 5520 | 2.1 |
| 3230 | 2.0 | 3690 | 2.1 | 4150 | 2.2 | 4610 | 2.2 | 5070 | 2.1 | 5530 | 2.1 |
| 3240 | 2.0 | 3700 | 2.1 | 4160 | 2.2 | 4620 | 2.2 | 5080 | 2.1 | 5540 | 2.1 |
| 3250 | 2.0 | 3710 | 2.1 | 4170 | 2.2 | 4630 | 2.2 | 5090 | 2.1 | 5550 | 2.1 |
| 3260 | 2.0 | 3720 | 2.1 | 4180 | 2.2 | 4640 | 2.2 | 5100 | 2.1 | 5560 | 2.1 |
| 3270 | 2.0 | 3730 | 2.1 | 4190 | 2.2 | 4650 | 2.2 | 5110 | 2.1 | 5570 | 2.1 |
| 3280 | 2.0 | 3740 | 2.1 | 4200 | 2.2 | 4660 | 2.2 | 5120 | 2.1 | 5580 | 2.1 |
| 3290 | 2.0 | 3750 | 2.1 | 4210 | 2.2 | 4670 | 2.2 | 5130 | 2.1 | 5590 | 2.1 |
| 3300 | 2.0 | 3760 | 2.1 | 4220 | 2.2 | 4680 | 2.2 | 5140 | 2.1 | 5600 | 2.1 |
| 3310 | 2.0 | 3770 | 2.2 | 4230 | 2.2 | 4690 | 2.2 | 5150 | 2.1 | 5610 | 2.1 |
| 3320 | 2.0 | 3780 | 2.2 | 4240 | 2.2 | 4700 | 2.2 | 5160 | 2.1 | 5620 | 2.1 |
| 3330 | 2.0 | 3790 | 2.2 | 4250 | 2.2 | 4710 | 2.2 | 5170 | 2.1 | 5630 | 2.1 |
| 3340 | 2.0 | 3800 | 2.2 | 4260 | 2.2 | 4720 | 2.2 | 5180 | 2.1 | 5640 | 2.1 |
| 3350 | 2.0 | 3810 | 2.2 | 4270 | 2.2 | 4730 | 2.2 | 5190 | 2.1 | 5650 | 2.1 |
| 3360 | 2.1 | 3820 | 2.2 | 4280 | 2.2 | 4740 | 2.2 | 5200 | 2.1 | 5660 | 2.1 |
| 3370 | 2.1 | 3830 | 2.2 | 4290 | 2.2 | 4750 | 2.2 | 5210 | 2.1 | 5670 | 2.1 |
| 3380 | 2.1 | 3840 | 2.2 | 4300 | 2.2 | 4760 | 2.2 | 5220 | 2.1 | 5680 | 2.1 |
| 3390 | 2.1 | 3850 | 2.2 | 4310 | 2.2 | 4770 | 2.2 | 5230 | 2.1 | 5690 | 2.1 |
| 3400 | 2.1 | 3860 | 2.2 | 4320 | 2.2 | 4780 | 2.2 | 5240 | 2.1 | 5700 | 2.1 |
| 3410 | 2.1 | 3870 | 2.2 | 4330 | 2.2 | 4790 | 2.2 | 5250 | 2.1 | 5710 | 2.1 |
| 3420 | 2.1 | 3880 | 2.2 | 4340 | 2.2 | 4800 | 2.2 | 5260 | 2.1 | 5720 | 2.1 |
| 3430 | 2.1 | 3890 | 2.2 | 4350 | 2.2 | 4810 | 2.2 | 5270 | 2.1 | 5730 | 2.1 |
| 3440 | 2.1 | 3900 | 2.2 | 4360 | 2.2 | 4820 | 2.2 | 5280 | 2.1 | 5740 | 2.1 |
| 3450 | 2.1 | 3910 | 2.2 | 4370 | 2.2 | 4830 | 2.2 | 5290 | 2.1 | 5750 | 2.1 |
| 3460 | 2.1 | 3920 | 2.2 | 4380 | 2.2 | 4840 | 2.2 | 5300 | 2.1 | 5760 | 2.1 |


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| Microstrain Ltd | | Page 1 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-M 6.65l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1432 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|-----------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|--------|
| 15 min Winter | 0.280 | 0.280 | 0.0 | 5.5 | 5.5 | 265.0 | O K |
| 30 min Winter | 0.388 | 0.388 | 0.0 | 5.5 | 5.5 | 367.0 | O K |
| 60 min Winter | 0.504 | 0.504 | 0.0 | 5.5 | 5.5 | 476.3 | O K |
| 120 min Winter | 0.632 | 0.632 | 0.0 | 5.5 | 5.5 | 597.5 | O K |
| 180 min Winter | 0.713 | 0.713 | 0.0 | 5.5 | 5.5 | 673.3 | O K |
| 240 min Winter | 0.770 | 0.770 | 0.0 | 5.7 | 5.7 | 727.9 | O K |
| 360 min Winter | 0.851 | 0.851 | 0.0 | 6.0 | 6.0 | 804.5 | O K |
| 480 min Winter | 0.906 | 0.906 | 0.0 | 6.1 | 6.1 | 856.2 | O K |
| 600 min Winter | 0.946 | 0.946 | 0.0 | 6.3 | 6.3 | 893.6 | O K |
| 720 min Winter | 0.975 | 0.975 | 0.0 | 6.3 | 6.3 | 921.3 | O K |
| 960 min Winter | 1.013 | 1.013 | 0.0 | 6.5 | 6.5 | 957.7 | O K |
| 1440 min Winter | 1.043 | 1.043 | 0.0 | 6.6 | 6.6 | 985.6 | O K |
| 2160 min Winter | 1.051 | 1.051 | 0.0 | 6.6 | 6.6 | 993.2 | O K |
| 2880 min Winter | 1.040 | 1.040 | 0.0 | 6.5 | 6.5 | 982.6 | O K |
| 4320 min Winter | 0.987 | 0.987 | 0.0 | 6.4 | 6.4 | 933.1 | O K |
| 5760 min Winter | 0.922 | 0.922 | 0.0 | 6.2 | 6.2 | 870.9 | O K |
| 7200 min Winter | 0.853 | 0.853 | 0.0 | 6.0 | 6.0 | 806.5 | O K |
| 8640 min Winter | 0.786 | 0.786 | 0.0 | 5.8 | 5.8 | 742.8 | O K |


| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|-----------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 243.4 | 19 |
| 30 min Winter | 66.979 | 0.0 | 335.4 | 33 |
| 60 min Winter | 43.888 | 0.0 | 476.5 | 62 |
| 120 min Winter | 28.007 | 0.0 | 606.0 | 122 |
| 180 min Winter | 21.389 | 0.0 | 690.3 | 180 |
| 240 min Winter | 17.621 | 0.0 | 752.9 | 240 |
| 360 min Winter | 13.379 | 0.0 | 839.5 | 356 |
| 480 min Winter | 10.992 | 0.0 | 888.3 | 472 |
| 600 min Winter | 9.434 | 0.0 | 905.4 | 586 |
| 720 min Winter | 8.326 | 0.0 | 906.5 | 700 |
| 960 min Winter | 6.836 | 0.0 | 905.2 | 922 |
| 1440 min Winter | 5.168 | 0.0 | 906.1 | 1340 |
| 2160 min Winter | 3.900 | 0.0 | 1545.2 | 1668 |
| 2880 min Winter | 3.191 | 0.0 | 1665.5 | 2136 |
| 4320 min Winter | 2.402 | 0.0 | 1658.6 | 3068 |
| 5760 min Winter | 1.964 | 0.0 | 2100.5 | 3976 |
| 7200 min Winter | 1.680 | 0.0 | 2245.0 | 4832 |
| 8640 min Winter | 1.479 | 0.0 | 2370.0 | 5704 |

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| Microstrain Ltd | | Page 2 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E Outflow (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|---------------------|------------------------------|--------|
| 10080 min Winter | 0.720 | 0.720 | 0.0 | 5.6 | 5.6 | 680.4 | 0 K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------------------------|------------------|
| 10080 min Winter | 1.329 | 0.0 | 2479.0 | 6552 |

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| Microstrain Ltd | | Page 3 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |


Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 1.329

| Time (mins) | Area |
|--------------------|-------------|
| From: To: | (ha) |
| 0 | 4 1.329 |

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| Microstrain Ltd | | Page 4 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure


Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 1575.0 | 1575.0 | 1.200 | 0.0 | 1751.0 |
| 1.100 | 1575.0 | 1751.0 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 6.7 Diameter (mm) 106

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 3.3 | 1.200 | 7.0 | 3.000 | 11.1 | 7.000 | 17.0 |
| 0.200 | 5.5 | 1.400 | 7.6 | 3.500 | 12.0 | 7.500 | 17.6 |
| 0.300 | 5.4 | 1.600 | 8.1 | 4.000 | 12.8 | 8.000 | 18.1 |
| 0.400 | 5.1 | 1.800 | 8.6 | 4.500 | 13.6 | 8.500 | 18.7 |
| 0.500 | 5.1 | 2.000 | 9.1 | 5.000 | 14.3 | 9.000 | 19.2 |
| 0.600 | 5.2 | 2.200 | 9.5 | 5.500 | 15.0 | 9.500 | 19.8 |
| 0.800 | 5.8 | 2.400 | 9.9 | 6.000 | 15.7 | | |
| 1.000 | 6.4 | 2.600 | 10.3 | 6.500 | 16.3 | | |


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| Microstrain Ltd | | Page 1 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-N 5.23l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1436 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|-----------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|--------|
| 15 min Winter | 0.290 | 0.290 | 0.0 | 4.1 | 4.1 | 208.9 | O K |
| 30 min Winter | 0.402 | 0.402 | 0.0 | 4.1 | 4.1 | 289.4 | O K |
| 60 min Winter | 0.522 | 0.522 | 0.0 | 4.1 | 4.1 | 375.5 | O K |
| 120 min Winter | 0.654 | 0.654 | 0.0 | 4.2 | 4.2 | 471.0 | O K |
| 180 min Winter | 0.737 | 0.737 | 0.0 | 4.4 | 4.4 | 530.6 | O K |
| 240 min Winter | 0.797 | 0.797 | 0.0 | 4.5 | 4.5 | 573.5 | O K |
| 360 min Winter | 0.880 | 0.880 | 0.0 | 4.7 | 4.7 | 633.6 | O K |
| 480 min Winter | 0.936 | 0.936 | 0.0 | 4.9 | 4.9 | 674.2 | O K |
| 600 min Winter | 0.977 | 0.977 | 0.0 | 5.0 | 5.0 | 703.4 | O K |
| 720 min Winter | 1.007 | 1.007 | 0.0 | 5.1 | 5.1 | 725.1 | O K |
| 960 min Winter | 1.046 | 1.046 | 0.0 | 5.2 | 5.2 | 753.5 | O K |
| 1440 min Winter | 1.076 | 1.076 | 0.0 | 5.2 | 5.2 | 775.0 | O K |
| 2160 min Winter | 1.086 | 1.086 | 0.0 | 5.3 | 5.3 | 781.8 | O K |
| 2880 min Winter | 1.075 | 1.075 | 0.0 | 5.2 | 5.2 | 773.9 | O K |
| 4320 min Winter | 1.023 | 1.023 | 0.0 | 5.1 | 5.1 | 736.2 | O K |
| 5760 min Winter | 0.958 | 0.958 | 0.0 | 4.9 | 4.9 | 689.4 | O K |
| 7200 min Winter | 0.891 | 0.891 | 0.0 | 4.8 | 4.8 | 641.6 | O K |
| 8640 min Winter | 0.826 | 0.826 | 0.0 | 4.6 | 4.6 | 594.6 | O K |


| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|-----------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 194.6 | 19 |
| 30 min Winter | 66.979 | 0.0 | 266.0 | 33 |
| 60 min Winter | 43.888 | 0.0 | 377.0 | 62 |
| 120 min Winter | 28.007 | 0.0 | 479.1 | 122 |
| 180 min Winter | 21.389 | 0.0 | 545.3 | 180 |
| 240 min Winter | 17.621 | 0.0 | 594.0 | 240 |
| 360 min Winter | 13.379 | 0.0 | 658.6 | 356 |
| 480 min Winter | 10.992 | 0.0 | 688.5 | 472 |
| 600 min Winter | 9.434 | 0.0 | 695.5 | 586 |
| 720 min Winter | 8.326 | 0.0 | 698.4 | 700 |
| 960 min Winter | 6.836 | 0.0 | 705.4 | 922 |
| 1440 min Winter | 5.168 | 0.0 | 714.9 | 1330 |
| 2160 min Winter | 3.900 | 0.0 | 1219.2 | 1664 |
| 2880 min Winter | 3.191 | 0.0 | 1312.5 | 2132 |
| 4320 min Winter | 2.402 | 0.0 | 1295.6 | 3068 |
| 5760 min Winter | 1.964 | 0.0 | 1655.5 | 3968 |
| 7200 min Winter | 1.680 | 0.0 | 1769.5 | 4824 |
| 8640 min Winter | 1.479 | 0.0 | 1868.1 | 5704 |

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| Microstrain Ltd | | Page 2 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-N 5.23l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E Outflow (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|---------------------|------------------------------|--------|
| 10080 min Winter | 0.763 | 0.763 | 0.0 | 4.4 | 4.4 | 549.4 | 0 K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------------------------|------------------|
| 10080 min Winter | 1.329 | 0.0 | 1953.9 | 6552 |

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| Microstrain Ltd | | Page 3 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |


Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 1.047

| Time (mins) | Area |
|-------------|---------|
| From: To: | (ha) |
| 0 | 4 1.047 |

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| Microstrain Ltd | | Page 4 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-N 5.23l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 1200.0 | 1200.0 | 1.200 | 0.0 | 1354.0 |
| 1.100 | 1200.0 | 1354.0 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 5.2 Diameter (mm) 94

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 2.8 | 1.200 | 5.5 | 3.000 | 8.7 | 7.000 | 13.3 |
| 0.200 | 4.1 | 1.400 | 6.0 | 3.500 | 9.4 | 7.500 | 13.8 |
| 0.300 | 3.9 | 1.600 | 6.4 | 4.000 | 10.1 | 8.000 | 14.3 |
| 0.400 | 3.8 | 1.800 | 6.8 | 4.500 | 10.7 | 8.500 | 14.7 |
| 0.500 | 3.8 | 2.000 | 7.1 | 5.000 | 11.3 | 9.000 | 15.1 |
| 0.600 | 4.0 | 2.200 | 7.5 | 5.500 | 11.8 | 9.500 | 15.5 |
| 0.800 | 4.5 | 2.400 | 7.8 | 6.000 | 12.3 | | |
| 1.000 | 5.0 | 2.600 | 8.1 | 6.500 | 12.9 | | |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- P 30.04 |
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| Date 12NOV19 File | Designed by SC740 Checked by LP |
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XP Solutions Source Control 2015.1

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 45 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ (l/s) | Max Outflow Volume (m³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------------|--------|
| 15 min Winter | 0.678 | 0.678 | 0.0 | 27.5 | 27.5 | 98.2 | O K |
| 30 min Winter | 0.905 | 0.905 | 0.0 | 28.3 | 28.3 | 131.1 | O K |
| 60 min Winter | 1.041 | 1.041 | 0.0 | 29.6 | 29.6 | 150.8 | O K |
| 120 min Winter | 1.064 | 1.064 | 0.0 | 29.9 | 29.9 | 154.2 | O K |
| 180 min Winter | 1.008 | 1.008 | 0.0 | 29.3 | 29.3 | 146.0 | O K |
| 240 min Winter | 0.928 | 0.928 | 0.0 | 28.5 | 28.5 | 134.4 | O K |
| 360 min Winter | 0.753 | 0.753 | 0.0 | 27.5 | 27.5 | 109.1 | O K |
| 480 min Winter | 0.584 | 0.584 | 0.0 | 27.5 | 27.5 | 84.6 | O K |
| 600 min Winter | 0.451 | 0.451 | 0.0 | 27.5 | 27.5 | 65.4 | O K |
| 720 min Winter | 0.368 | 0.368 | 0.0 | 26.8 | 26.8 | 53.4 | O K |
| 960 min Winter | 0.286 | 0.286 | 0.0 | 24.4 | 24.4 | 41.4 | O K |
| 1440 min Winter | 0.231 | 0.231 | 0.0 | 21.2 | 21.2 | 33.5 | O K |
| 2160 min Winter | 0.284 | 0.284 | 0.0 | 24.3 | 24.3 | 41.1 | O K |
| 2880 min Winter | 0.284 | 0.284 | 0.0 | 24.3 | 24.3 | 41.1 | O K |
| 4320 min Winter | 0.284 | 0.284 | 0.0 | 24.3 | 24.3 | 41.1 | O K |
| 5760 min Winter | 0.314 | 0.314 | 0.0 | 25.5 | 25.5 | 45.5 | O K |
| 7200 min Winter | 0.522 | 0.522 | 0.0 | 27.5 | 27.5 | 75.7 | O K |
| 8640 min Winter | 0.866 | 0.866 | 0.0 | 28.0 | 28.0 | 125.4 | O K |
| 10080 min Winter | 0.888 | 0.888 | 0.0 | 28.2 | 28.2 | 128.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 390.4 | 22 |
| 30 min Winter | 66.979 | 0.0 | 438.3 | 34 |
| 60 min Winter | 43.888 | 0.0 | 1510.8 | 56 |
| 120 min Winter | 28.007 | 0.0 | 1572.5 | 94 |
| 180 min Winter | 21.389 | 0.0 | 1614.0 | 132 |
| 240 min Winter | 17.621 | 0.0 | 1646.2 | 168 |
| 360 min Winter | 13.379 | 0.0 | 1696.0 | 236 |
| 480 min Winter | 10.992 | 0.0 | 1735.0 | 298 |
| 600 min Winter | 9.434 | 0.0 | 1767.6 | 354 |
| 720 min Winter | 8.326 | 0.0 | 1796.0 | 408 |
| 960 min Winter | 6.836 | 0.0 | 1844.1 | 522 |
| 1440 min Winter | 5.168 | 0.0 | 1918.8 | 758 |
| 2160 min Winter | 3.900 | 0.0 | 5768.1 | 5760 |
| 2880 min Winter | 3.191 | 0.0 | 5833.0 | 5760 |
| 4320 min Winter | 2.402 | 0.0 | 5933.9 | 5760 |
| 5760 min Winter | 1.964 | 0.0 | 6057.1 | 4552 |
| 7200 min Winter | 1.680 | 0.0 | 6123.7 | 4616 |
| 8640 min Winter | 1.479 | 0.0 | 6181.9 | 5016 |
| 10080 min Winter | 1.329 | 0.0 | 6234.1 | 5760 |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- P 30.04 |  |
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| Date 12NOV19 File | Designed by SC740 Checked by LP | |
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| XP Solutions | Source Control 2015.1 |
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Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 0.606

| Time (mins) | Area | Time (mins) | Area | Time (mins) | Area |
|-------------|---------|-------------|---------|-------------|----------|
| From: To: | (ha) | From: To: | (ha) | From: To: | (ha) |
| 0 | 4 0.202 | 4 | 8 0.202 | 8 | 12 0.202 |

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| Unit B3 | Ballyvolane |
| Metropoint Business Park | AT- P |
| Swords Co. Dublin | 30.04 |



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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 241.5 | 241.5 | 1.200 | 0.0 | 309.9 |
| 1.100 | 241.5 | 309.9 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md5 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 30.0 Diameter (mm) 217

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 7.7 | 1.200 | 31.4 | 3.000 | 49.1 | 7.000 | 75.0 |
| 0.200 | 18.4 | 1.400 | 33.7 | 3.500 | 53.0 | 7.500 | 77.6 |
| 0.300 | 25.0 | 1.600 | 35.9 | 4.000 | 56.7 | 8.000 | 80.2 |
| 0.400 | 27.3 | 1.800 | 38.0 | 4.500 | 60.1 | 8.500 | 82.6 |
| 0.500 | 27.5 | 2.000 | 40.1 | 5.000 | 63.4 | 9.000 | 85.0 |
| 0.600 | 27.2 | 2.200 | 42.0 | 5.500 | 66.5 | 9.500 | 87.4 |
| 0.800 | 27.6 | 2.400 | 43.9 | 6.000 | 69.4 | | |
| 1.000 | 29.2 | 2.600 | 45.7 | 6.500 | 72.3 | | |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- P 30.04 |
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XP Solutions Source Control 2015.1

Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 10 | 0.0 | 510 | 0.5 | 1010 | 2.4 | 1510 | 4.5 | 2010 | 6.2 | 2510 | 7.9 |
| 20 | 0.0 | 520 | 0.5 | 1020 | 2.4 | 1520 | 4.5 | 2020 | 6.2 | 2520 | 7.9 |
| 30 | 0.0 | 530 | 0.5 | 1030 | 2.5 | 1530 | 4.6 | 2030 | 6.2 | 2530 | 7.9 |
| 40 | 0.0 | 540 | 0.6 | 1040 | 2.5 | 1540 | 4.6 | 2040 | 6.3 | 2540 | 8.0 |
| 50 | 0.0 | 550 | 0.6 | 1050 | 2.6 | 1550 | 4.7 | 2050 | 6.3 | 2550 | 8.0 |
| 60 | 0.0 | 560 | 0.6 | 1060 | 2.6 | 1560 | 4.7 | 2060 | 6.3 | 2560 | 8.0 |
| 70 | 0.0 | 570 | 0.6 | 1070 | 2.7 | 1570 | 4.7 | 2070 | 6.4 | 2570 | 8.1 |
| 80 | 0.0 | 580 | 0.7 | 1080 | 2.7 | 1580 | 4.8 | 2080 | 6.4 | 2580 | 8.1 |
| 90 | 0.0 | 590 | 0.7 | 1090 | 2.8 | 1590 | 4.8 | 2090 | 6.4 | 2590 | 8.2 |
| 100 | 0.0 | 600 | 0.7 | 1100 | 2.8 | 1600 | 4.8 | 2100 | 6.5 | 2600 | 8.2 |
| 110 | 0.0 | 610 | 0.8 | 1110 | 2.8 | 1610 | 4.9 | 2110 | 6.5 | 2610 | 8.2 |
| 120 | 0.0 | 620 | 0.8 | 1120 | 2.9 | 1620 | 4.9 | 2120 | 6.5 | 2620 | 8.3 |
| 130 | 0.0 | 630 | 0.8 | 1130 | 2.9 | 1630 | 4.9 | 2130 | 6.5 | 2630 | 8.3 |
| 140 | 0.0 | 640 | 0.9 | 1140 | 3.0 | 1640 | 5.0 | 2140 | 6.6 | 2640 | 8.4 |
| 150 | 0.0 | 650 | 0.9 | 1150 | 3.0 | 1650 | 5.0 | 2150 | 6.6 | 2650 | 8.4 |
| 160 | 0.0 | 660 | 0.9 | 1160 | 3.1 | 1660 | 5.0 | 2160 | 6.7 | 2660 | 8.5 |
| 170 | 0.0 | 670 | 1.0 | 1170 | 3.1 | 1670 | 5.1 | 2170 | 6.7 | 2670 | 8.5 |
| 180 | 0.0 | 680 | 1.0 | 1180 | 3.2 | 1680 | 5.1 | 2180 | 6.7 | 2680 | 8.5 |
| 190 | 0.0 | 690 | 1.1 | 1190 | 3.2 | 1690 | 5.1 | 2190 | 6.8 | 2690 | 8.6 |
| 200 | 0.0 | 700 | 1.1 | 1200 | 3.3 | 1700 | 5.2 | 2200 | 6.8 | 2700 | 8.6 |
| 210 | 0.0 | 710 | 1.1 | 1210 | 3.3 | 1710 | 5.2 | 2210 | 6.8 | 2710 | 8.7 |
| 220 | 0.0 | 720 | 1.2 | 1220 | 3.3 | 1720 | 5.2 | 2220 | 6.8 | 2720 | 8.7 |
| 230 | 0.0 | 730 | 1.2 | 1230 | 3.4 | 1730 | 5.3 | 2230 | 6.9 | 2730 | 8.7 |
| 240 | 0.0 | 740 | 1.2 | 1240 | 3.4 | 1740 | 5.3 | 2240 | 6.9 | 2740 | 8.8 |
| 250 | 0.0 | 750 | 1.3 | 1250 | 3.4 | 1750 | 5.4 | 2250 | 7.0 | 2750 | 8.8 |
| 260 | 0.1 | 760 | 1.3 | 1260 | 3.5 | 1760 | 5.4 | 2260 | 7.0 | 2760 | 8.9 |
| 270 | 0.1 | 770 | 1.3 | 1270 | 3.6 | 1770 | 5.4 | 2270 | 7.0 | 2770 | 8.9 |
| 280 | 0.1 | 780 | 1.4 | 1280 | 3.6 | 1780 | 5.4 | 2280 | 7.1 | 2780 | 9.0 |
| 290 | 0.1 | 790 | 1.4 | 1290 | 3.6 | 1790 | 5.5 | 2290 | 7.1 | 2790 | 9.0 |
| 300 | 0.1 | 800 | 1.5 | 1300 | 3.7 | 1800 | 5.5 | 2300 | 7.1 | 2800 | 9.0 |
| 310 | 0.1 | 810 | 1.5 | 1310 | 3.7 | 1810 | 5.5 | 2310 | 7.1 | 2810 | 9.1 |
| 320 | 0.1 | 820 | 1.6 | 1320 | 3.8 | 1820 | 5.6 | 2320 | 7.2 | 2820 | 9.1 |
| 330 | 0.1 | 830 | 1.6 | 1330 | 3.8 | 1830 | 5.6 | 2330 | 7.2 | 2830 | 9.2 |
| 340 | 0.1 | 840 | 1.7 | 1340 | 3.8 | 1840 | 5.7 | 2340 | 7.3 | 2840 | 9.2 |
| 350 | 0.1 | 850 | 1.7 | 1350 | 3.9 | 1850 | 5.7 | 2350 | 7.3 | 2850 | 9.3 |
| 360 | 0.2 | 860 | 1.8 | 1360 | 3.9 | 1860 | 5.7 | 2360 | 7.3 | 2860 | 9.3 |
| 370 | 0.2 | 870 | 1.8 | 1370 | 4.0 | 1870 | 5.7 | 2370 | 7.4 | 2870 | 9.4 |
| 380 | 0.2 | 880 | 1.8 | 1380 | 4.0 | 1880 | 5.8 | 2380 | 7.4 | 2880 | 9.4 |
| 390 | 0.2 | 890 | 1.9 | 1390 | 4.0 | 1890 | 5.8 | 2390 | 7.4 | 2890 | 9.5 |
| 400 | 0.2 | 900 | 1.9 | 1400 | 4.1 | 1900 | 5.8 | 2400 | 7.4 | 2900 | 9.5 |
| 410 | 0.2 | 910 | 1.9 | 1410 | 4.1 | 1910 | 5.9 | 2410 | 7.5 | 2910 | 9.6 |
| 420 | 0.3 | 920 | 2.0 | 1420 | 4.2 | 1920 | 5.9 | 2420 | 7.5 | 2920 | 9.6 |
| 430 | 0.3 | 930 | 2.1 | 1430 | 4.2 | 1930 | 5.9 | 2430 | 7.6 | 2930 | 9.6 |
| 440 | 0.3 | 940 | 2.1 | 1440 | 4.2 | 1940 | 5.9 | 2440 | 7.6 | 2940 | 9.7 |
| 450 | 0.3 | 950 | 2.2 | 1450 | 4.3 | 1950 | 6.0 | 2450 | 7.7 | 2950 | 9.8 |
| 460 | 0.3 | 960 | 2.2 | 1460 | 4.3 | 1960 | 6.0 | 2460 | 7.7 | 2960 | 9.8 |
| 470 | 0.4 | 970 | 2.2 | 1470 | 4.4 | 1970 | 6.1 | 2470 | 7.7 | 2970 | 9.8 |
| 480 | 0.4 | 980 | 2.3 | 1480 | 4.4 | 1980 | 6.1 | 2480 | 7.7 | 2980 | 9.9 |
| 490 | 0.4 | 990 | 2.3 | 1490 | 4.4 | 1990 | 6.1 | 2490 | 7.8 | 2990 | 10.0 |
| 500 | 0.5 | 1000 | 2.4 | 1500 | 4.4 | 2000 | 6.2 | 2500 | 7.8 | 3000 | 10.0 |

Unit B3
 Metropoint Business Park
 Swords Co. Dublin

Ballyvolane
 AT- P
 30.04



Date 12NOV19
 File


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XP Solutions Source Control 2015.1

Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
| 3010 | 10.1 | 3470 | 12.8 | 3930 | 15.6 | 4390 | 17.3 | 4850 | 17.4 | 5310 | 17.4 |
| 3020 | 10.1 | 3480 | 12.8 | 3940 | 15.6 | 4400 | 17.3 | 4860 | 17.4 | 5320 | 17.4 |
| 3030 | 10.2 | 3490 | 12.9 | 3950 | 15.7 | 4410 | 17.3 | 4870 | 17.4 | 5330 | 17.4 |
| 3040 | 10.2 | 3500 | 13.0 | 3960 | 15.7 | 4420 | 17.3 | 4880 | 17.4 | 5340 | 17.4 |
| 3050 | 10.3 | 3510 | 13.1 | 3970 | 15.8 | 4430 | 17.4 | 4890 | 17.3 | 5350 | 17.4 |
| 3060 | 10.3 | 3520 | 13.1 | 3980 | 15.8 | 4440 | 17.4 | 4900 | 17.3 | 5360 | 17.4 |
| 3070 | 10.4 | 3530 | 13.2 | 3990 | 15.8 | 4450 | 17.4 | 4910 | 17.3 | 5370 | 17.4 |
| 3080 | 10.4 | 3540 | 13.3 | 4000 | 15.9 | 4460 | 17.4 | 4920 | 17.3 | 5380 | 17.4 |
| 3090 | 10.5 | 3550 | 13.3 | 4010 | 15.9 | 4470 | 17.4 | 4930 | 17.3 | 5390 | 17.5 |
| 3100 | 10.6 | 3560 | 13.4 | 4020 | 16.0 | 4480 | 17.4 | 4940 | 17.3 | 5400 | 17.5 |
| 3110 | 10.6 | 3570 | 13.4 | 4030 | 16.0 | 4490 | 17.4 | 4950 | 17.3 | 5410 | 17.5 |
| 3120 | 10.7 | 3580 | 13.5 | 4040 | 16.1 | 4500 | 17.4 | 4960 | 17.3 | 5420 | 17.5 |
| 3130 | 10.7 | 3590 | 13.6 | 4050 | 16.1 | 4510 | 17.5 | 4970 | 17.3 | 5430 | 17.5 |
| 3140 | 10.8 | 3600 | 13.6 | 4060 | 16.2 | 4520 | 17.5 | 4980 | 17.3 | 5440 | 17.5 |
| 3150 | 10.8 | 3610 | 13.7 | 4070 | 16.2 | 4530 | 17.5 | 4990 | 17.3 | 5450 | 17.6 |
| 3160 | 10.9 | 3620 | 13.8 | 4080 | 16.3 | 4540 | 17.5 | 5000 | 17.3 | 5460 | 17.6 |
| 3170 | 10.9 | 3630 | 13.8 | 4090 | 16.3 | 4550 | 17.5 | 5010 | 17.3 | 5470 | 17.6 |
| 3180 | 11.0 | 3640 | 13.9 | 4100 | 16.3 | 4560 | 17.5 | 5020 | 17.3 | 5480 | 17.6 |
| 3190 | 11.1 | 3650 | 14.0 | 4110 | 16.4 | 4570 | 17.5 | 5030 | 17.3 | 5490 | 17.6 |
| 3200 | 11.1 | 3660 | 14.0 | 4120 | 16.4 | 4580 | 17.5 | 5040 | 17.3 | 5500 | 17.6 |
| 3210 | 11.2 | 3670 | 14.1 | 4130 | 16.5 | 4590 | 17.5 | 5050 | 17.3 | 5510 | 17.7 |
| 3220 | 11.2 | 3680 | 14.1 | 4140 | 16.5 | 4600 | 17.5 | 5060 | 17.3 | 5520 | 17.7 |
| 3230 | 11.3 | 3690 | 14.2 | 4150 | 16.6 | 4610 | 17.5 | 5070 | 17.3 | 5530 | 17.7 |
| 3240 | 11.4 | 3700 | 14.3 | 4160 | 16.6 | 4620 | 17.5 | 5080 | 17.2 | 5540 | 17.7 |
| 3250 | 11.4 | 3710 | 14.3 | 4170 | 16.6 | 4630 | 17.5 | 5090 | 17.2 | 5550 | 17.7 |
| 3260 | 11.5 | 3720 | 14.4 | 4180 | 16.7 | 4640 | 17.5 | 5100 | 17.2 | 5560 | 17.8 |
| 3270 | 11.5 | 3730 | 14.5 | 4190 | 16.7 | 4650 | 17.5 | 5110 | 17.2 | 5570 | 17.8 |
| 3280 | 11.6 | 3740 | 14.5 | 4200 | 16.7 | 4660 | 17.5 | 5120 | 17.2 | 5580 | 17.8 |
| 3290 | 11.7 | 3750 | 14.6 | 4210 | 16.8 | 4670 | 17.5 | 5130 | 17.2 | 5590 | 17.8 |
| 3300 | 11.7 | 3760 | 14.7 | 4220 | 16.8 | 4680 | 17.5 | 5140 | 17.2 | 5600 | 17.9 |
| 3310 | 11.8 | 3770 | 14.7 | 4230 | 16.8 | 4690 | 17.5 | 5150 | 17.3 | 5610 | 17.9 |
| 3320 | 11.9 | 3780 | 14.8 | 4240 | 16.9 | 4700 | 17.5 | 5160 | 17.3 | 5620 | 17.9 |
| 3330 | 11.9 | 3790 | 14.8 | 4250 | 16.9 | 4710 | 17.5 | 5170 | 17.3 | 5630 | 17.9 |
| 3340 | 12.0 | 3800 | 14.9 | 4260 | 16.9 | 4720 | 17.5 | 5180 | 17.3 | 5640 | 17.9 |
| 3350 | 12.0 | 3810 | 14.9 | 4270 | 17.0 | 4730 | 17.5 | 5190 | 17.3 | 5650 | 18.0 |
| 3360 | 12.1 | 3820 | 15.0 | 4280 | 17.0 | 4740 | 17.5 | 5200 | 17.3 | 5660 | 18.0 |
| 3370 | 12.1 | 3830 | 15.0 | 4290 | 17.0 | 4750 | 17.5 | 5210 | 17.3 | 5670 | 18.0 |
| 3380 | 12.2 | 3840 | 15.1 | 4300 | 17.1 | 4760 | 17.4 | 5220 | 17.3 | 5680 | 18.0 |
| 3390 | 12.3 | 3850 | 15.2 | 4310 | 17.1 | 4770 | 17.4 | 5230 | 17.3 | 5690 | 18.1 |
| 3400 | 12.3 | 3860 | 15.2 | 4320 | 17.1 | 4780 | 17.4 | 5240 | 17.3 | 5700 | 18.1 |
| 3410 | 12.4 | 3870 | 15.3 | 4330 | 17.1 | 4790 | 17.4 | 5250 | 17.3 | 5710 | 18.1 |
| 3420 | 12.5 | 3880 | 15.3 | 4340 | 17.2 | 4800 | 17.4 | 5260 | 17.3 | 5720 | 18.1 |
| 3430 | 12.6 | 3890 | 15.4 | 4350 | 17.2 | 4810 | 17.4 | 5270 | 17.3 | 5730 | 18.1 |
| 3440 | 12.6 | 3900 | 15.4 | 4360 | 17.2 | 4820 | 17.4 | 5280 | 17.3 | 5740 | 18.2 |
| 3450 | 12.7 | 3910 | 15.5 | 4370 | 17.2 | 4830 | 17.4 | 5290 | 17.3 | 5750 | 18.2 |
| 3460 | 12.7 | 3920 | 15.5 | 4380 | 17.3 | 4840 | 17.4 | 5300 | 17.3 | 5760 | 18.2 |

Additional Hydrograph #2


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- P 30.04 |  |
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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #2

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 10 | 0.0 | 510 | 0.9 | 1010 | 2.7 | 1510 | 4.4 | 2010 | 5.5 | 2510 | 5.1 |
| 20 | 0.0 | 520 | 1.0 | 1020 | 2.7 | 1520 | 4.4 | 2020 | 5.5 | 2520 | 5.1 |
| 30 | 0.0 | 530 | 1.0 | 1030 | 2.8 | 1530 | 4.5 | 2030 | 5.5 | 2530 | 5.1 |
| 40 | 0.0 | 540 | 1.1 | 1040 | 2.8 | 1540 | 4.5 | 2040 | 5.5 | 2540 | 5.1 |
| 50 | 0.0 | 550 | 1.1 | 1050 | 2.9 | 1550 | 4.5 | 2050 | 5.5 | 2550 | 5.1 |
| 60 | 0.0 | 560 | 1.1 | 1060 | 2.9 | 1560 | 4.6 | 2060 | 5.5 | 2560 | 5.1 |
| 70 | 0.0 | 570 | 1.2 | 1070 | 2.9 | 1570 | 4.6 | 2070 | 5.5 | 2570 | 5.1 |
| 80 | 0.0 | 580 | 1.2 | 1080 | 2.9 | 1580 | 4.7 | 2080 | 5.5 | 2580 | 5.1 |
| 90 | 0.0 | 590 | 1.3 | 1090 | 3.0 | 1590 | 4.7 | 2090 | 5.5 | 2590 | 5.1 |
| 100 | 0.0 | 600 | 1.3 | 1100 | 3.0 | 1600 | 4.7 | 2100 | 5.5 | 2600 | 5.1 |
| 110 | 0.0 | 610 | 1.3 | 1110 | 3.0 | 1610 | 4.8 | 2110 | 5.5 | 2610 | 5.1 |
| 120 | 0.0 | 620 | 1.4 | 1120 | 3.1 | 1620 | 4.8 | 2120 | 5.5 | 2620 | 5.1 |
| 130 | 0.0 | 630 | 1.4 | 1130 | 3.1 | 1630 | 4.8 | 2130 | 5.5 | 2630 | 5.1 |
| 140 | 0.0 | 640 | 1.5 | 1140 | 3.1 | 1640 | 4.9 | 2140 | 5.4 | 2640 | 5.2 |
| 150 | 0.0 | 650 | 1.5 | 1150 | 3.1 | 1650 | 4.9 | 2150 | 5.4 | 2650 | 5.2 |
| 160 | 0.0 | 660 | 1.5 | 1160 | 3.2 | 1660 | 5.0 | 2160 | 5.4 | 2660 | 5.2 |
| 170 | 0.0 | 670 | 1.6 | 1170 | 3.2 | 1670 | 5.0 | 2170 | 5.4 | 2670 | 5.2 |
| 180 | 0.1 | 680 | 1.6 | 1180 | 3.2 | 1680 | 5.0 | 2180 | 5.4 | 2680 | 5.2 |
| 190 | 0.1 | 690 | 1.7 | 1190 | 3.3 | 1690 | 5.1 | 2190 | 5.4 | 2690 | 5.2 |
| 200 | 0.1 | 700 | 1.7 | 1200 | 3.3 | 1700 | 5.1 | 2200 | 5.4 | 2700 | 5.2 |
| 210 | 0.1 | 710 | 1.7 | 1210 | 3.3 | 1710 | 5.1 | 2210 | 5.3 | 2710 | 5.2 |
| 220 | 0.1 | 720 | 1.8 | 1220 | 3.4 | 1720 | 5.2 | 2220 | 5.3 | 2720 | 5.3 |
| 230 | 0.1 | 730 | 1.8 | 1230 | 3.4 | 1730 | 5.2 | 2230 | 5.3 | 2730 | 5.3 |
| 240 | 0.1 | 740 | 1.8 | 1240 | 3.4 | 1740 | 5.2 | 2240 | 5.3 | 2740 | 5.3 |
| 250 | 0.1 | 750 | 1.9 | 1250 | 3.5 | 1750 | 5.2 | 2250 | 5.3 | 2750 | 5.3 |
| 260 | 0.2 | 760 | 1.9 | 1260 | 3.5 | 1760 | 5.3 | 2260 | 5.3 | 2760 | 5.3 |
| 270 | 0.2 | 770 | 1.9 | 1270 | 3.5 | 1770 | 5.3 | 2270 | 5.3 | 2770 | 5.3 |
| 280 | 0.2 | 780 | 2.0 | 1280 | 3.5 | 1780 | 5.3 | 2280 | 5.2 | 2780 | 5.4 |
| 290 | 0.2 | 790 | 2.0 | 1290 | 3.6 | 1790 | 5.3 | 2290 | 5.2 | 2790 | 5.4 |
| 300 | 0.2 | 800 | 2.1 | 1300 | 3.6 | 1800 | 5.3 | 2300 | 5.2 | 2800 | 5.4 |
| 310 | 0.3 | 810 | 2.1 | 1310 | 3.6 | 1810 | 5.4 | 2310 | 5.2 | 2810 | 5.4 |
| 320 | 0.3 | 820 | 2.1 | 1320 | 3.7 | 1820 | 5.4 | 2320 | 5.2 | 2820 | 5.4 |
| 330 | 0.3 | 830 | 2.2 | 1330 | 3.7 | 1830 | 5.4 | 2330 | 5.2 | 2830 | 5.4 |
| 340 | 0.4 | 840 | 2.2 | 1340 | 3.8 | 1840 | 5.4 | 2340 | 5.2 | 2840 | 5.5 |
| 350 | 0.4 | 850 | 2.2 | 1350 | 3.8 | 1850 | 5.4 | 2350 | 5.2 | 2850 | 5.5 |
| 360 | 0.4 | 860 | 2.3 | 1360 | 3.8 | 1860 | 5.4 | 2360 | 5.1 | 2860 | 5.5 |
| 370 | 0.4 | 870 | 2.3 | 1370 | 3.8 | 1870 | 5.4 | 2370 | 5.1 | 2870 | 5.5 |
| 380 | 0.5 | 880 | 2.3 | 1380 | 3.9 | 1880 | 5.5 | 2380 | 5.1 | 2880 | 5.5 |
| 390 | 0.5 | 890 | 2.4 | 1390 | 3.9 | 1890 | 5.5 | 2390 | 5.1 | 2890 | 5.5 |
| 400 | 0.5 | 900 | 2.4 | 1400 | 4.0 | 1900 | 5.5 | 2400 | 5.1 | 2900 | 5.6 |
| 410 | 0.6 | 910 | 2.4 | 1410 | 4.0 | 1910 | 5.5 | 2410 | 5.1 | 2910 | 5.6 |
| 420 | 0.6 | 920 | 2.5 | 1420 | 4.0 | 1920 | 5.5 | 2420 | 5.1 | 2920 | 5.6 |
| 430 | 0.6 | 930 | 2.5 | 1430 | 4.1 | 1930 | 5.5 | 2430 | 5.1 | 2930 | 5.6 |
| 440 | 0.7 | 940 | 2.5 | 1440 | 4.1 | 1940 | 5.5 | 2440 | 5.1 | 2940 | 5.6 |
| 450 | 0.7 | 950 | 2.5 | 1450 | 4.1 | 1950 | 5.5 | 2450 | 5.1 | 2950 | 5.6 |
| 460 | 0.8 | 960 | 2.6 | 1460 | 4.2 | 1960 | 5.5 | 2460 | 5.1 | 2960 | 5.7 |
| 470 | 0.8 | 970 | 2.6 | 1470 | 4.2 | 1970 | 5.5 | 2470 | 5.1 | 2970 | 5.7 |
| 480 | 0.8 | 980 | 2.6 | 1480 | 4.3 | 1980 | 5.5 | 2480 | 5.1 | 2980 | 5.7 |
| 490 | 0.9 | 990 | 2.7 | 1490 | 4.3 | 1990 | 5.5 | 2490 | 5.1 | 2990 | 5.7 |
| 500 | 0.9 | 1000 | 2.7 | 1500 | 4.3 | 2000 | 5.5 | 2500 | 5.1 | 3000 | 5.7 |


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- P 30.04 |  |
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| Date 12NOV19 File | Designed by SC740 Checked by LP |
|----------------------|------------------------------------|

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| XP Solutions | Source Control 2015.1 |
|--------------|-----------------------|

Additional Hydrograph #2

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 3010 | 5.7 | 3470 | 6.3 | 3930 | 6.6 | 4390 | 6.6 | 4850 | 6.5 | 5310 | 6.5 |
| 3020 | 5.8 | 3480 | 6.3 | 3940 | 6.6 | 4400 | 6.6 | 4860 | 6.5 | 5320 | 6.4 |
| 3030 | 5.8 | 3490 | 6.4 | 3950 | 6.6 | 4410 | 6.6 | 4870 | 6.5 | 5330 | 6.4 |
| 3040 | 5.8 | 3500 | 6.4 | 3960 | 6.6 | 4420 | 6.6 | 4880 | 6.5 | 5340 | 6.4 |
| 3050 | 5.8 | 3510 | 6.4 | 3970 | 6.6 | 4430 | 6.6 | 4890 | 6.5 | 5350 | 6.4 |
| 3060 | 5.8 | 3520 | 6.4 | 3980 | 6.6 | 4440 | 6.6 | 4900 | 6.5 | 5360 | 6.4 |
| 3070 | 5.8 | 3530 | 6.4 | 3990 | 6.6 | 4450 | 6.6 | 4910 | 6.5 | 5370 | 6.4 |
| 3080 | 5.9 | 3540 | 6.4 | 4000 | 6.6 | 4460 | 6.6 | 4920 | 6.5 | 5380 | 6.4 |
| 3090 | 5.9 | 3550 | 6.4 | 4010 | 6.6 | 4470 | 6.6 | 4930 | 6.5 | 5390 | 6.4 |
| 3100 | 5.9 | 3560 | 6.4 | 4020 | 6.6 | 4480 | 6.6 | 4940 | 6.5 | 5400 | 6.4 |
| 3110 | 5.9 | 3570 | 6.4 | 4030 | 6.6 | 4490 | 6.6 | 4950 | 6.5 | 5410 | 6.4 |
| 3120 | 5.9 | 3580 | 6.4 | 4040 | 6.6 | 4500 | 6.6 | 4960 | 6.5 | 5420 | 6.4 |
| 3130 | 5.9 | 3590 | 6.4 | 4050 | 6.6 | 4510 | 6.6 | 4970 | 6.5 | 5430 | 6.4 |
| 3140 | 6.0 | 3600 | 6.4 | 4060 | 6.6 | 4520 | 6.6 | 4980 | 6.5 | 5440 | 6.4 |
| 3150 | 6.0 | 3610 | 6.4 | 4070 | 6.6 | 4530 | 6.6 | 4990 | 6.5 | 5450 | 6.4 |
| 3160 | 6.0 | 3620 | 6.4 | 4080 | 6.6 | 4540 | 6.6 | 5000 | 6.5 | 5460 | 6.4 |
| 3170 | 6.0 | 3630 | 6.5 | 4090 | 6.6 | 4550 | 6.6 | 5010 | 6.5 | 5470 | 6.4 |
| 3180 | 6.0 | 3640 | 6.5 | 4100 | 6.6 | 4560 | 6.6 | 5020 | 6.5 | 5480 | 6.4 |
| 3190 | 6.0 | 3650 | 6.5 | 4110 | 6.6 | 4570 | 6.6 | 5030 | 6.5 | 5490 | 6.4 |
| 3200 | 6.0 | 3660 | 6.5 | 4120 | 6.6 | 4580 | 6.6 | 5040 | 6.5 | 5500 | 6.4 |
| 3210 | 6.0 | 3670 | 6.5 | 4130 | 6.6 | 4590 | 6.6 | 5050 | 6.5 | 5510 | 6.4 |
| 3220 | 6.1 | 3680 | 6.5 | 4140 | 6.6 | 4600 | 6.6 | 5060 | 6.5 | 5520 | 6.4 |
| 3230 | 6.1 | 3690 | 6.5 | 4150 | 6.6 | 4610 | 6.6 | 5070 | 6.5 | 5530 | 6.3 |
| 3240 | 6.1 | 3700 | 6.5 | 4160 | 6.6 | 4620 | 6.6 | 5080 | 6.5 | 5540 | 6.3 |
| 3250 | 6.1 | 3710 | 6.5 | 4170 | 6.6 | 4630 | 6.6 | 5090 | 6.5 | 5550 | 6.3 |
| 3260 | 6.1 | 3720 | 6.5 | 4180 | 6.6 | 4640 | 6.6 | 5100 | 6.5 | 5560 | 6.3 |
| 3270 | 6.1 | 3730 | 6.5 | 4190 | 6.6 | 4650 | 6.5 | 5110 | 6.5 | 5570 | 6.3 |
| 3280 | 6.1 | 3740 | 6.5 | 4200 | 6.6 | 4660 | 6.5 | 5120 | 6.5 | 5580 | 6.3 |
| 3290 | 6.2 | 3750 | 6.5 | 4210 | 6.6 | 4670 | 6.5 | 5130 | 6.5 | 5590 | 6.3 |
| 3300 | 6.2 | 3760 | 6.5 | 4220 | 6.6 | 4680 | 6.5 | 5140 | 6.5 | 5600 | 6.3 |
| 3310 | 6.2 | 3770 | 6.5 | 4230 | 6.6 | 4690 | 6.5 | 5150 | 6.5 | 5610 | 6.3 |
| 3320 | 6.2 | 3780 | 6.5 | 4240 | 6.6 | 4700 | 6.5 | 5160 | 6.5 | 5620 | 6.3 |
| 3330 | 6.2 | 3790 | 6.5 | 4250 | 6.6 | 4710 | 6.5 | 5170 | 6.5 | 5630 | 6.3 |
| 3340 | 6.2 | 3800 | 6.5 | 4260 | 6.6 | 4720 | 6.5 | 5180 | 6.5 | 5640 | 6.3 |
| 3350 | 6.2 | 3810 | 6.5 | 4270 | 6.6 | 4730 | 6.5 | 5190 | 6.5 | 5650 | 6.3 |
| 3360 | 6.2 | 3820 | 6.5 | 4280 | 6.6 | 4740 | 6.5 | 5200 | 6.5 | 5660 | 6.3 |
| 3370 | 6.2 | 3830 | 6.5 | 4290 | 6.6 | 4750 | 6.5 | 5210 | 6.5 | 5670 | 6.3 |
| 3380 | 6.3 | 3840 | 6.5 | 4300 | 6.6 | 4760 | 6.5 | 5220 | 6.5 | 5680 | 6.3 |
| 3390 | 6.3 | 3850 | 6.5 | 4310 | 6.6 | 4770 | 6.5 | 5230 | 6.5 | 5690 | 6.3 |
| 3400 | 6.3 | 3860 | 6.5 | 4320 | 6.6 | 4780 | 6.5 | 5240 | 6.5 | 5700 | 6.3 |
| 3410 | 6.3 | 3870 | 6.5 | 4330 | 6.6 | 4790 | 6.5 | 5250 | 6.5 | 5710 | 6.3 |
| 3420 | 6.3 | 3880 | 6.6 | 4340 | 6.6 | 4800 | 6.5 | 5260 | 6.5 | 5720 | 6.3 |
| 3430 | 6.3 | 3890 | 6.6 | 4350 | 6.6 | 4810 | 6.5 | 5270 | 6.5 | 5730 | 6.2 |
| 3440 | 6.3 | 3900 | 6.6 | 4360 | 6.6 | 4820 | 6.5 | 5280 | 6.5 | 5740 | 6.2 |
| 3450 | 6.3 | 3910 | 6.6 | 4370 | 6.6 | 4830 | 6.5 | 5290 | 6.5 | 5750 | 6.2 |
| 3460 | 6.3 | 3920 | 6.6 | 4380 | 6.6 | 4840 | 6.5 | 5300 | 6.5 | 5760 | 6.2 |


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| Microstrain Ltd | | Page 1 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-T 2.2l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1495 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m ³) | Status |
|-----------------|---------------|---------------|------------------------|-------------------|----------------------------|------------------------------|--------|
| 15 min Winter | 0.276 | 0.276 | 0.0 | 1.4 | 1.4 | 87.0 | O K |
| 30 min Winter | 0.382 | 0.382 | 0.0 | 1.4 | 1.4 | 120.5 | O K |
| 60 min Winter | 0.496 | 0.496 | 0.0 | 1.5 | 1.5 | 156.3 | O K |
| 120 min Winter | 0.623 | 0.623 | 0.0 | 1.7 | 1.7 | 196.1 | O K |
| 180 min Winter | 0.702 | 0.702 | 0.0 | 1.8 | 1.8 | 221.0 | O K |
| 240 min Winter | 0.759 | 0.759 | 0.0 | 1.8 | 1.8 | 239.0 | O K |
| 360 min Winter | 0.839 | 0.839 | 0.0 | 1.9 | 1.9 | 264.2 | O K |
| 480 min Winter | 0.893 | 0.893 | 0.0 | 2.0 | 2.0 | 281.4 | O K |
| 600 min Winter | 0.933 | 0.933 | 0.0 | 2.1 | 2.1 | 293.8 | O K |
| 720 min Winter | 0.962 | 0.962 | 0.0 | 2.1 | 2.1 | 303.1 | O K |
| 960 min Winter | 1.001 | 1.001 | 0.0 | 2.1 | 2.1 | 315.5 | O K |
| 1440 min Winter | 1.033 | 1.033 | 0.0 | 2.2 | 2.2 | 325.5 | O K |
| 2160 min Winter | 1.046 | 1.046 | 0.0 | 2.2 | 2.2 | 329.5 | O K |
| 2880 min Winter | 1.039 | 1.039 | 0.0 | 2.2 | 2.2 | 327.4 | O K |
| 4320 min Winter | 0.997 | 0.997 | 0.0 | 2.1 | 2.1 | 313.9 | O K |
| 5760 min Winter | 0.942 | 0.942 | 0.0 | 2.1 | 2.1 | 296.7 | O K |
| 7200 min Winter | 0.886 | 0.886 | 0.0 | 2.0 | 2.0 | 279.0 | O K |
| 8640 min Winter | 0.831 | 0.831 | 0.0 | 1.9 | 1.9 | 261.8 | O K |


| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|-----------------|--------------|----------------------------------|------------------------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 82.1 | 19 |
| 30 min Winter | 66.979 | 0.0 | 107.8 | 33 |
| 60 min Winter | 43.888 | 0.0 | 157.5 | 64 |
| 120 min Winter | 28.007 | 0.0 | 199.4 | 122 |
| 180 min Winter | 21.389 | 0.0 | 225.6 | 180 |
| 240 min Winter | 17.621 | 0.0 | 242.6 | 240 |
| 360 min Winter | 13.379 | 0.0 | 256.6 | 356 |
| 480 min Winter | 10.992 | 0.0 | 263.0 | 472 |
| 600 min Winter | 9.434 | 0.0 | 269.2 | 586 |
| 720 min Winter | 8.326 | 0.0 | 274.9 | 700 |
| 960 min Winter | 6.836 | 0.0 | 283.6 | 922 |
| 1440 min Winter | 5.168 | 0.0 | 291.2 | 1340 |
| 2160 min Winter | 3.900 | 0.0 | 506.0 | 1664 |
| 2880 min Winter | 3.191 | 0.0 | 532.3 | 2132 |
| 4320 min Winter | 2.402 | 0.0 | 523.2 | 3068 |
| 5760 min Winter | 1.964 | 0.0 | 688.2 | 3928 |
| 7200 min Winter | 1.680 | 0.0 | 735.6 | 4824 |
| 8640 min Winter | 1.479 | 0.0 | 776.7 | 5696 |

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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E (l/s) | Max Outflow (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------|------------------------------|--------|
| 10080 min Winter | 0.779 | 0.779 | 0.0 | 1.9 | 1.9 | 1.9 | 245.5 | 0 K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------------------------|------------------|
| 10080 min Winter | 1.329 | 0.0 | 811.5 | 6464 |

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| Microstrain Ltd | | Page 3 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |


Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 0.435

| Time (mins) | | Area |
|--------------------|------------|-------------|
| From: | To: | (ha) |
| 0 | 4 | 0.435 |

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| Microstrain Ltd | | Page 4 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure


Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 525.0 | 525.0 | 1.200 | 0.0 | 629.5 |
| 1.100 | 525.0 | 629.5 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 2.2 Diameter (mm) 61

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 1.3 | 1.200 | 2.3 | 3.000 | 3.7 | 7.000 | 5.6 |
| 0.200 | 1.3 | 1.400 | 2.5 | 3.500 | 4.0 | 7.500 | 5.8 |
| 0.300 | 1.3 | 1.600 | 2.7 | 4.000 | 4.2 | 8.000 | 6.0 |
| 0.400 | 1.4 | 1.800 | 2.8 | 4.500 | 4.5 | 8.500 | 6.2 |
| 0.500 | 1.5 | 2.000 | 3.0 | 5.000 | 4.7 | 9.000 | 6.4 |
| 0.600 | 1.6 | 2.200 | 3.1 | 5.500 | 5.0 | 9.500 | 6.5 |
| 0.800 | 1.9 | 2.400 | 3.3 | 6.000 | 5.2 | | |
| 1.000 | 2.1 | 2.600 | 3.4 | 6.500 | 5.4 | | |


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| Microstrain Ltd | | Page 1 |
| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT-U 9.26l/s |  |
| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | | Source Control 2015.1 |

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1370 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|-----------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|--------|
| 15 min Winter | 0.285 | 0.285 | 0.0 | 8.3 | 8.3 | 369.0 | O K |
| 30 min Winter | 0.394 | 0.394 | 0.0 | 8.3 | 8.3 | 510.9 | O K |
| 60 min Winter | 0.511 | 0.511 | 0.0 | 8.3 | 8.3 | 662.7 | O K |
| 120 min Winter | 0.641 | 0.641 | 0.0 | 8.3 | 8.3 | 831.0 | O K |
| 180 min Winter | 0.722 | 0.722 | 0.0 | 8.3 | 8.3 | 936.3 | O K |
| 240 min Winter | 0.781 | 0.781 | 0.0 | 8.3 | 8.3 | 1012.0 | O K |
| 360 min Winter | 0.863 | 0.863 | 0.0 | 8.4 | 8.4 | 1118.1 | O K |
| 480 min Winter | 0.918 | 0.918 | 0.0 | 8.7 | 8.7 | 1189.6 | O K |
| 600 min Winter | 0.958 | 0.958 | 0.0 | 8.8 | 8.8 | 1241.0 | O K |
| 720 min Winter | 0.987 | 0.987 | 0.0 | 8.9 | 8.9 | 1279.0 | O K |
| 960 min Winter | 1.025 | 1.025 | 0.0 | 9.1 | 9.1 | 1328.6 | O K |
| 1440 min Winter | 1.053 | 1.053 | 0.0 | 9.2 | 9.2 | 1365.2 | O K |
| 2160 min Winter | 1.060 | 1.060 | 0.0 | 9.2 | 9.2 | 1373.2 | O K |
| 2880 min Winter | 1.046 | 1.046 | 0.0 | 9.2 | 9.2 | 1355.1 | O K |
| 4320 min Winter | 0.987 | 0.987 | 0.0 | 8.9 | 8.9 | 1278.7 | O K |
| 5760 min Winter | 0.914 | 0.914 | 0.0 | 8.6 | 8.6 | 1184.0 | O K |
| 7200 min Winter | 0.837 | 0.837 | 0.0 | 8.3 | 8.3 | 1085.2 | O K |
| 8640 min Winter | 0.761 | 0.761 | 0.0 | 8.3 | 8.3 | 985.7 | O K |


| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|-----------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 334.2 | 19 |
| 30 min Winter | 66.979 | 0.0 | 464.6 | 33 |
| 60 min Winter | 43.888 | 0.0 | 661.4 | 62 |
| 120 min Winter | 28.007 | 0.0 | 842.4 | 122 |
| 180 min Winter | 21.389 | 0.0 | 961.0 | 180 |
| 240 min Winter | 17.621 | 0.0 | 1049.9 | 238 |
| 360 min Winter | 13.379 | 0.0 | 1178.2 | 356 |
| 480 min Winter | 10.992 | 0.0 | 1262.2 | 472 |
| 600 min Winter | 9.434 | 0.0 | 1309.8 | 586 |
| 720 min Winter | 8.326 | 0.0 | 1325.3 | 700 |
| 960 min Winter | 6.836 | 0.0 | 1314.5 | 922 |
| 1440 min Winter | 5.168 | 0.0 | 1291.2 | 1340 |
| 2160 min Winter | 3.900 | 0.0 | 2152.6 | 1668 |
| 2880 min Winter | 3.191 | 0.0 | 2326.9 | 2136 |
| 4320 min Winter | 2.402 | 0.0 | 2387.3 | 3068 |
| 5760 min Winter | 1.964 | 0.0 | 2926.2 | 3976 |
| 7200 min Winter | 1.680 | 0.0 | 3127.5 | 4832 |
| 8640 min Winter | 1.479 | 0.0 | 3301.9 | 5704 |

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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E (l/s) | Max Outflow (l/s) | Max Volume (m ³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------|------------------------------|--------|
| 10080 min Winter | 0.684 | 0.684 | 0.0 | 8.3 | 8.3 | 8.3 | 885.9 | 0 K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m ³) | Discharge Volume (m ³) | Time-Peak (mins) |
|------------------|--------------|----------------------------------|------------------------------------|------------------|
| 10080 min Winter | 1.329 | 0.0 | 3453.7 | 6552 |

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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |


Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 1.852

| Time (mins) | Area |
|-------------|---------|
| From: To: | (ha) |
| 0 | 4 1.852 |

| | | |
|--|------------------------------------|---|
| Microstrain Ltd | | Page 4 |
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| Date 03 Sep 2019 File | Designed by SC740 Checked by JM | |
| XP Solutions | Source Control 2015.1 | |

Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 2160.0 | 2160.0 | 1.200 | 0.0 | 2366.8 |
| 1.100 | 2160.0 | 2366.8 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md6 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 9.3 Diameter (mm) 125

| 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 | 9.8 | 3.000 | 15.4 | 7.000 | 23.6 |
| 0.200 | 7.9 | 1.400 | 10.6 | 3.500 | 16.7 | 7.500 | 24.4 |
| 0.300 | 8.3 | 1.600 | 11.3 | 4.000 | 17.8 | 8.000 | 25.2 |
| 0.400 | 8.0 | 1.800 | 12.0 | 4.500 | 18.9 | 8.500 | 26.0 |
| 0.500 | 7.7 | 2.000 | 12.6 | 5.000 | 19.9 | 9.000 | 26.7 |
| 0.600 | 7.7 | 2.200 | 13.2 | 5.500 | 20.9 | 9.500 | 27.5 |
| 0.800 | 8.2 | 2.400 | 13.8 | 6.000 | 21.8 | | |
| 1.000 | 9.0 | 2.600 | 14.4 | 6.500 | 22.7 | | |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- Z 20.46/s |
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| Date 12NOV19 File | Designed by SC740 Checked by LP |
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XP Solutions Source Control 2015.1

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 667 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ (l/s) | Max Outflow Volume (m³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|-------------|-------------------------|--------|
| 15 min Winter | 0.309 | 0.309 | 0.0 | 17.1 | 17.1 | 438.1 | O K |
| 30 min Winter | 0.427 | 0.427 | 0.0 | 17.5 | 17.5 | 605.0 | O K |
| 60 min Winter | 0.551 | 0.551 | 0.0 | 17.5 | 17.5 | 780.2 | O K |
| 120 min Winter | 0.682 | 0.682 | 0.0 | 17.6 | 17.6 | 965.1 | O K |
| 180 min Winter | 0.758 | 0.758 | 0.0 | 18.0 | 18.0 | 1073.0 | O K |
| 240 min Winter | 0.809 | 0.809 | 0.0 | 18.4 | 18.4 | 1145.2 | O K |
| 360 min Winter | 0.872 | 0.872 | 0.0 | 18.9 | 18.9 | 1234.7 | O K |
| 480 min Winter | 0.908 | 0.908 | 0.0 | 19.2 | 19.2 | 1285.9 | O K |
| 600 min Winter | 0.930 | 0.930 | 0.0 | 19.3 | 19.3 | 1316.9 | O K |
| 720 min Winter | 0.944 | 0.944 | 0.0 | 19.5 | 19.5 | 1336.8 | O K |
| 960 min Winter | 0.963 | 0.963 | 0.0 | 19.6 | 19.6 | 1364.1 | O K |
| 1440 min Winter | 0.989 | 0.989 | 0.0 | 19.8 | 19.8 | 1400.6 | O K |
| 2160 min Winter | 1.014 | 1.014 | 0.0 | 20.1 | 20.1 | 1435.3 | O K |
| 2880 min Winter | 1.052 | 1.052 | 0.0 | 20.4 | 20.4 | 1489.7 | O K |
| 4320 min Winter | 1.065 | 1.065 | 0.0 | 20.5 | 20.5 | 1508.2 | O K |
| 5760 min Winter | 1.052 | 1.052 | 0.0 | 20.4 | 20.4 | 1489.2 | O K |
| 7200 min Winter | 1.018 | 1.018 | 0.0 | 20.1 | 20.1 | 1440.9 | O K |
| 8640 min Winter | 0.972 | 0.972 | 0.0 | 19.7 | 19.7 | 1377.0 | O K |
| 10080 min Winter | 0.853 | 0.853 | 0.0 | 18.7 | 18.7 | 1208.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 15 min Winter | 96.268 | 0.0 | 540.4 | 26 |
| 30 min Winter | 66.979 | 0.0 | 714.6 | 40 |
| 60 min Winter | 43.888 | 0.0 | 1514.6 | 68 |
| 120 min Winter | 28.007 | 0.0 | 1742.5 | 126 |
| 180 min Winter | 21.389 | 0.0 | 1895.7 | 182 |
| 240 min Winter | 17.621 | 0.0 | 2014.3 | 240 |
| 360 min Winter | 13.379 | 0.0 | 2197.5 | 354 |
| 480 min Winter | 10.992 | 0.0 | 2340.0 | 464 |
| 600 min Winter | 9.434 | 0.0 | 2457.4 | 572 |
| 720 min Winter | 8.326 | 0.0 | 2555.8 | 676 |
| 960 min Winter | 6.836 | 0.0 | 2700.1 | 774 |
| 1440 min Winter | 5.168 | 0.0 | 2740.8 | 1098 |
| 2160 min Winter | 3.900 | 0.0 | 4859.4 | 1608 |
| 2880 min Winter | 3.191 | 0.0 | 5095.1 | 2108 |
| 4320 min Winter | 2.402 | 0.0 | 5242.9 | 2988 |
| 5760 min Winter | 1.964 | 0.0 | 5947.6 | 3920 |
| 7200 min Winter | 1.680 | 0.0 | 6192.9 | 4760 |
| 8640 min Winter | 1.479 | 0.0 | 6405.9 | 5544 |
| 10080 min Winter | 1.329 | 0.0 | 6592.6 | 5768 |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- Z 20.46/s |  |
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| Date 12NOV19 File | Designed by SC740 Checked by LP | |
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| XP Solutions | Source Control 2015.1 |
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Rainfall Details

| | | | |
|-----------------------|----------------------|-----------------------|-------|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | Scotland and Ireland | Cv (Winter) | 0.840 |
| M5-60 (mm) | 18.800 | Shortest Storm (mins) | 15 |
| Ratio R | 0.250 | Longest Storm (mins) | 10080 |
| Summer Storms | No | Climate Change % | +20 |

Time Area Diagram

Total Area (ha) 2.238

| Time (mins) | Area | Time (mins) | Area | Time (mins) | Area |
|-------------|---------|-------------|---------|-------------|----------|
| From: To: | (ha) | From: To: | (ha) | From: To: | (ha) |
| 0 | 4 0.746 | 4 | 8 0.746 | 8 | 12 0.746 |

| | |
|--------------------------|-------------|
| Unit B3 | Ballyvolane |
| Metropoint Business Park | AT- Z |
| Swords Co. Dublin | 20.46/s |



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| Date 12NOV19 | Designed by SC740 |
| File | Checked by LP |

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| XP Solutions | Source Control 2015.1 |
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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure


Invert Level (m) 0.000 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
 Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m ²) | Inf. Area (m ²) | Depth (m) | Area (m ²) | Inf. Area (m ²) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000 | 2360.0 | 2360.0 | 1.200 | 0.0 | 2577.8 |
| 1.100 | 2360.0 | 2577.8 | | | |

Hydro-Brake® Outflow Control

Design Head (m) 1.060 Hydro-Brake® Type Md5 SW Only Invert Level (m) 0.000
 Design Flow (l/s) 20.5 Diameter (mm) 181

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100 | 6.3 | 1.200 | 21.7 | 3.000 | 34.2 | 7.000 | 52.2 |
| 0.200 | 13.9 | 1.400 | 23.4 | 3.500 | 36.9 | 7.500 | 54.0 |
| 0.300 | 17.0 | 1.600 | 24.9 | 4.000 | 39.4 | 8.000 | 55.8 |
| 0.400 | 17.5 | 1.800 | 26.5 | 4.500 | 41.8 | 8.500 | 57.5 |
| 0.500 | 17.3 | 2.000 | 27.9 | 5.000 | 44.1 | 9.000 | 59.2 |
| 0.600 | 17.3 | 2.200 | 29.2 | 5.500 | 46.2 | 9.500 | 60.8 |
| 0.800 | 18.3 | 2.400 | 30.5 | 6.000 | 48.3 | | |
| 1.000 | 19.9 | 2.600 | 31.8 | 6.500 | 50.3 | | |


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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- Z 20.46/s |  |
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| Date 12NOV19 File | Designed by SC740 Checked by LP |
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| XP Solutions | Source Control 2015.1 |
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Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 10 | 0.0 | 510 | 1.1 | 1010 | 3.5 | 1510 | 5.9 | 2010 | 8.3 | 2510 | 7.7 |
| 20 | 0.0 | 520 | 1.2 | 1020 | 3.6 | 1520 | 6.0 | 2020 | 8.3 | 2520 | 7.7 |
| 30 | 0.0 | 530 | 1.2 | 1030 | 3.6 | 1530 | 6.1 | 2030 | 8.3 | 2530 | 7.7 |
| 40 | 0.0 | 540 | 1.3 | 1040 | 3.6 | 1540 | 6.1 | 2040 | 8.3 | 2540 | 7.7 |
| 50 | 0.0 | 550 | 1.3 | 1050 | 3.7 | 1550 | 6.2 | 2050 | 8.3 | 2550 | 7.7 |
| 60 | 0.0 | 560 | 1.4 | 1060 | 3.7 | 1560 | 6.2 | 2060 | 8.3 | 2560 | 7.7 |
| 70 | 0.0 | 570 | 1.4 | 1070 | 3.8 | 1570 | 6.3 | 2070 | 8.3 | 2570 | 7.7 |
| 80 | 0.0 | 580 | 1.5 | 1080 | 3.8 | 1580 | 6.4 | 2080 | 8.3 | 2580 | 7.7 |
| 90 | 0.0 | 590 | 1.5 | 1090 | 3.9 | 1590 | 6.4 | 2090 | 8.3 | 2590 | 7.7 |
| 100 | 0.0 | 600 | 1.6 | 1100 | 3.9 | 1600 | 6.5 | 2100 | 8.3 | 2600 | 7.7 |
| 110 | 0.0 | 610 | 1.6 | 1110 | 3.9 | 1610 | 6.5 | 2110 | 8.3 | 2610 | 7.7 |
| 120 | 0.0 | 620 | 1.7 | 1120 | 4.0 | 1620 | 6.6 | 2120 | 8.3 | 2620 | 7.7 |
| 130 | 0.0 | 630 | 1.8 | 1130 | 4.0 | 1630 | 6.7 | 2130 | 8.3 | 2630 | 7.7 |
| 140 | 0.0 | 640 | 1.8 | 1140 | 4.1 | 1640 | 6.7 | 2140 | 8.3 | 2640 | 7.7 |
| 150 | 0.0 | 650 | 1.9 | 1150 | 4.1 | 1650 | 6.8 | 2150 | 8.3 | 2650 | 7.7 |
| 160 | 0.0 | 660 | 1.9 | 1160 | 4.1 | 1660 | 6.9 | 2160 | 8.3 | 2660 | 7.7 |
| 170 | 0.0 | 670 | 1.9 | 1170 | 4.2 | 1670 | 6.9 | 2170 | 8.3 | 2670 | 7.7 |
| 180 | 0.1 | 680 | 2.0 | 1180 | 4.2 | 1680 | 7.0 | 2180 | 8.3 | 2680 | 7.7 |
| 190 | 0.1 | 690 | 2.0 | 1190 | 4.3 | 1690 | 7.1 | 2190 | 8.3 | 2690 | 7.7 |
| 200 | 0.1 | 700 | 2.1 | 1200 | 4.3 | 1700 | 7.1 | 2200 | 8.3 | 2700 | 7.7 |
| 210 | 0.1 | 710 | 2.1 | 1210 | 4.4 | 1710 | 7.2 | 2210 | 8.3 | 2710 | 7.7 |
| 220 | 0.1 | 720 | 2.2 | 1220 | 4.4 | 1720 | 7.2 | 2220 | 8.3 | 2720 | 7.7 |
| 230 | 0.1 | 730 | 2.2 | 1230 | 4.5 | 1730 | 7.3 | 2230 | 8.2 | 2730 | 7.7 |
| 240 | 0.2 | 740 | 2.3 | 1240 | 4.5 | 1740 | 7.4 | 2240 | 8.2 | 2740 | 7.7 |
| 250 | 0.2 | 750 | 2.4 | 1250 | 4.5 | 1750 | 7.4 | 2250 | 8.2 | 2750 | 7.7 |
| 260 | 0.2 | 760 | 2.4 | 1260 | 4.6 | 1760 | 7.5 | 2260 | 8.2 | 2760 | 7.7 |
| 270 | 0.2 | 770 | 2.5 | 1270 | 4.6 | 1770 | 7.5 | 2270 | 8.2 | 2770 | 7.8 |
| 280 | 0.2 | 780 | 2.5 | 1280 | 4.7 | 1780 | 7.6 | 2280 | 8.2 | 2780 | 7.8 |
| 290 | 0.3 | 790 | 2.5 | 1290 | 4.7 | 1790 | 7.6 | 2290 | 8.1 | 2790 | 7.8 |
| 300 | 0.3 | 800 | 2.6 | 1300 | 4.8 | 1800 | 7.7 | 2300 | 8.1 | 2800 | 7.8 |
| 310 | 0.3 | 810 | 2.6 | 1310 | 4.8 | 1810 | 7.7 | 2310 | 8.1 | 2810 | 7.8 |
| 320 | 0.3 | 820 | 2.7 | 1320 | 4.9 | 1820 | 7.8 | 2320 | 8.1 | 2820 | 7.8 |
| 330 | 0.4 | 830 | 2.7 | 1330 | 4.9 | 1830 | 7.8 | 2330 | 8.1 | 2830 | 7.8 |
| 340 | 0.4 | 840 | 2.8 | 1340 | 5.0 | 1840 | 7.9 | 2340 | 8.0 | 2840 | 7.9 |
| 350 | 0.4 | 850 | 2.8 | 1350 | 5.0 | 1850 | 7.9 | 2350 | 8.0 | 2850 | 7.9 |
| 360 | 0.5 | 860 | 2.9 | 1360 | 5.1 | 1860 | 7.9 | 2360 | 8.0 | 2860 | 7.9 |
| 370 | 0.5 | 870 | 2.9 | 1370 | 5.1 | 1870 | 8.0 | 2370 | 8.0 | 2870 | 7.9 |
| 380 | 0.6 | 880 | 3.0 | 1380 | 5.2 | 1880 | 8.0 | 2380 | 7.9 | 2880 | 7.9 |
| 390 | 0.6 | 890 | 3.0 | 1390 | 5.3 | 1890 | 8.0 | 2390 | 7.9 | 2890 | 7.9 |
| 400 | 0.6 | 900 | 3.1 | 1400 | 5.3 | 1900 | 8.1 | 2400 | 7.9 | 2900 | 8.0 |
| 410 | 0.7 | 910 | 3.1 | 1410 | 5.4 | 1910 | 8.1 | 2410 | 7.9 | 2910 | 8.0 |
| 420 | 0.7 | 920 | 3.1 | 1420 | 5.4 | 1920 | 8.1 | 2420 | 7.9 | 2920 | 8.0 |
| 430 | 0.8 | 930 | 3.2 | 1430 | 5.4 | 1930 | 8.2 | 2430 | 7.8 | 2930 | 8.0 |
| 440 | 0.8 | 940 | 3.2 | 1440 | 5.5 | 1940 | 8.2 | 2440 | 7.8 | 2940 | 8.0 |
| 450 | 0.9 | 950 | 3.3 | 1450 | 5.6 | 1950 | 8.2 | 2450 | 7.8 | 2950 | 8.1 |
| 460 | 0.9 | 960 | 3.3 | 1460 | 5.6 | 1960 | 8.2 | 2460 | 7.8 | 2960 | 8.1 |
| 470 | 1.0 | 970 | 3.4 | 1470 | 5.7 | 1970 | 8.2 | 2470 | 7.8 | 2970 | 8.1 |
| 480 | 1.0 | 980 | 3.4 | 1480 | 5.7 | 1980 | 8.2 | 2480 | 7.8 | 2980 | 8.1 |
| 490 | 1.0 | 990 | 3.4 | 1490 | 5.8 | 1990 | 8.3 | 2490 | 7.7 | 2990 | 8.1 |
| 500 | 1.1 | 1000 | 3.5 | 1500 | 5.9 | 2000 | 8.3 | 2500 | 7.7 | 3000 | 8.1 |

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| Unit B3 Metropoint Business Park Swords Co. Dublin | Ballyvolane AT- Z 20.46/s |  |
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| Date 12NOV19 File | Designed by SC740 Checked by LP | |
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| XP Solutions | Source Control 2015.1 |
|--------------|-----------------------|

Additional Hydrograph #1

| Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) | Time (mins) | Flow (l/s) |
|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|----------------|---------------|
| 3010 | 8.2 | 3470 | 8.9 | 3930 | 9.2 | 4390 | 9.2 | 4850 | 9.2 | 5310 | 9.0 |
| 3020 | 8.2 | 3480 | 8.9 | 3940 | 9.2 | 4400 | 9.2 | 4860 | 9.2 | 5320 | 9.0 |
| 3030 | 8.2 | 3490 | 8.9 | 3950 | 9.2 | 4410 | 9.2 | 4870 | 9.2 | 5330 | 9.0 |
| 3040 | 8.2 | 3500 | 8.9 | 3960 | 9.2 | 4420 | 9.2 | 4880 | 9.1 | 5340 | 9.0 |
| 3050 | 8.2 | 3510 | 8.9 | 3970 | 9.2 | 4430 | 9.2 | 4890 | 9.1 | 5350 | 9.0 |
| 3060 | 8.3 | 3520 | 9.0 | 3980 | 9.2 | 4440 | 9.2 | 4900 | 9.1 | 5360 | 9.0 |
| 3070 | 8.3 | 3530 | 9.0 | 3990 | 9.2 | 4450 | 9.2 | 4910 | 9.1 | 5370 | 9.0 |
| 3080 | 8.3 | 3540 | 9.0 | 4000 | 9.2 | 4460 | 9.2 | 4920 | 9.1 | 5380 | 9.0 |
| 3090 | 8.3 | 3550 | 9.0 | 4010 | 9.2 | 4470 | 9.2 | 4930 | 9.1 | 5390 | 9.0 |
| 3100 | 8.3 | 3560 | 9.0 | 4020 | 9.2 | 4480 | 9.2 | 4940 | 9.1 | 5400 | 9.0 |
| 3110 | 8.4 | 3570 | 9.0 | 4030 | 9.2 | 4490 | 9.2 | 4950 | 9.1 | 5410 | 9.0 |
| 3120 | 8.4 | 3580 | 9.0 | 4040 | 9.2 | 4500 | 9.2 | 4960 | 9.1 | 5420 | 9.0 |
| 3130 | 8.4 | 3590 | 9.0 | 4050 | 9.2 | 4510 | 9.2 | 4970 | 9.1 | 5430 | 9.0 |
| 3140 | 8.4 | 3600 | 9.0 | 4060 | 9.2 | 4520 | 9.2 | 4980 | 9.1 | 5440 | 9.0 |
| 3150 | 8.4 | 3610 | 9.0 | 4070 | 9.2 | 4530 | 9.2 | 4990 | 9.1 | 5450 | 9.0 |
| 3160 | 8.4 | 3620 | 9.0 | 4080 | 9.2 | 4540 | 9.2 | 5000 | 9.1 | 5460 | 9.0 |
| 3170 | 8.5 | 3630 | 9.0 | 4090 | 9.2 | 4550 | 9.2 | 5010 | 9.1 | 5470 | 8.9 |
| 3180 | 8.5 | 3640 | 9.1 | 4100 | 9.2 | 4560 | 9.2 | 5020 | 9.1 | 5480 | 8.9 |
| 3190 | 8.5 | 3650 | 9.1 | 4110 | 9.2 | 4570 | 9.2 | 5030 | 9.1 | 5490 | 8.9 |
| 3200 | 8.5 | 3660 | 9.1 | 4120 | 9.2 | 4580 | 9.2 | 5040 | 9.1 | 5500 | 8.9 |
| 3210 | 8.5 | 3670 | 9.1 | 4130 | 9.2 | 4590 | 9.2 | 5050 | 9.1 | 5510 | 8.9 |
| 3220 | 8.5 | 3680 | 9.1 | 4140 | 9.2 | 4600 | 9.2 | 5060 | 9.1 | 5520 | 8.9 |
| 3230 | 8.6 | 3690 | 9.1 | 4150 | 9.2 | 4610 | 9.2 | 5070 | 9.1 | 5530 | 8.9 |
| 3240 | 8.6 | 3700 | 9.1 | 4160 | 9.2 | 4620 | 9.2 | 5080 | 9.1 | 5540 | 8.9 |
| 3250 | 8.6 | 3710 | 9.1 | 4170 | 9.2 | 4630 | 9.2 | 5090 | 9.1 | 5550 | 8.9 |
| 3260 | 8.6 | 3720 | 9.1 | 4180 | 9.2 | 4640 | 9.2 | 5100 | 9.1 | 5560 | 8.9 |
| 3270 | 8.6 | 3730 | 9.1 | 4190 | 9.2 | 4650 | 9.2 | 5110 | 9.1 | 5570 | 8.9 |
| 3280 | 8.6 | 3740 | 9.1 | 4200 | 9.2 | 4660 | 9.2 | 5120 | 9.1 | 5580 | 8.9 |
| 3290 | 8.7 | 3750 | 9.1 | 4210 | 9.2 | 4670 | 9.2 | 5130 | 9.1 | 5590 | 8.9 |
| 3300 | 8.7 | 3760 | 9.1 | 4220 | 9.2 | 4680 | 9.2 | 5140 | 9.1 | 5600 | 8.9 |
| 3310 | 8.7 | 3770 | 9.1 | 4230 | 9.2 | 4690 | 9.2 | 5150 | 9.1 | 5610 | 8.9 |
| 3320 | 8.7 | 3780 | 9.1 | 4240 | 9.2 | 4700 | 9.2 | 5160 | 9.1 | 5620 | 8.8 |
| 3330 | 8.7 | 3790 | 9.1 | 4250 | 9.2 | 4710 | 9.2 | 5170 | 9.1 | 5630 | 8.8 |
| 3340 | 8.7 | 3800 | 9.2 | 4260 | 9.2 | 4720 | 9.2 | 5180 | 9.1 | 5640 | 8.8 |
| 3350 | 8.7 | 3810 | 9.2 | 4270 | 9.2 | 4730 | 9.2 | 5190 | 9.1 | 5650 | 8.8 |
| 3360 | 8.8 | 3820 | 9.2 | 4280 | 9.2 | 4740 | 9.2 | 5200 | 9.1 | 5660 | 8.8 |
| 3370 | 8.8 | 3830 | 9.2 | 4290 | 9.2 | 4750 | 9.2 | 5210 | 9.1 | 5670 | 8.8 |
| 3380 | 8.8 | 3840 | 9.2 | 4300 | 9.2 | 4760 | 9.2 | 5220 | 9.1 | 5680 | 8.8 |
| 3390 | 8.8 | 3850 | 9.2 | 4310 | 9.2 | 4770 | 9.2 | 5230 | 9.1 | 5690 | 8.8 |
| 3400 | 8.8 | 3860 | 9.2 | 4320 | 9.2 | 4780 | 9.2 | 5240 | 9.1 | 5700 | 8.8 |
| 3410 | 8.8 | 3870 | 9.2 | 4330 | 9.2 | 4790 | 9.2 | 5250 | 9.1 | 5710 | 8.8 |
| 3420 | 8.8 | 3880 | 9.2 | 4340 | 9.2 | 4800 | 9.2 | 5260 | 9.1 | 5720 | 8.8 |
| 3430 | 8.9 | 3890 | 9.2 | 4350 | 9.2 | 4810 | 9.2 | 5270 | 9.1 | 5730 | 8.8 |
| 3440 | 8.9 | 3900 | 9.2 | 4360 | 9.2 | 4820 | 9.2 | 5280 | 9.1 | 5740 | 8.8 |
| 3450 | 8.9 | 3910 | 9.2 | 4370 | 9.2 | 4830 | 9.2 | 5290 | 9.1 | 5750 | 8.8 |
| 3460 | 8.9 | 3920 | 9.2 | 4380 | 9.2 | 4840 | 9.2 | 5300 | 9.0 | 5760 | 8.8 |

APPENDIX D –Soakpit design sheets



Carrig Mór House
10 High Street
Douglas Road, Cork
Tel: 021-4840214

Longview Estates Ltd

| | | | |
|--------------------------------|------------------------|-------------------------|--|
| Section: Soakpit Houses | Job No: 17066HD | Revision | |
| | Prepared By: AR | Page: C/01 | |
| | | Date: 14/12/2017 | |

| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|-------|-------|
| | trench soakaways | | |
| | 450 | 600 | 900 |
| width of trench [mm]: | | | |
| required trench length [m]: | 19.27 | 16.19 | 12.78 |
| | ring soakaways | | |
| | 1050 | 1200 | 1350 |
| diameter of ring [mm]: | | | |
| required pit diameter [m]: | 2.01 | 2.02 | 2.02 |

**Based on effective depth and number of pits as in Soakaway Data table*

| SUMMARY OF CALCULATIONS | |
|--|----------------------|
| critical design rainfall duration 't _{crit} ' = | 120 min |
| required storage volume 'V _{req} ' = | 10.41 m ³ |
| provided storage volume 'V _{prov} ' = | 10.64 m ³ |
| utilisation factor = | 0.98 .OK |
| required time to discharge 50% 't ₅₀ ' = | 1.40 hours |
| utilisation factor = | 0.06 .OK |

| GENERAL DATA | |
|--|------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] = | 290 |
| 60 min rainfall depth of 5 year return period 'R' [mm] = | 20 |
| M5-60 to M5-2d rainfall ratio 'r' = | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|------|
| soakaway width 'W' [m] = | 4.00 |
| soakaway length 'L' [m] = | 4.00 |
| total depth from ground level 'D _s ' [m] = | 1.10 |
| depth to drain invert level 'D _d ' [m] = | 0.40 |
| soakaway effective depth 'D _{ev} ' [m] = | 0.70 |
| free volume in infill aggregate [%] = | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'f' [m/s] = | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | | |
|---|--------------------|---------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 4.02 | | | | | | 0.32 | 3.70 | |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 6.15 | | | | | | 0.63 | 5.52 | |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 7.62 | | | | | | 0.95 | 6.67 | |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 10.44 | | | | | | 1.90 | 8.54 | |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 14.13 | | | | | | 3.79 | 10.34 | |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 17.99 | | | | | | 7.58 | 10.41 | |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 22.78 | | | | | | 15.16 | 7.62 | |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 25.87 | | | | | | 22.74 | 3.13 | |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 29.96 | | | | | | 37.90 | 0.00 | |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 38.78 | | | | | | 90.96 | 0.00 | |



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Longview

| | | | |
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| Section: Soakpit 2.0 | | Job No: 17066HD | Revision |
| | | Prepared By: SM | Page: 1.00 |
| | | Date: 15/11/2019 | |

| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|--------|--------|
| | trench soakaways | | |
| width of trench [mm]: | 450 | 600 | 900 |
| required trench length [m]: | 668.09 | 554.30 | 413.44 |
| | ring soakaways | | |
| diameter of ring [mm]: | 1050 | 1200 | 1350 |
| required pit diameter [m]: | 3.07 | 3.08 | 3.08 |

*Based on effective depth and number of pits as in Soakaway Data table

| SUMMARY OF CALCULATIONS | |
|--|-------------------------|
| critical design rainfall duration t_{crit} | = 60 min |
| required storage volume V_{req} | = 184.61 m ³ |
| provided storage volume V_{prov} | = 216.60 m ³ |
| utilisation factor | = 0.85 .OK |
| required time to discharge 50% t_{50} | = 0.81 hours |
| utilisation factor | = 0.03 .OK |

| GENERAL DATA | |
|--|------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] | = 6536.95 |
| 0 min rainfall depth of 5 year return period 'R' [mm] | = 20 |
| M5-60 to M5-2d rainfall ratio 'r' | = 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|---------|
| soakaway width 'W' [m] | = 57.00 |
| soakaway length 'L' [m] | = 10.00 |
| total depth from ground level 'D _g ' [m] | = 1.90 |
| depth to drain invert level 'D _d ' [m] | = 1.50 |
| soakaway effective depth 'D _{eff} ' [m] | = 0.40 |
| free volume in infill aggregate [%] | = 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | 30% |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'f' [m/s] | = 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | | |
|---|--------------------|---------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|---------|---|------------------------------------|--|--|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | outflow from soakaway [m ³] | required storage [m ³] | | |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | | | | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 90.52 | | | | 11.16 | 79.36 | | | |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 138.67 | | | | 22.31 | 116.36 | | | |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 171.70 | | | | 33.47 | 138.23 | | | |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 235.26 | | | | 66.94 | 168.32 | | | |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 318.48 | | | | 133.87 | 184.61 | | | |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 405.50 | | | | 267.74 | 137.75 | | | |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 513.39 | | | | 535.48 | 0.00 | | | |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 583.14 | | | | 803.23 | 0.00 | | | |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 675.40 | | | | 1338.71 | 0.00 | | | |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 874.18 | | | | 3212.90 | 0.00 | | | |

*Z2 is a growth factor from M5 rainfalls.



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Section: **Soakpit 2.1**

| | | | |
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| Prepared By: | SM | Page: | 1.00 |
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| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------------|------------|------------|
| | trench soakaways | | |
| | width of trench [mm]: | 450 | 600 |
| required trench length [m]: | 71.77 | 60.45 | 48.31 |
| | ring soakaways | | |
| | diameter of ring [mm]: | 1050 | 1200 |
| required pit diameter [m]: | 1.72 | 1.73 | 1.73 |

*Based on effective depth and number of pits as in Soakaway Data table.

| SUMMARY OF CALCULATIONS | |
|---|----------------------|
| critical design rainfall duration t_{crit}' = | 120 min |
| required storage volume V_{req}' = | 83.03 m ³ |
| provided storage volume V_{prov}' = | 93.86 m ³ |
| utilisation factor = | 0.88 .OK |
| required time to discharge 50% t_{50}' = | 2.32 hours |
| utilisation factor = | 0.10 .OK |

| GENERAL DATA | |
|--|-------------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] = | 1991 |
| 0 min rainfall depth of 5 year return period 'R' [mm] = | 20 |
| M5-60 to M5-2d rainfall ratio 'r' = | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|--------------|
| soakaway width 'W' [m] = | 19.00 |
| soakaway length 'L' [m] = | 4.00 |
| total depth from ground level 'D _b ' [m] = | 1.50 |
| depth to drain invert level 'D _d ' [m] = | 0.20 |
| soakaway effective depth 'D _{eff} ' [m] = | 1.30 |
| free volume in infill aggregate [%] = | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'f' [m/s] = | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | |
|---|--------------------|---------------------|-------------|----------------|--------------------------|--------|----------------|--------------------------|----|---|------------------------------------|----------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | outflow from soakaway [m ³] | required storage [m ³] | |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | | | rainfalls [mm] |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 27.57 | | | | | 1.69 | 25.88 | |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 42.23 | | | | | 3.37 | 38.86 | |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 52.30 | | | | | 5.06 | 47.24 | |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 71.65 | | | | | 10.12 | 61.54 | |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 97.00 | | | | | 20.24 | 76.77 | |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 123.50 | | | | | 40.47 | 83.03 | |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 156.37 | | | | | 80.95 | 75.42 | |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 177.61 | | | | | 121.42 | 56.19 | |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 205.71 | | | | | 202.36 | 3.35 | |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 266.26 | | | | | 485.67 | 0.00 | |

*Z2 is a growth factor from M5 rainfalls.



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Section: **Soakpit 2.2**

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| Prepared By: | SM | Page: | 1.00 |
| | | Date: | 15/11/2019 |

| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------------|------------|------------|
| | trench soakaways | | |
| | width of trench [mm]: | 450 | 600 |
| required trench length [m]: | 154.91 | 130.55 | 104.59 |
| | ring soakaways | | |
| | diameter of ring [mm]: | 1050 | 1200 |
| required pit diameter [m]: | 2.23 | 2.23 | 2.23 |

*Based on effective depth and number of pits as in Soakaway Data table

| SUMMARY OF CALCULATIONS | |
|---|-----------------|
| critical design rainfall duration t_{crit}' = | 240 min |
| required storage volume V_{req}' = | 167.20 m^3 |
| provided storage volume V_{prov}' = | 179.55 m^3 |
| utilisation factor = | 0.93 .OK |
| required time to discharge 50% t_{50}' = | 3.90 hours |
| utilisation factor = | 0.16 .OK |

| GENERAL DATA | |
|---|-------------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m^2] = | 3301 |
| 0 min rainfall depth of 5 year return period 'R' [mm] = | 20 |
| M5-60 to M5-2d rainfall ratio 'r' = | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|--------------|
| soakaway width 'W' [m] = | 27.00 |
| soakaway length 'L' [m] = | 7.00 |
| total depth from ground level 'D _b ' [m] = | 1.00 |
| depth to drain invert level 'D _d ' [m] = | 0.00 |
| soakaway effective depth 'D _{eff} ' [m] = | 1.00 |
| free volume in infill aggregate [%] = | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate \uparrow [m/s] = | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | |
|---|--------------------|---------------------|-------------|----------------|------------------|--------|----------------|------------------|----|---------------------------------|----------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | outflow from soakaway [m^3] | required storage [m^3] |
| | | | Z2 | rainfalls [mm] | inflow [m^3] | Z2 | rainfalls [mm] | inflow [m^3] | Z2 | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 45.71 | | | | | 1.92 | 43.79 |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 70.02 | | | | | 3.84 | 66.19 |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 86.70 | | | | | 5.75 | 80.95 |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 118.80 | | | | | 11.51 | 107.29 |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 160.82 | | | | | 23.01 | 137.81 |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 204.77 | | | | | 46.02 | 158.74 |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 259.25 | | | | | 92.04 | 167.20 |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 294.47 | | | | | 138.07 | 156.40 |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 341.06 | | | | | 230.11 | 110.95 |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 441.44 | | | | | 552.27 | 0.00 |

*Z2 is a growth factor from M5 rainfalls



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Section: **Soakpit 2.3**

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| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------------|------------|------------|
| | trench soakaways | | |
| | width of trench [mm]: | 450 | 600 |
| required trench length [m]: | 278.68 | 234.91 | 188.37 |
| | ring soakaways | | |
| | diameter of ring [mm]: | 1050 | 1200 |
| required pit diameter [m]: | 3.23 | 3.24 | 3.24 |

| SUMMARY OF CALCULATIONS | |
|--|-------------------------|
| critical design rainfall duration t_{crit}^* | = 360 min |
| required storage volume V_{req}^* | = 362.95 m ³ |
| provided storage volume V_{prov}^* | = 370.50 m ³ |
| utilisation factor | = 0.98 .OK |
| required time to discharge 50% t_{50}^* | = 6.68 hours |
| utilisation factor | = 0.28 .OK |

*Based on effective depth and number of pits as in Soakaway Data table

| GENERAL DATA | |
|--|-------------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] | = 5935 |
| 0 min rainfall depth of 5 year return period 'R' [mm] | = 20 |
| M5-60 to M5-2d rainfall ratio 'r' | = 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|----------------|
| soakaway width 'W' [m] | = 26.00 |
| soakaway length 'L' [m] | = 15.00 |
| total depth from ground level 'D _h ' [m] | = 1.00 |
| depth to drain invert level 'D _d ' [m] | = 0.00 |
| soakaway effective depth 'D _{eff} ' [m] | = 1.00 |
| free volume in infill aggregate [%] | = 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'r' [m/s] | = 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | |
|---|--------------------|---------------------|-------------|----------------|--------------------------|--------|----------------|--------------------------|----|----------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 82.18 | | | | | | 2.31 | 79.87 |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 125.90 | | | | | | 4.62 | 121.27 |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 155.89 | | | | | | 6.94 | 148.95 |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 213.59 | | | | | | 13.87 | 199.72 |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 289.15 | | | | | | 27.75 | 261.40 |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 368.16 | | | | | | 55.50 | 312.66 |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 466.11 | | | | | | 111.00 | 355.12 |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 529.44 | | | | | | 166.49 | 362.95 |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 613.21 | | | | | | 277.49 | 335.72 |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 793.68 | | | | | | 665.97 | 127.71 |

*Z2 is a growth factor from M5 rainfalls



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Section: **Soakpit 5.1**

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| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|--------|--------|
| | trench soakaways | | |
| | 450 | 600 | 900 |
| width of trench [mm]: | | | |
| required trench length [m]: | 656.08 | 553.11 | 443.82 |
| | ring soakaways | | |
| | 1050 | 1200 | 1350 |
| diameter of ring [mm]: | | | |
| required pit diameter [m]: | 3.59 | 3.60 | 3.60 |

| SUMMARY OF CALCULATIONS | |
|--|------------------------|
| critical design rainfall duration t_{crit} = | 600 min |
| required storage volume V_{req} = | 1155.02 m ³ |
| provided storage volume V_{prov} = | 1162.80 m ³ |
| utilisation factor = | 0.99 .OK |
| required time to discharge 50% t_{50} = | 10.08 hours |
| utilisation factor = | 0.42 .OK |

*Based on effective depth and number of pits as in Soakaway Data table

| GENERAL DATA | |
|--|------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] = | 16760 |
| 0 min rainfall depth of 5 year return period 'R' [mm] = | 20 |
| M5-60 to M5-2d rainfall ratio 'r' = | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|-------|
| soakaway width 'W' [m] = | 51.00 |
| soakaway length 'L' [m] = | 20.00 |
| total depth from ground level 'D _h ' [m] = | 1.50 |
| depth to drain invert level 'D _d ' [m] = | 0.30 |
| soakaway effective depth 'D _{eff} ' [m] = | 1.20 |
| free volume in infill aggregate [%] = | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'f' [m/s] = | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | | |
|---|--------------------|---------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 232.08 | | | | | | 4.81 | 227.27 | |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 355.53 | | | | | | 9.61 | 345.92 | |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 440.22 | | | | | | 14.42 | 425.80 | |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 603.17 | | | | | | 28.83 | 574.34 | |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 816.55 | | | | | | 57.66 | 758.88 | |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 1039.65 | | | | | | 115.33 | 924.32 | |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 1316.27 | | | | | | 230.65 | 1085.62 | |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 1495.10 | | | | | | 345.98 | 1149.12 | |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 1731.66 | | | | | | 576.63 | 1155.02 | |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 2241.31 | | | | | | 1383.92 | 857.39 | |

*Z2 is a growth factor from M5 rainfalls



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Section: **Soakpit 5.2**

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| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|------------|------------|
| | trench soakaways | | |
| width of trench [mm]: | 450 | 600 | 900 |
| required trench length [m]: | 82.03 | 69.11 | 55.26 |
| | ring soakaways | | |
| diameter of ring [mm]: | 1050 | 1200 | 1350 |
| required pit diameter [m]: | 3.15 | 3.16 | 3.16 |

*Based on effective depth and number of pits as in Soakaway Data table

| SUMMARY OF CALCULATIONS | |
|--|-------------------------|
| critical design rainfall duration t_{crit} | = 240 min |
| required storage volume V_{req} | = 99.95 m ³ |
| provided storage volume V_{prov} | = 109.44 m ³ |
| utilisation factor | = 0.91 .OK |
| required time to discharge 50% t_{50} | = 3.37 hours |
| utilisation factor | = 0.14 .OK |

| GENERAL DATA | |
|--|-------------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] | = 2100 |
| 0 min rainfall depth of 5 year return period 'R' [mm] | = 20 |
| M5-60 to M5-2d rainfall ratio 'r' | = 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|----------------|
| soakaway width 'W' [m] | = 8.00 |
| soakaway length 'L' [m] | = 12.00 |
| total depth from ground level 'D ₀ ' [m] | = 1.50 |
| depth to drain invert level 'D _d ' [m] | = 0.30 |
| soakaway effective depth 'D _{eff} ' [m] | = 1.20 |
| free volume in infill aggregate [%] | = 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'f' [m/s] | = 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | | |
|---|--------------------|---------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 29.08 | | | | | | | 1.35 | 27.73 |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 44.55 | | | | | | | 2.71 | 41.84 |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 55.16 | | | | | | | 4.06 | 51.10 |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 75.58 | | | | | | | 8.12 | 67.45 |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 102.31 | | | | | | | 16.24 | 86.07 |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 130.27 | | | | | | | 32.49 | 97.78 |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 164.93 | | | | | | | 64.97 | 99.95 |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 187.33 | | | | | | | 97.46 | 89.87 |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 216.97 | | | | | | | 162.43 | 54.54 |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 280.83 | | | | | | | 389.84 | 0.00 |

*Z2 is a growth factor from M5 rainfalls



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Longview

Section: **Soakpit 5.3**

| | | | |
|--------------|----------------|----------|-------------------|
| Job No: | 17066HD | Revision | |
| Prepared By: | SM | Page: | 1.00 |
| | | Date: | 15/11/2019 |

| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|------------|------------|
| | trench soakaways | | |
| width of trench [mm]: | 450 | 600 | 900 |
| required trench length [m]: | 87.12 | 73.40 | 58.71 |
| | ring soakaways | | |
| diameter of ring [mm]: | 1050 | 1200 | 1350 |
| required pit diameter [m]: | 3.15 | 3.16 | 3.16 |

| SUMMARY OF CALCULATIONS | |
|--|-----------------------|
| critical design rainfall duration t_{crit}^* | 240 min |
| required storage volume V_{req}^* | 108.54 m ³ |
| provided storage volume V_{prov}^* | 116.28 m ³ |
| utilisation factor | 0.93 .OK |
| required time to discharge 50% t_{50}^* | 3.49 hours |
| utilisation factor | 0.15 .OK |

*Based on effective depth and number of pits as in Soakaway Data table

| GENERAL DATA | |
|--|-------------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] | 2230 |
| 0 min rainfall depth of 5 year return period 'R' [mm] | 20 |
| M5-60 to M5-2d rainfall ratio 'r' | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|--------------|
| soakaway width 'W' [m] | 8.50 |
| soakaway length 'L' [m] | 12.00 |
| total depth from ground level 'D _g ' [m] | 1.50 |
| depth to drain invert level 'D _d ' [m] | 0.30 |
| soakaway effective depth 'D _{eff} ' [m] | 1.20 |
| free volume in infill aggregate [%] | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate 'T' [m/s] | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | |
|---|--------------------|---------------------|-------------|----------------|--------------------------|--------|----------------|--------------------------|----|----------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 30.88 | | | | | | 1.39 | 29.49 |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 47.30 | | | | | | 2.77 | 44.53 |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 58.57 | | | | | | 4.16 | 54.41 |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 80.26 | | | | | | 8.32 | 71.93 |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 108.65 | | | | | | 16.65 | 92.00 |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 138.33 | | | | | | 33.30 | 105.03 |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 175.14 | | | | | | 66.60 | 108.54 |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 198.93 | | | | | | 99.90 | 99.04 |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 230.41 | | | | | | 166.49 | 63.91 |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 298.22 | | | | | | 399.58 | 0.00 |

*Z2 is a growth factor from M5 rainfalls



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Longview

| | | | |
|-----------------------------|------------------------|-------------------------|--|
| Section: Soakpit 5.4 | Job No: 17066HD | Revision | |
| | Prepared By: SM | Page: 1.00 | |
| | | Date: 15/11/2019 | |

| ALTERNATIVE SOAKAWAY SIZES | | | |
|-----------------------------|------------------|-------|-------|
| | trench soakaways | | |
| width of trench [mm]: | 450 | 600 | 900 |
| required trench length [m]: | 77.80 | 65.54 | 52.40 |
| | ring soakaways | | |
| diameter of ring [mm]: | 1050 | 1200 | 1350 |
| required pit diameter [m]: | 3.31 | 3.31 | 3.31 |

*Based on effective depth and number of pits as in Soakaway Data table

| SUMMARY OF CALCULATIONS | |
|---|----------------------|
| critical design rainfall duration t_{crit}' = | 240 min |
| required storage volume V_{req}' = | 94.72 m ³ |
| provided storage volume V_{prov}' = | 95.76 m ³ |
| utilisation factor = | 0.99 .OK |
| required time to discharge 50% t_{50}' = | 3.10 hours |
| utilisation factor = | 0.13 .OK |

| GENERAL DATA | |
|--|------------------------|
| site location: | England and Wales |
| soakaway type: | infilled pit or trench |
| impermeable area drained to soakaway 'A' [m ²] = | 1992 |
| 0 min rainfall depth of 5 year return period 'R' [mm] = | 20 |
| M5-60 to M5-2d rainfall ratio 'r' = | 0.25 |
| allowance for climate change: | 20% |

| SOAKAWAY DATA | |
|---|-------|
| soakaway width 'W' [m] = | 7.00 |
| soakaway length 'L' [m] = | 12.00 |
| total depth from ground level 'D ₀ ' [m] = | 1.50 |
| depth to drain invert level 'D _d ' [m] = | 0.30 |
| soakaway effective depth 'D _{eff} ' [m] = | 1.20 |
| free volume in infill aggregate [%] = | 95 |

| SOIL INFILTRATION DATA | |
|---|---|
| allowance for infiltration through soakaway base: | No |
| available on-site infiltration test results: | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| soil infiltration rate τ [m/s] = | 1.88E-04 |

| REQUIRED STORAGE CAPACITY PER RAINFALL DURATION | | | | | | | | | | | | |
|---|--------------------|---------------------|--------|----------------|--------------------------|--------|----------------|--------------------------|----|----------------|---|------------------------------------|
| rainfall duration [min] | rainfall factor Z1 | M5-D rainfalls [mm] | M100-D | | | ignore | | ignore | | | outflow from soakaway [m ³] | required storage [m ³] |
| | | | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | inflow [m ³] | Z2 | rainfalls [mm] | | |
| 5 | 0.32 | 6.33 | 1.82 | 13.85 | 27.58 | | | | | 1.29 | 26.30 | |
| 10 | 0.47 | 9.33 | 1.89 | 21.21 | 42.26 | | | | | 2.57 | 39.68 | |
| 15 | 0.57 | 11.33 | 1.93 | 26.27 | 52.32 | | | | | 3.86 | 48.46 | |
| 30 | 0.75 | 15.07 | 1.99 | 35.99 | 71.69 | | | | | 7.72 | 63.97 | |
| 60 | 1.00 | 20.00 | 2.03 | 48.72 | 97.05 | | | | | 15.43 | 81.62 | |
| 120 | 1.29 | 25.80 | 2.00 | 62.03 | 123.57 | | | | | 30.86 | 92.70 | |
| 240 | 1.69 | 33.73 | 1.94 | 78.54 | 156.44 | | | | | 61.72 | 94.72 | |
| 360 | 1.96 | 39.20 | 1.90 | 89.21 | 177.70 | | | | | 92.59 | 85.11 | |
| 600 | 2.35 | 46.93 | 1.83 | 103.32 | 205.82 | | | | | 154.31 | 51.50 | |
| 1440 | 3.27 | 65.33 | 1.71 | 133.73 | 266.39 | | | | | 370.34 | 0.00 | |

*Z2 is a growth factor from M5 rainfalls

APPENDIX E: - HR Wallingford Greenfield Runoff Estimation

Redline Boundary:



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:
 Site name: Longview Estates, Redline
 Site location: Ballyvolane

Site coordinates
 Latitude: 51.92797° N
 Longitude: 8.44839° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/WTR/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:
 Date: 2019-09-02 14:05

| | |
|--------------------|-------|
| Methodology | IH124 |
|--------------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 45.919 |
|----------------------|--------|

Methodology

| | | |
|------------------------|-----------------------------|--------|
| Qbar estimation method | Calculate from SPR and SAAR | |
| SPR estimation method | Calculate from SOIL type | |
| | Default | Edited |
| SOIL type | 4 | 3 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | | |
|-------------------------------|---------|--------|
| | Default | Edited |
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

| |
|---------------------------------|
| (1) Is $Q_{BAR} < 2.0$ l/s/ha? |
| (2) Are flow rates < 5.0 l/s? |
| (3) Is $SPR/SPRHOST \leq 0.3$? |

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 392.65 | 233.64 |
| 1 in 1 year (l/s) | 333.75 | 198.6 |
| 1 in 30 years (l/s) | 647.87 | 385.51 |
| 1 in 100 years (l/s) | 765.67 | 455.6 |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and license agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEM, Hydrosoft/Clara or any other organisation for use of this data in the design or operational characteristics of any drainage scheme.

Neighbourhood 1 (phase 1):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:
 Site name: Longview Estates, N1
 Site location: Ballyvolane

Site coordinates
 Latitude: 51.92797° N
 Longitude: 8.44839° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:
 Date: 2019-09-02 14:00

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 5.8738 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

- (1) Is $Q_{BAR} < 2.0$ l/s/ha?
- (2) Are flow rates < 5.0 l/s?
- (3) Is $SPR/SPRHOST \leq 0.3$?

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 50.23 | 29.89 |
| 1 in 1 year (l/s) | 42.69 | 25.4 |
| 1 in 30 years (l/s) | 82.87 | 49.31 |
| 1 in 100 years (l/s) | 97.94 | 58.28 |

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Neighbourhood 2 (phase 2):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:
 Site name: Longview Estates, N2
 Site location: Ballyvolane

Site coordinates
 Latitude: 51.92797° N
 Longitude: 8.44839° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/W/TR/1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:
 Date: 2019-09-02 14:02

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 8.0406 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

- (1) Is $Q_{BAR} < 2.0$ l/s/ha?
- (2) Are flow rates < 5.0 l/s?
- (3) Is $SPR/SPRHOST \leq 0.3?$

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 68.75 | 40.91 |
| 1 in 1 year (l/s) | 58.44 | 34.77 |
| 1 in 30 years (l/s) | 113.45 | 67.5 |
| 1 in 100 years (l/s) | 134.07 | 79.78 |

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Neighbourhood 3 (phase 3):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:
 Site name: Longview Estates, N3
 Site location: Ballyvolane

Site coordinates
 Latitude: 51.92797° N
 Longitude: 8.44839° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/ATR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:
 Date: 2019-09-02 14:03

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 5.9368 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | — | — |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

- (1) Is $Q_{BAR} < 2.0$ l/s/ha?
- (2) Are flow rates < 5.0 l/s?
- (3) Is $SPR/SPRHOST \leq 0.3$?

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 50.77 | 30.21 |
| 1 in 1 year (l/s) | 43.15 | 25.68 |
| 1 in 30 years (l/s) | 83.76 | 49.84 |
| 1 in 100 years (l/s) | 98.99 | 58.9 |

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Neighbourhood 4 (phase 4):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:
 Site name: Longview Estates, N4
 Site location: Ballyvolane

Site coordinates
 Latitude: 51.92797° N
 Longitude: 8.44839° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:
 Date: 2019-09-02 14:03

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 5.3195 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | — | — |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

- (1) Is $Q_{BAR} < 2.0$ l/s/ha?
- (2) Are flow rates < 5.0 l/s?
- (3) Is $SPR/SPRHOST \leq 0.3$?

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 45.49 | 27.07 |
| 1 in 1 year (l/s) | 38.66 | 23.01 |
| 1 in 30 years (l/s) | 75.05 | 44.66 |
| 1 in 100 years (l/s) | 88.7 | 52.78 |

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Neighbourhood 5 (phase 5):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

Site coordinates

Latitude:

Longitude:

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074(A/TR)1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:

Date:

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 6.4618 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

(2) Are flow rates < 5.0 l/s?

(3) Is SPR/SPRHOST ≤ 0.3 ?

| Greenfield runoff rates | Default | Edited |
|-------------------------|---------|--------|
| Qbar (l/s) | 55.25 | 32.88 |
| 1 in 1 year (l/s) | 46.97 | 27.95 |
| 1 in 30 years (l/s) | 91.17 | 54.25 |
| 1 in 100 years (l/s) | 107.75 | 64.11 |

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Neighbourhood 6 (phase 6):



Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

Site coordinates

Latitude:

Longitude:

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/ATR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:

Date:

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|--------|
| Total site area (ha) | 1.9338 |
|----------------------|--------|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 4 | 3 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.47 | 0.37 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 1141 | 1141 |
| Hydrological region | 13 | 13 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 1.65 | 1.65 |
| Growth curve factor: 100 year | 1.95 | 1.95 |

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

(2) Are flow rates < 5.0 l/s?

(3) Is $SPR/SPRHOST \leq 0.3$?

Greenfield runoff rates

| | Default | Edited |
|----------------------|---------|--------|
| Qbar (l/s) | 16.54 | 9.84 |
| 1 in 1 year (l/s) | 14.06 | 8.36 |
| 1 in 30 years (l/s) | 27.28 | 16.24 |
| 1 in 100 years (l/s) | 32.24 | 19.19 |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEF, Hydro Solutions or any other organisation for use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX F: - Public Lighting

Public Lighting reports separated as follows:

1. Longview Estates Development – Main Distributor
2. Longview Estates Development – Estate Roads
3. Ballyhooly Road upgrade

DATE: 4 October 2019
DESIGNER: MHL & Associates
PROJECT No: 17066HD
PROJECT NAME: Longview Estae Public Lighting Report



Outdoor Lighting Report

PREPARED BY: MHL & Associates Ltd
Carraig Mor House,
Douglas Road,
Cork

Layout Report

General Data

Dimensions in Metres Angles in Degrees
Grid Origin 568758,4m x 574874,4m
Area 805,3m x 497,1m
Sample Spacing 4,97m x 4,97m

Luminaires



Luminaire D Data

| | |
|----------------------|---|
| Supplier | Philips |
| Type | BGP615_DW50_5000_20LED_5,1S_CLO_L9_0_NW |
| Lamp(s) | LED-HB 5,1S NW |
| Lamp Flux (klm) | 5,00 |
| File Name | Luma Micro_BGP615_DW50_5000_20LED_5,1S_CLO_L90_NW.ies |
| Maintenance Factor | 0,85 |
| Imax70,80,90(cd/klm) | 616,7, 39,5, 0,0 |
| No. in Project | 72 |

Layout

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 1 | D | 568779.95 | 575053.86 | 8.00 | 50.00 | 0.00 | 0.00 | 0.50 | | | |
| 2 | D | 568803.14 | 575052.89 | 8.00 | 217.00 | 0.00 | 0.00 | 0.50 | | | |
| 3 | D | 568807.31 | 575029.24 | 8.00 | 24.00 | 0.00 | 0.00 | 0.50 | | | |
| 4 | D | 568829.38 | 575011.45 | 8.00 | 198.00 | 0.00 | 0.00 | 0.50 | | | |
| 5 | D | 568829.80 | 574985.68 | 8.00 | 28.00 | 0.00 | 0.00 | 0.50 | | | |
| 6 | D | 568851.74 | 574967.05 | 8.00 | 207.00 | 0.00 | 0.00 | 0.50 | | | |
| 7 | D | 568855.20 | 574944.32 | 8.00 | 38.00 | 0.00 | 0.00 | 0.50 | | | |
| 8 | D | 568895.54 | 574927.43 | 8.00 | 97.00 | 0.00 | 0.00 | 0.50 | | | |
| 9 | D | 568915.22 | 574939.38 | 8.00 | 272.00 | 0.00 | 0.00 | 0.50 | | | |
| 10 | D | 568935.29 | 574929.62 | 8.00 | 98.00 | 0.00 | 0.00 | 0.50 | | | |
| 11 | D | 568955.13 | 574942.11 | 8.00 | 275.00 | 0.00 | 0.00 | 0.50 | | | |
| 12 | D | 568975.83 | 574932.27 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 13 | D | 568994.10 | 574948.59 | 8.00 | 306.00 | 0.00 | 0.00 | 0.50 | | | |
| 14 | D | 569021.67 | 574957.50 | 8.00 | 138.00 | 0.00 | 0.00 | 0.50 | | | |
| 15 | D | 569021.04 | 574982.02 | 8.00 | 340.00 | 0.00 | 0.00 | 0.50 | | | |
| 16 | D | 569033.29 | 575001.73 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 17 | D | 568989.45 | 575063.64 | 8.00 | 26.00 | 0.00 | 0.00 | 0.50 | | | |
| 18 | D | 569006.50 | 575082.13 | 8.00 | 206.00 | 0.00 | 0.00 | 0.50 | | | |
| 19 | D | 568979.83 | 575099.54 | 8.00 | 23.00 | 0.00 | 0.00 | 0.50 | | | |
| 20 | D | 568982.47 | 575120.89 | 8.00 | 204.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

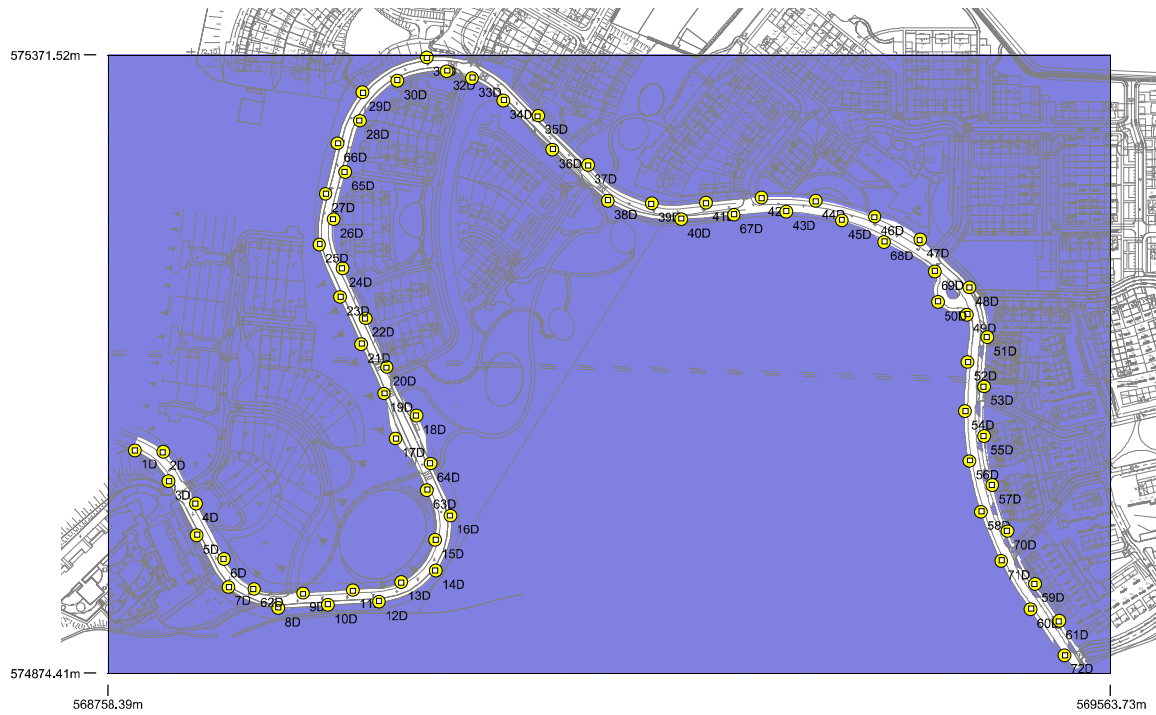
| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 21 | D | 568961.94 | 575139.36 | 8.00 | 30.00 | 0.00 | 0.00 | 0.50 | | | |
| 22 | D | 568965.08 | 575160.05 | 8.00 | 198.00 | 0.00 | 0.00 | 0.50 | | | |
| 23 | D | 568945.21 | 575177.20 | 8.00 | 29.00 | 0.00 | 0.00 | 0.50 | | | |
| 24 | D | 568946.94 | 575200.12 | 8.00 | 193.00 | 0.00 | 0.00 | 0.50 | | | |
| 25 | D | 568928.47 | 575219.58 | 8.00 | 13.00 | 0.00 | 0.00 | 0.50 | | | |
| 26 | D | 568939.93 | 575239.69 | 8.00 | 162.00 | 0.00 | 0.00 | 0.50 | | | |
| 27 | D | 568933.34 | 575259.97 | 8.00 | 345.00 | 0.00 | 0.00 | 0.50 | | | |
| 28 | D | 568960.61 | 575318.65 | 8.00 | 140.00 | 0.00 | 0.00 | 0.50 | | | |
| 29 | D | 568962.62 | 575341.53 | 8.00 | 325.00 | 0.00 | 0.00 | 0.50 | | | |
| 30 | D | 568991.38 | 575350.96 | 8.00 | 113.00 | 0.00 | 0.00 | 0.50 | | | |
| 31 | D | 569014.52 | 575369.27 | 8.00 | 268.00 | 0.00 | 0.00 | 0.50 | | | |
| 32 | D | 569030.47 | 575358.38 | 8.00 | 63.00 | 0.00 | 0.00 | 0.50 | | | |
| 33 | D | 569051.22 | 575352.72 | 8.00 | 72.00 | 0.00 | 0.00 | 0.50 | | | |
| 34 | D | 569075.95 | 575335.09 | 8.00 | 49.00 | 0.00 | 0.00 | 0.50 | | | |
| 35 | D | 569104.16 | 575322.83 | 8.00 | 219.00 | 0.00 | 0.00 | 0.50 | | | |
| 36 | D | 569115.40 | 575295.38 | 8.00 | 43.00 | 0.00 | 0.00 | 0.50 | | | |
| 37 | D | 569143.95 | 575283.21 | 8.00 | 236.00 | 0.00 | 0.00 | 0.50 | | | |
| 38 | D | 569159.81 | 575254.50 | 8.00 | 57.00 | 0.00 | 0.00 | 0.50 | | | |
| 39 | D | 569194.90 | 575252.15 | 8.00 | 252.00 | 0.00 | 0.00 | 0.50 | | | |
| 40 | D | 569218.82 | 575239.56 | 8.00 | 98.00 | 0.00 | 0.00 | 0.50 | | | |
| 41 | D | 569238.72 | 575252.74 | 8.00 | 274.00 | 0.00 | 0.00 | 0.50 | | | |
| 42 | D | 569283.13 | 575256.85 | 8.00 | 263.00 | 0.00 | 0.00 | 0.50 | | | |
| 43 | D | 569303.10 | 575245.86 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 44 | D | 569327.11 | 575254.50 | 8.00 | 259.00 | 0.00 | 0.00 | 0.50 | | | |
| 45 | D | 569347.59 | 575238.72 | 8.00 | 74.00 | 0.00 | 0.00 | 0.50 | | | |
| 46 | D | 569373.87 | 575241.74 | 8.00 | 262.00 | 0.00 | 0.00 | 0.50 | | | |
| 47 | D | 569410.60 | 575223.39 | 8.00 | 229.00 | 0.00 | 0.00 | 0.50 | | | |
| 48 | D | 569450.37 | 575185.02 | 8.00 | 210.00 | 0.00 | 0.00 | 0.50 | | | |
| 49 | D | 569448.32 | 575163.23 | 8.00 | 16.00 | 0.00 | 0.00 | 0.50 | | | |
| 50 | D | 569424.57 | 575173.20 | 8.00 | 45.00 | 0.00 | 0.00 | 0.50 | | | |
| 51 | D | 569464.56 | 575144.68 | 8.00 | 174.00 | 0.00 | 0.00 | 0.50 | | | |
| 52 | D | 569448.66 | 575125.28 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 53 | D | 569461.65 | 575105.36 | 8.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 54 | D | 569446.69 | 575085.70 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 55 | D | 569461.99 | 575065.62 | 8.00 | 182.00 | 0.00 | 0.00 | 0.50 | | | |
| 56 | D | 569450.03 | 575045.53 | 8.00 | 20.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 57 | D | 569468.49 | 575026.13 | 8.00 | 196.00 | 0.00 | 0.00 | 0.50 | | | |
| 58 | D | 569459.43 | 575005.02 | 8.00 | 15.00 | 0.00 | 0.00 | 0.50 | | | |
| 59 | D | 569502.96 | 574947.24 | 8.00 | 207.00 | 0.00 | 0.00 | 0.50 | | | |
| 60 | D | 569499.30 | 574926.42 | 8.00 | 38.00 | 0.00 | 0.00 | 0.50 | | | |
| 61 | D | 569522.05 | 574916.88 | 8.00 | 206.00 | 0.00 | 0.00 | 0.50 | | | |
| 62 | D | 568875.95 | 574943.23 | 8.00 | 234.00 | 0.00 | 0.00 | 0.50 | | | |
| 63 | D | 569014.57 | 575022.33 | 8.00 | 23.00 | 0.00 | 0.00 | 0.50 | | | |
| 64 | D | 569017.38 | 575043.53 | 8.00 | 199.00 | 0.00 | 0.00 | 0.50 | | | |
| 65 | D | 568949.02 | 575277.83 | 8.00 | 167.00 | 0.00 | 0.00 | 0.50 | | | |
| 66 | D | 568943.07 | 575300.52 | 8.00 | 339.00 | 0.00 | 0.00 | 0.50 | | | |
| 67 | D | 569261.22 | 575243.42 | 8.00 | 98.00 | 0.00 | 0.00 | 0.50 | | | |
| 68 | D | 569381.84 | 575221.60 | 8.00 | 58.00 | 0.00 | 0.00 | 0.50 | | | |
| 69 | D | 569422.14 | 575197.76 | 8.00 | 53.00 | 0.00 | 0.00 | 0.50 | | | |
| 70 | D | 569480.45 | 574989.18 | 8.00 | 205.00 | 0.00 | 0.00 | 0.50 | | | |
| 71 | D | 569475.68 | 574965.42 | 8.00 | 37.00 | 0.00 | 0.00 | 0.50 | | | |
| 72 | D | 569526.20 | 574889.66 | 8.00 | 23.00 | 0.00 | 0.00 | 0.50 | | | |

Horizontal Illuminance (lux)

Grid 1



Results

| | |
|-----------------------|-------|
| Eav | 7.64 |
| Emin | 2.43 |
| E _{max} | 11.15 |
| Emin/E _{max} | 0.22 |
| Emin/Eav | 0.32 |

Horizontal Illuminance (lux)

Grid 1



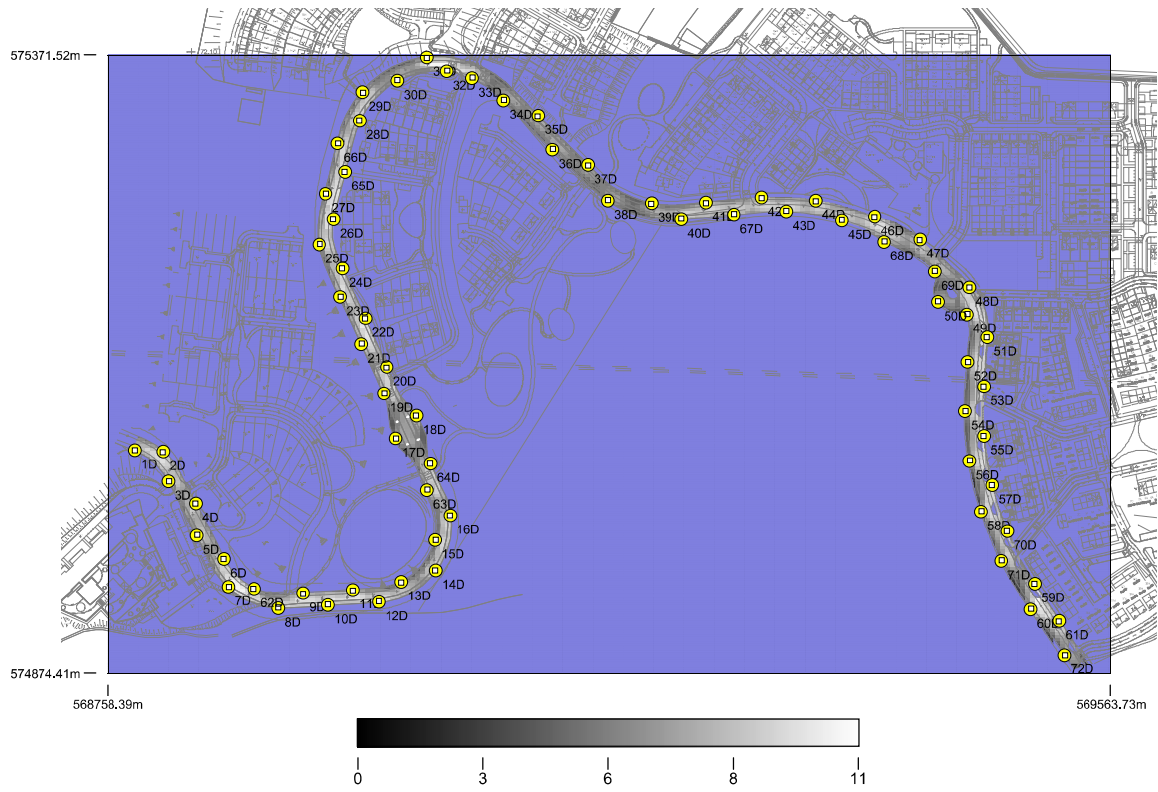
Horizontal Illuminance (lux)

Grid 1



Horizontal Illuminance (lux)

Grid 1



DATE: 2 October 2019
DESIGNER: MHL & Associates
PROJECT No: 17066HD
PROJECT NAME: Longview Estate Public Lighting



Outdoor Lighting Report

PREPARED BY: MHL & Associates Ltd
Carraig Mor House,
Douglas Road,
Cork

Layout Report

General Data

Dimensions in Metres Angles in Degrees

Calculation Grids

| ID | Grid Name | X | Y | X' Length | Y' Length | X' Spacing | Y' Spacing |
|----|-------------------------------|-----------|-----------|-----------|-----------|------------|------------|
| 1 | Neighborhood 6 | 568632.08 | 575002.54 | 185.54 | 176.32 | 4.88 | 4.90 |
| 2 | Neighborhood 1 | 568728.23 | 575182.93 | 303.66 | 186.74 | 4.98 | 4.91 |
| 3 | Neighborhood 4 | 568832.61 | 575361.18 | 334.74 | 206.72 | 5.00 | 4.92 |
| 4 | Neighborhood 2 | 569184.52 | 575194.63 | 449.66 | 234.95 | 5.00 | 4.89 |
| 5 | Neighborhood 5 | 569452.25 | 574882.93 | 264.45 | 311.75 | 4.99 | 4.95 |
| 6 | Isolated Paths | 568952.74 | 575147.45 | 134.17 | 251.43 | 4.97 | 4.93 |
| 7 | Neighborhood 6 Internal Pa... | 568698.08 | 574868.68 | 141.76 | 67.96 | 4.89 | 4.85 |
| 8 | Isolated Paths 2 | 568884.37 | 574924.75 | 167.00 | 96.60 | 4.91 | 4.83 |
| 9 | Isolated Path 3 | 569014.23 | 575375.10 | 52.88 | 125.25 | 4.81 | 4.82 |
| 10 | Isolated Path 4 | 569177.89 | 575256.57 | 159.39 | 46.69 | 4.98 | 4.67 |
| 11 | Isolated Path 5 | 569406.30 | 575188.88 | 116.01 | 148.04 | 4.83 | 4.93 |
| 12 | Neighborhood 3 | 568854.71 | 575216.63 | 206.31 | 230.22 | 4.91 | 4.90 |
| 13 | Neighborhood 5 Internal 1 | 569529.59 | 574869.42 | 188.46 | 13.09 | 4.96 | 4.36 |
| 14 | Neighborhood 5 Internal 2 | 569564.77 | 575039.21 | 84.09 | 35.19 | 4.95 | 4.40 |

Luminaires



Luminaire A Data

| | |
|----------------------|---|
| Supplier | Philips |
| Type | BGP615_DW50_3400_20LED_5.1S_CLO_L90_NW |
| Lamp(s) | LED-HB 5.1S NW |
| Lamp Flux (klm) | 3.40 |
| File Name | Luma Micro_BGP615_DW50_3400_20LED_5.1S_CLO_L90_NW.ies |
| Maintenance Factor | 0.85 |
| Imax70,80,90(cd/klm) | 616.7, 39.5, 0.0 |
| No. in Project | 243 |



Luminaire B Data

| | |
|----------------------|--|
| Supplier | Philips |
| Type | BGP615_DW50_1400_6LED_5.1S_CLO_L90_NW |
| Lamp(s) | LED-HB 5.1S NW |
| Lamp Flux (klm) | 1.40 |
| File Name | Luma Micro_BGP615_DW50_1400_6LED_5.1S_CLO_L90_NW.ies |
| Maintenance Factor | 0.85 |
| Imax70,80,90(cd/klm) | 616.7, 39.5, 0.0 |
| No. in Project | 65 |

Layout

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 1 | A | 568830.71 | 574950.64 | 8.00 | 108.00 | 0.00 | 0.00 | 0.50 | | | |
| 2 | A | 568825.67 | 574973.38 | 8.00 | 206.00 | 0.00 | 0.00 | 0.50 | | | |
| 3 | A | 568807.69 | 574993.64 | 8.00 | 24.00 | 0.00 | 0.00 | 0.50 | | | |
| 4 | A | 568802.47 | 575019.65 | 8.00 | 210.00 | 0.00 | 0.00 | 0.50 | | | |
| 5 | A | 568777.54 | 575018.06 | 8.00 | 113.00 | 0.00 | 0.00 | 0.50 | | | |
| 6 | A | 568755.57 | 575008.20 | 8.00 | 317.00 | 0.00 | 0.00 | 0.50 | | | |
| 7 | A | 568740.94 | 574984.69 | 8.00 | 139.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 8 | A | 568717.72 | 574971.73 | 8.00 | 315.00 | 0.00 | 0.00 | 0.50 | | | |
| 9 | A | 568703.93 | 574947.71 | 8.00 | 147.00 | 0.00 | 0.00 | 0.50 | | | |
| 10 | A | 568685.49 | 574923.31 | 8.00 | 352.00 | 0.00 | 0.00 | 0.50 | | | |
| 11 | A | 568696.52 | 574908.36 | 8.00 | 108.00 | 0.00 | 0.00 | 0.50 | | | |
| 12 | A | 568793.04 | 575003.04 | 8.00 | 312.00 | 0.00 | 0.00 | 0.50 | | | |
| 13 | A | 568830.35 | 575022.50 | 8.00 | 124.00 | 0.00 | 0.00 | 0.50 | | | |
| 14 | A | 568842.65 | 575045.21 | 8.00 | 331.00 | 0.00 | 0.00 | 0.50 | | | |
| 15 | A | 568857.25 | 575064.59 | 8.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 16 | A | 568846.06 | 575096.58 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 17 | A | 568855.83 | 575120.07 | 8.00 | 173.00 | 0.00 | 0.00 | 0.50 | | | |
| 18 | A | 568851.49 | 575146.11 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 19 | A | 568867.33 | 575169.03 | 8.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 20 | A | 568857.78 | 575197.01 | 8.00 | 356.00 | 0.00 | 0.00 | 0.50 | | | |
| 21 | A | 568873.14 | 575221.35 | 8.00 | 127.00 | 0.00 | 0.00 | 0.50 | | | |
| 22 | A | 568892.29 | 575229.47 | 8.00 | 266.00 | 0.00 | 0.00 | 0.50 | | | |
| 23 | A | 568915.89 | 575225.92 | 8.00 | 179.00 | 0.00 | 0.00 | 0.50 | | | |
| 24 | A | 568849.93 | 575025.65 | 8.00 | 215.00 | 0.00 | 0.00 | 0.50 | | | |
| 25 | A | 568849.93 | 574994.92 | 8.00 | 64.00 | 0.00 | 0.00 | 0.50 | | | |
| 26 | A | 568839.57 | 575084.43 | 8.00 | 266.00 | 0.00 | 0.00 | 0.50 | | | |
| 27 | A | 568816.85 | 575080.01 | 8.00 | 95.00 | 0.00 | 0.00 | 0.50 | | | |
| 28 | A | 568862.38 | 575094.02 | 8.00 | 264.00 | 0.00 | 0.00 | 0.50 | | | |
| 29 | A | 568914.71 | 575065.56 | 8.00 | 66.00 | 0.00 | 0.00 | 0.60 | | | |
| 30 | A | 568931.63 | 575055.67 | 8.00 | 211.00 | 0.00 | 0.00 | 0.50 | | | |
| 31 | A | 568928.67 | 575030.33 | 8.00 | 14.00 | 0.00 | 0.00 | 0.50 | | | |
| 32 | A | 568935.70 | 575006.52 | 8.00 | 155.00 | 0.00 | 0.00 | 0.50 | | | |
| 33 | A | 568916.98 | 574993.64 | 8.00 | 338.00 | 0.00 | 0.00 | 0.50 | | | |
| 34 | A | 568914.64 | 574965.93 | 8.00 | 169.00 | 0.00 | 0.00 | 0.50 | | | |
| 35 | A | 568870.69 | 575111.68 | 8.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 36 | A | 568832.99 | 575134.97 | 8.00 | 89.00 | 0.00 | 0.00 | 0.50 | | | |
| 37 | A | 568891.30 | 575161.61 | 8.00 | 259.00 | 0.00 | 0.00 | 0.50 | | | |
| 38 | A | 568914.50 | 575148.07 | 8.00 | 85.00 | 0.00 | 0.00 | 0.50 | | | |
| 39 | A | 568842.22 | 575213.25 | 8.00 | 267.00 | 0.00 | 0.00 | 0.50 | | | |
| 40 | A | 568902.06 | 574941.70 | 8.00 | 9.00 | 0.00 | 0.00 | 0.50 | | | |
| 41 | A | 568900.68 | 575088.38 | 8.00 | 250.00 | 0.00 | 0.00 | 0.50 | | | |
| 42 | A | 568877.34 | 575081.29 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 43 | A | 568870.15 | 575137.08 | 8.00 | 217.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 44 | A | 568918.02 | 575168.31 | 8.00 | 210.00 | 0.00 | 0.00 | 0.50 | | | |
| 45 | A | 568844.97 | 575426.87 | 8.00 | 81.00 | 0.00 | 0.00 | 0.50 | | | |
| 46 | A | 568862.17 | 575440.15 | 8.00 | 322.00 | 0.00 | 0.00 | 0.50 | | | |
| 47 | A | 568869.73 | 575459.46 | 8.00 | 172.00 | 0.00 | 0.00 | 0.50 | | | |
| 48 | A | 568866.77 | 575484.13 | 8.00 | 328.00 | 0.00 | 0.00 | 0.50 | | | |
| 49 | A | 568895.14 | 575490.47 | 8.00 | 100.00 | 0.00 | 0.00 | 0.50 | | | |
| 50 | A | 568920.22 | 575496.97 | 8.00 | 264.00 | 0.00 | 0.00 | 0.50 | | | |
| 51 | A | 568943.07 | 575481.15 | 8.00 | 67.00 | 0.00 | 0.00 | 0.50 | | | |
| 52 | A | 568969.17 | 575483.02 | 8.00 | 253.00 | 0.00 | 0.00 | 0.50 | | | |
| 53 | A | 568993.40 | 575478.76 | 8.00 | 265.00 | 0.00 | 0.00 | 0.50 | | | |
| 54 | A | 569015.71 | 575467.69 | 8.00 | 82.00 | 0.00 | 0.00 | 0.50 | | | |
| 55 | A | 569047.22 | 575471.20 | 8.00 | 253.00 | 0.00 | 0.00 | 0.50 | | | |
| 56 | A | 569070.78 | 575461.46 | 8.00 | 106.00 | 0.00 | 0.00 | 0.50 | | | |
| 57 | A | 569084.77 | 575485.26 | 8.00 | 327.00 | 0.00 | 0.00 | 0.50 | | | |
| 58 | A | 569103.60 | 575503.79 | 8.00 | 154.00 | 0.00 | 0.00 | 0.50 | | | |
| 59 | A | 569105.79 | 575528.98 | 8.00 | 326.00 | 0.00 | 0.00 | 0.50 | | | |
| 60 | A | 568912.66 | 575473.84 | 8.00 | 314.00 | 0.00 | 0.00 | 0.50 | | | |
| 61 | A | 568905.84 | 575453.74 | 8.00 | 140.00 | 0.00 | 0.00 | 0.50 | | | |
| 62 | A | 568881.54 | 575436.19 | 8.00 | 337.00 | 0.00 | 0.00 | 0.50 | | | |
| 63 | A | 568875.74 | 575411.30 | 8.00 | 155.00 | 0.00 | 0.00 | 0.50 | | | |
| 64 | A | 568858.27 | 575390.03 | 8.00 | 339.00 | 0.00 | 0.00 | 0.50 | | | |
| 65 | A | 568862.71 | 575365.64 | 8.00 | 166.00 | 0.00 | 0.00 | 0.50 | | | |
| 66 | A | 568992.43 | 575453.98 | 8.00 | 163.00 | 0.00 | 0.00 | 0.50 | | | |
| 67 | A | 568971.15 | 575433.72 | 8.00 | 330.00 | 0.00 | 0.00 | 0.50 | | | |
| 68 | A | 568961.07 | 575408.51 | 8.00 | 145.00 | 0.00 | 0.00 | 0.50 | | | |
| 69 | A | 568936.40 | 575392.15 | 8.00 | 338.00 | 0.00 | 0.00 | 0.50 | | | |
| 70 | A | 568941.36 | 575368.14 | 8.00 | 173.00 | 0.00 | 0.00 | 0.50 | | | |
| 71 | A | 568983.48 | 575413.35 | 8.00 | 235.00 | 0.00 | 0.00 | 0.50 | | | |
| 72 | A | 569010.95 | 575384.33 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 73 | A | 569058.12 | 575366.13 | 8.00 | 154.00 | 0.00 | 0.00 | 0.50 | | | |
| 74 | A | 569059.07 | 575391.67 | 8.00 | 337.00 | 0.00 | 0.00 | 0.50 | | | |
| 75 | A | 569077.18 | 575406.58 | 8.00 | 147.00 | 0.00 | 0.00 | 0.50 | | | |
| 76 | A | 569083.99 | 575428.85 | 8.00 | 322.00 | 0.00 | 0.00 | 0.50 | | | |
| 77 | A | 569103.24 | 575442.60 | 8.00 | 155.00 | 0.00 | 0.00 | 0.50 | | | |
| 78 | A | 569105.92 | 575411.96 | 8.00 | 246.00 | 0.00 | 0.00 | 0.50 | | | |
| 79 | A | 569125.41 | 575390.73 | 8.00 | 52.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 80 | A | 569151.73 | 575387.19 | 8.00 | 155.00 | 0.00 | 0.00 | 0.50 | | | |
| 81 | A | 569153.41 | 575412.70 | 8.00 | 331.00 | 0.00 | 0.00 | 0.50 | | | |
| 82 | A | 569170.74 | 575425.53 | 8.00 | 151.00 | 0.00 | 0.00 | 0.50 | | | |
| 83 | A | 569127.37 | 575366.84 | 8.00 | 330.00 | 0.00 | 0.00 | 0.50 | | | |
| 84 | A | 569126.96 | 575344.64 | 8.00 | 142.00 | 0.00 | 0.00 | 0.50 | | | |
| 85 | A | 569027.35 | 575406.79 | 8.00 | 254.00 | 0.00 | 0.00 | 0.50 | | | |
| 86 | A | 569112.42 | 575336.15 | 8.00 | 64.00 | 0.00 | 0.00 | 0.50 | | | |
| 87 | A | 569102.95 | 575468.38 | 8.00 | 321.00 | 0.00 | 0.00 | 0.50 | | | |
| 88 | A | 568927.66 | 575358.69 | 8.00 | 79.00 | 0.00 | 0.00 | 0.50 | | | |
| 89 | A | 569000.13 | 575397.46 | 8.00 | 78.00 | 0.00 | 0.00 | 0.50 | | | |
| 90 | A | 569178.28 | 575443.86 | 8.00 | 242.00 | 0.00 | 0.00 | 0.50 | | | |
| 91 | A | 569266.96 | 575258.89 | 8.00 | 8.00 | 0.00 | 0.00 | 0.50 | | | |
| 92 | A | 569284.68 | 575276.12 | 8.00 | 136.00 | 0.00 | 0.00 | 0.50 | | | |
| 93 | A | 569278.79 | 575298.81 | 8.00 | 311.00 | 0.00 | 0.00 | 0.50 | | | |
| 94 | A | 569310.39 | 575307.39 | 8.00 | 155.00 | 0.00 | 0.00 | 0.50 | | | |
| 95 | A | 569307.95 | 575331.06 | 8.00 | 50.00 | 0.00 | 0.00 | 0.50 | | | |
| 96 | A | 569300.80 | 575358.64 | 8.00 | 227.00 | 0.00 | 0.00 | 0.50 | | | |
| 97 | A | 569270.17 | 575353.97 | 8.00 | 53.00 | 0.00 | 0.00 | 0.50 | | | |
| 98 | A | 569279.87 | 575403.84 | 8.00 | 323.00 | 0.00 | 0.00 | 0.50 | | | |
| 99 | A | 569305.31 | 575421.52 | 8.00 | 160.00 | 0.00 | 0.00 | 0.50 | | | |
| 100 | A | 569260.11 | 575378.44 | 8.00 | 331.00 | 0.00 | 0.00 | 0.50 | | | |
| 101 | A | 569248.24 | 575351.76 | 8.00 | 141.00 | 0.00 | 0.00 | 0.50 | | | |
| 102 | A | 569224.83 | 575335.10 | 8.00 | 322.00 | 0.00 | 0.00 | 0.50 | | | |
| 103 | A | 569210.70 | 575305.38 | 8.00 | 149.00 | 0.00 | 0.00 | 0.50 | | | |
| 104 | A | 569187.17 | 575284.30 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 105 | A | 569434.02 | 575211.21 | 8.00 | 137.00 | 0.00 | 0.00 | 0.50 | | | |
| 106 | A | 569436.51 | 575234.34 | 8.00 | 337.00 | 0.00 | 0.00 | 0.50 | | | |
| 107 | A | 569450.92 | 575253.54 | 8.00 | 181.00 | 0.00 | 0.00 | 0.50 | | | |
| 108 | A | 569435.33 | 575278.96 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 109 | A | 569452.09 | 575302.70 | 8.00 | 179.00 | 0.00 | 0.00 | 0.50 | | | |
| 110 | A | 569438.90 | 575323.73 | 8.00 | 239.00 | 0.00 | 0.00 | 0.50 | | | |
| 111 | A | 569477.13 | 575317.92 | 8.00 | 269.00 | 0.00 | 0.00 | 0.50 | | | |
| 112 | A | 569505.06 | 575308.07 | 8.00 | 73.00 | 0.00 | 0.00 | 0.50 | | | |
| 113 | A | 569412.60 | 575309.05 | 8.00 | 100.00 | 0.00 | 0.00 | 0.50 | | | |
| 114 | A | 569385.39 | 575326.49 | 8.00 | 354.00 | 0.00 | 0.00 | 0.50 | | | |
| 115 | A | 569375.68 | 575309.22 | 8.00 | 86.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 116 | A | 569399.32 | 575342.68 | 8.00 | 182.00 | 0.00 | 0.00 | 0.50 | | | |
| 117 | A | 569390.47 | 575368.55 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 118 | A | 569373.17 | 575363.58 | 8.00 | 51.00 | 0.00 | 0.00 | 0.50 | | | |
| 119 | A | 569363.73 | 575386.82 | 8.00 | 222.00 | 0.00 | 0.00 | 0.50 | | | |
| 120 | A | 569341.53 | 575394.77 | 8.00 | 82.00 | 0.00 | 0.00 | 0.50 | | | |
| 121 | A | 569464.30 | 575226.61 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 122 | A | 569490.65 | 575226.73 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 123 | A | 569468.28 | 575325.45 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 124 | A | 569456.94 | 575351.60 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 125 | A | 569467.52 | 575377.28 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 126 | A | 569531.69 | 575318.47 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 127 | A | 569556.74 | 575308.59 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 128 | A | 569586.89 | 575314.62 | 8.00 | 192.00 | 0.00 | 0.00 | 0.50 | | | |
| 129 | A | 569574.90 | 575338.11 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 130 | A | 569572.70 | 575302.89 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 131 | A | 569591.62 | 575281.57 | 8.00 | 181.00 | 0.00 | 0.00 | 0.50 | | | |
| 132 | A | 569572.56 | 575257.99 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 133 | A | 569591.78 | 575239.21 | 8.00 | 178.00 | 0.00 | 0.00 | 0.50 | | | |
| 134 | A | 569572.64 | 575213.94 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 135 | A | 569592.69 | 575196.79 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 136 | A | 569601.25 | 575237.37 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 137 | A | 569567.50 | 575234.99 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 138 | A | 569539.41 | 575227.11 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 139 | A | 569522.07 | 575236.69 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 140 | A | 569508.08 | 575258.67 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 141 | A | 569522.45 | 575284.84 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 142 | A | 569504.22 | 575211.49 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 143 | A | 569522.39 | 575197.64 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 144 | A | 569509.17 | 575323.75 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 145 | A | 569625.10 | 575225.54 | 8.00 | 91.00 | 0.00 | 0.00 | 0.50 | | | |
| 146 | A | 569354.18 | 575318.52 | 8.00 | 327.00 | 0.00 | 0.00 | 0.50 | | | |
| 147 | A | 569572.71 | 575282.17 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 148 | A | 569591.84 | 575257.97 | 8.00 | 180.00 | 0.00 | 0.00 | 0.50 | | | |
| 149 | A | 569516.92 | 575334.46 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 150 | A | 569587.59 | 575348.34 | 8.00 | 151.00 | 0.00 | 0.00 | 0.50 | | | |
| 151 | A | 569393.62 | 575382.59 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 152 | A | 569360.90 | 575401.91 | 8.00 | 228.00 | 0.00 | 0.00 | 0.50 | | | |
| 153 | A | 569286.11 | 575420.15 | 8.00 | 319.00 | 0.00 | 0.00 | 0.50 | | | |
| 154 | A | 569282.85 | 575373.27 | 8.00 | 228.00 | 0.00 | 0.00 | 0.50 | | | |
| 155 | A | 569459.63 | 575183.26 | 8.00 | 268.00 | 0.00 | 0.00 | 0.50 | | | |
| 156 | A | 569485.76 | 575174.33 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 157 | A | 569510.03 | 575182.28 | 8.00 | 270.00 | 0.00 | 0.00 | 0.50 | | | |
| 158 | A | 569534.53 | 575183.31 | 8.00 | 273.00 | 0.00 | 0.00 | 0.50 | | | |
| 159 | A | 569561.08 | 575174.79 | 8.00 | 104.00 | 0.00 | 0.00 | 0.50 | | | |
| 160 | A | 569582.02 | 575194.44 | 8.00 | 288.00 | 0.00 | 0.00 | 0.50 | | | |
| 161 | A | 569602.96 | 575182.21 | 8.00 | 36.00 | 0.00 | 0.00 | 0.50 | | | |
| 162 | A | 569620.62 | 575162.92 | 8.00 | 196.00 | 0.00 | 0.00 | 0.50 | | | |
| 163 | A | 569617.17 | 575139.52 | 8.00 | 19.00 | 0.00 | 0.00 | 0.50 | | | |
| 164 | A | 569634.53 | 575120.11 | 8.00 | 196.00 | 0.00 | 0.00 | 0.50 | | | |
| 165 | A | 569629.01 | 575102.90 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 166 | A | 569615.43 | 575084.90 | 8.00 | 107.00 | 0.00 | 0.00 | 0.50 | | | |
| 167 | A | 569588.94 | 575086.71 | 8.00 | 281.00 | 0.00 | 0.00 | 0.50 | | | |
| 168 | A | 569565.15 | 575073.42 | 8.00 | 109.00 | 0.00 | 0.00 | 0.50 | | | |
| 169 | A | 569539.10 | 575075.52 | 8.00 | 285.00 | 0.00 | 0.00 | 0.50 | | | |
| 170 | A | 569512.77 | 575066.96 | 8.00 | 68.00 | 0.00 | 0.00 | 0.50 | | | |
| 171 | A | 569496.59 | 575086.69 | 8.00 | 242.00 | 0.00 | 0.00 | 0.50 | | | |
| 172 | A | 569469.80 | 575087.05 | 8.00 | 63.00 | 0.00 | 0.00 | 0.50 | | | |
| 173 | A | 569487.48 | 575099.39 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 174 | A | 569506.14 | 575117.49 | 8.00 | 177.00 | 0.00 | 0.00 | 0.50 | | | |
| 175 | A | 569557.88 | 575092.82 | 8.00 | 21.00 | 0.00 | 0.00 | 0.50 | | | |
| 176 | A | 569559.08 | 575117.52 | 8.00 | 195.00 | 0.00 | 0.00 | 0.50 | | | |
| 177 | A | 569552.13 | 575138.61 | 8.00 | 190.00 | 0.00 | 0.00 | 0.50 | | | |
| 178 | A | 569535.33 | 575159.70 | 8.00 | 15.00 | 0.00 | 0.00 | 0.50 | | | |
| 179 | A | 569548.04 | 575062.87 | 8.00 | 6.00 | 0.00 | 0.00 | 0.50 | | | |
| 180 | A | 569565.13 | 575040.51 | 8.00 | 189.00 | 0.00 | 0.00 | 0.50 | | | |
| 181 | A | 569644.87 | 575081.92 | 8.00 | 182.00 | 0.00 | 0.00 | 0.50 | | | |
| 182 | A | 569649.74 | 575060.43 | 8.00 | 191.00 | 0.00 | 0.00 | 0.50 | | | |
| 183 | A | 569489.32 | 575070.28 | 8.00 | 10.00 | 0.00 | 0.00 | 0.50 | | | |
| 184 | A | 569515.38 | 575043.53 | 8.00 | 189.00 | 0.00 | 0.00 | 0.50 | | | |
| 185 | A | 569501.48 | 575016.47 | 8.00 | 12.00 | 0.00 | 0.00 | 0.50 | | | |
| 186 | A | 569495.61 | 574973.29 | 8.00 | 135.00 | 0.00 | 0.00 | 0.50 | | | |
| 187 | A | 569507.88 | 575005.73 | 8.00 | 318.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 188 | A | 569537.47 | 575024.24 | 8.00 | 126.00 | 0.00 | 0.00 | 0.50 | | | |
| 189 | A | 569557.91 | 575027.47 | 8.00 | 26.00 | 0.00 | 0.00 | 0.50 | | | |
| 190 | A | 569584.14 | 575043.46 | 8.00 | 290.00 | 0.00 | 0.00 | 0.50 | | | |
| 191 | A | 569610.96 | 575040.80 | 8.00 | 103.00 | 0.00 | 0.00 | 0.50 | | | |
| 192 | A | 569634.25 | 575054.82 | 8.00 | 284.00 | 0.00 | 0.00 | 0.50 | | | |
| 193 | A | 569648.63 | 575033.16 | 8.00 | 25.00 | 0.00 | 0.00 | 0.50 | | | |
| 194 | A | 569665.99 | 575013.85 | 8.00 | 198.00 | 0.00 | 0.00 | 0.50 | | | |
| 195 | A | 569663.15 | 574988.49 | 6.00 | 14.00 | 0.00 | 0.00 | 1.00 | | | |
| 196 | A | 569684.45 | 574959.43 | 8.00 | 172.00 | 0.00 | 0.00 | 0.50 | | | |
| 197 | A | 569659.12 | 574951.54 | 8.00 | 281.00 | 0.00 | 0.00 | 0.50 | | | |
| 198 | A | 569637.26 | 574938.52 | 8.00 | 122.00 | 0.00 | 0.00 | 0.50 | | | |
| 199 | A | 569618.62 | 574924.85 | 8.00 | 130.00 | 0.00 | 0.00 | 0.50 | | | |
| 200 | A | 569595.79 | 574919.17 | 8.00 | 304.00 | 0.00 | 0.00 | 0.50 | | | |
| 201 | A | 569578.02 | 574900.57 | 8.00 | 125.00 | 0.00 | 0.00 | 0.50 | | | |
| 202 | A | 569554.54 | 574901.43 | 8.00 | 279.00 | 0.00 | 0.00 | 0.50 | | | |
| 203 | A | 569604.70 | 574939.92 | 8.00 | 35.00 | 0.00 | 0.00 | 0.50 | | | |
| 204 | A | 569597.11 | 574965.39 | 8.00 | 208.00 | 0.00 | 0.00 | 0.50 | | | |
| 205 | A | 569572.59 | 574988.15 | 8.00 | 23.00 | 0.00 | 0.00 | 0.50 | | | |
| 206 | A | 569567.36 | 575014.14 | 8.00 | 184.00 | 0.00 | 0.00 | 0.50 | | | |
| 207 | A | 569606.82 | 574979.70 | 8.00 | 184.00 | 0.00 | 0.00 | 0.50 | | | |
| 208 | A | 569572.55 | 574974.55 | 8.00 | 279.00 | 0.00 | 0.00 | 0.50 | | | |
| 209 | A | 569550.94 | 574962.28 | 8.00 | 106.00 | 0.00 | 0.00 | 0.50 | | | |
| 210 | A | 569536.98 | 574975.15 | 8.00 | 210.00 | 0.00 | 0.00 | 0.50 | | | |
| 211 | A | 569558.12 | 574945.83 | 8.00 | 201.00 | 0.00 | 0.00 | 0.50 | | | |
| 212 | A | 568991.68 | 575112.74 | 8.00 | 109.00 | 0.00 | 0.00 | 0.50 | | | |
| 213 | A | 569013.89 | 575130.49 | 8.00 | 295.00 | 0.00 | 0.00 | 0.50 | | | |
| 214 | A | 569037.94 | 575139.63 | 8.00 | 152.00 | 0.00 | 0.00 | 0.50 | | | |
| 215 | A | 569029.74 | 575162.22 | 8.00 | 16.00 | 0.00 | 0.00 | 0.50 | | | |
| 216 | A | 569027.93 | 575198.39 | 8.00 | 193.00 | 0.00 | 0.00 | 0.50 | | | |
| 217 | A | 569017.83 | 575229.43 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 218 | A | 569025.78 | 575257.65 | 8.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 219 | A | 569022.00 | 575285.45 | 8.00 | 344.00 | 0.00 | 0.00 | 0.50 | | | |
| 220 | A | 569034.94 | 575306.60 | 8.00 | 165.00 | 0.00 | 0.00 | 0.50 | | | |
| 221 | A | 569032.13 | 575331.27 | 8.00 | 39.00 | 0.00 | 0.00 | 0.50 | | | |
| 222 | A | 569048.31 | 575347.18 | 8.00 | 161.00 | 0.00 | 0.00 | 0.50 | | | |
| 223 | A | 569017.13 | 575345.30 | 8.00 | 244.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 224 | A | 569005.83 | 575205.46 | 8.00 | 283.00 | 0.00 | 0.00 | 0.50 | | | |
| 225 | A | 568978.71 | 575188.48 | 8.00 | 109.00 | 0.00 | 0.00 | 0.50 | | | |
| 226 | A | 569002.94 | 575267.18 | 8.00 | 86.00 | 0.00 | 0.00 | 0.50 | | | |
| 227 | A | 568978.22 | 575285.72 | 8.00 | 258.00 | 0.00 | 0.00 | 0.50 | | | |
| 228 | A | 569135.97 | 575270.40 | 8.00 | 312.00 | 0.00 | 0.00 | 0.50 | | | |
| 229 | A | 569126.74 | 575242.31 | 8.00 | 153.00 | 0.00 | 0.00 | 0.50 | | | |
| 230 | A | 569114.14 | 575222.82 | 8.00 | 145.00 | 0.00 | 0.00 | 0.50 | | | |
| 231 | A | 569098.10 | 575203.56 | 8.00 | 143.00 | 0.00 | 0.00 | 0.50 | | | |
| 232 | A | 569074.58 | 575192.40 | 8.00 | 321.00 | 0.00 | 0.00 | 0.50 | | | |
| 233 | A | 569063.29 | 575172.98 | 8.00 | 45.00 | 0.00 | 0.00 | 0.50 | | | |
| 234 | A | 569072.72 | 575225.32 | 8.00 | 233.00 | 0.00 | 0.00 | 0.50 | | | |
| 235 | A | 569049.52 | 575226.06 | 8.00 | 94.00 | 0.00 | 0.00 | 0.50 | | | |
| 236 | A | 569113.45 | 575279.87 | 8.00 | 226.00 | 0.00 | 0.00 | 0.50 | | | |
| 237 | A | 569091.63 | 575288.24 | 8.00 | 52.00 | 0.00 | 0.00 | 0.50 | | | |
| 238 | A | 569074.34 | 575311.36 | 8.00 | 224.00 | 0.00 | 0.00 | 0.50 | | | |
| 239 | A | 568962.86 | 575273.22 | 8.00 | 82.00 | 0.00 | 0.00 | 0.50 | | | |
| 240 | A | 569056.93 | 575313.57 | 8.00 | 338.00 | 0.00 | 0.00 | 0.50 | | | |
| 241 | A | 568995.07 | 575342.73 | 8.00 | 71.00 | 0.00 | 0.00 | 0.50 | | | |
| 242 | A | 569077.11 | 575207.76 | 8.00 | 52.00 | 0.00 | 0.00 | 0.50 | | | |
| 243 | A | 569031.66 | 575179.82 | 8.00 | 200.00 | 0.00 | 0.00 | 0.50 | | | |
| 244 | B | 569027.86 | 575043.77 | 8.00 | 165.00 | 0.00 | 0.00 | 0.50 | | | |
| 245 | B | 569036.26 | 575068.24 | 8.00 | 297.00 | 0.00 | 0.00 | 0.50 | | | |
| 246 | B | 569066.15 | 575063.55 | 8.00 | 90.00 | 0.00 | 0.00 | 0.50 | | | |
| 247 | B | 569090.29 | 575081.24 | 8.00 | 324.00 | 0.00 | 0.00 | 0.50 | | | |
| 248 | B | 569101.45 | 575104.22 | 8.00 | 172.00 | 0.00 | 0.00 | 0.50 | | | |
| 249 | B | 569096.73 | 575135.47 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 250 | B | 569102.57 | 575171.85 | 8.00 | 168.00 | 0.00 | 0.00 | 0.50 | | | |
| 251 | B | 569110.71 | 575200.94 | 8.00 | 329.00 | 0.00 | 0.00 | 0.50 | | | |
| 252 | B | 569133.67 | 575224.14 | 8.00 | 131.00 | 0.00 | 0.00 | 0.50 | | | |
| 253 | B | 569154.66 | 575235.88 | 8.00 | 335.00 | 0.00 | 0.00 | 0.50 | | | |
| 254 | B | 569151.21 | 575255.87 | 8.00 | 175.00 | 0.00 | 0.00 | 0.50 | | | |
| 255 | B | 569151.21 | 575194.10 | 8.00 | 105.00 | 0.00 | 0.00 | 0.50 | | | |
| 256 | B | 569127.29 | 575182.92 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 257 | B | 569177.04 | 575208.47 | 8.00 | 312.00 | 0.00 | 0.00 | 0.50 | | | |
| 258 | B | 569108.90 | 575156.66 | 8.00 | 196.00 | 0.00 | 0.00 | 0.50 | | | |
| 259 | B | 569021.97 | 575091.19 | 8.00 | 215.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

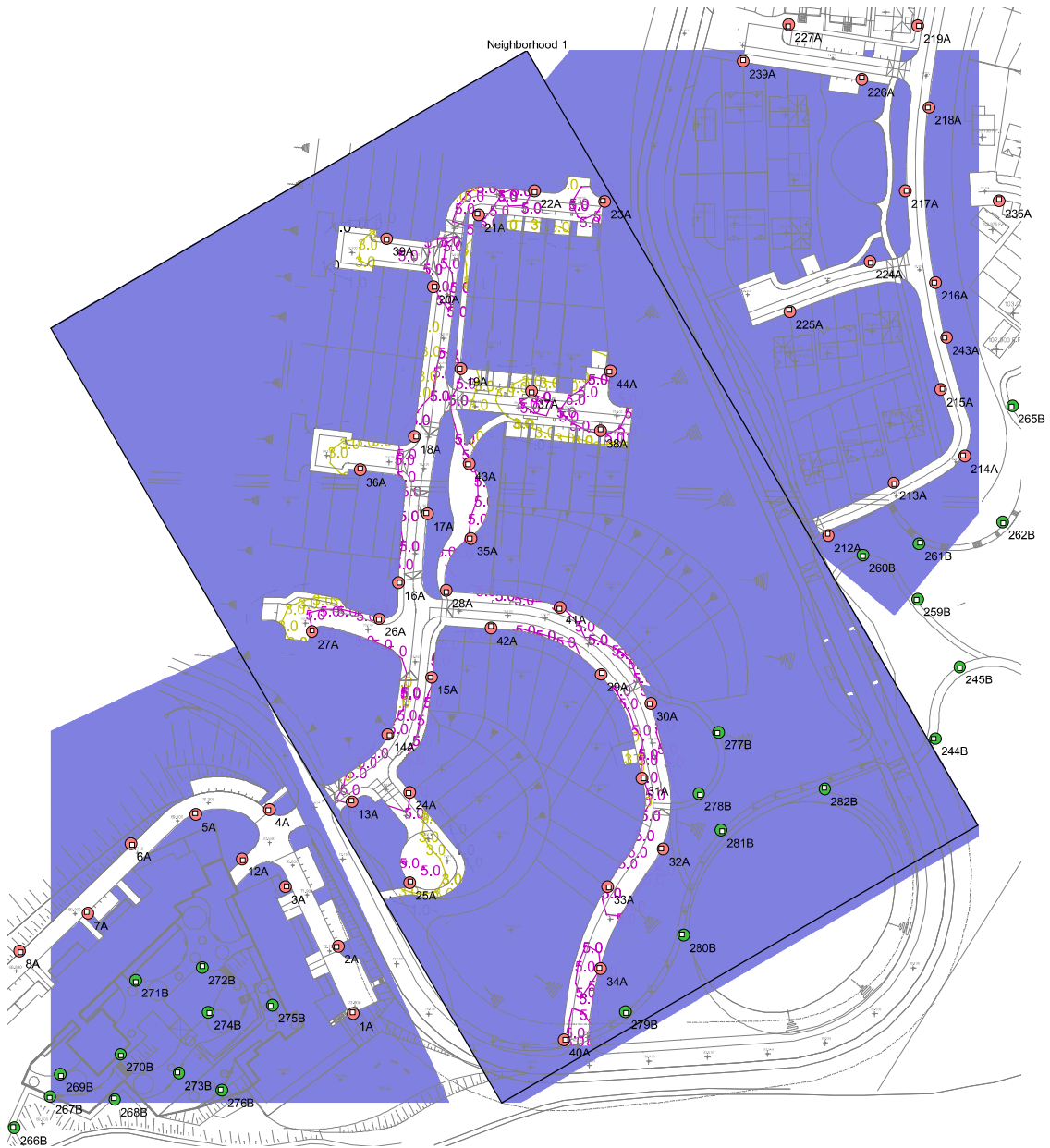
| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 260 | B | 569003.43 | 575105.98 | 8.00 | 274.00 | 0.00 | 0.00 | 0.50 | | | |
| 261 | B | 569022.32 | 575109.81 | 8.00 | 45.00 | 0.00 | 0.00 | 0.60 | | | |
| 262 | B | 569050.60 | 575117.23 | 8.00 | 311.00 | 0.00 | 0.00 | 0.50 | | | |
| 263 | B | 569061.14 | 575136.70 | 8.00 | 169.00 | 0.00 | 0.00 | 0.50 | | | |
| 264 | B | 569081.18 | 575163.77 | 8.00 | 132.00 | 0.00 | 0.00 | 0.50 | | | |
| 265 | B | 569054.03 | 575156.54 | 8.00 | 207.00 | 0.00 | 0.00 | 0.50 | | | |
| 266 | B | 568716.01 | 574911.97 | 8.00 | 157.00 | 0.00 | 0.00 | 0.50 | | | |
| 267 | B | 568728.03 | 574922.57 | 8.00 | 245.00 | 0.00 | 0.00 | 0.50 | | | |
| 268 | B | 568750.01 | 574921.57 | 8.00 | 136.00 | 0.00 | 0.00 | 0.50 | | | |
| 269 | B | 568731.63 | 574930.05 | 8.00 | 286.00 | 0.00 | 0.00 | 0.50 | | | |
| 270 | B | 568751.95 | 574936.78 | 8.00 | 301.00 | 0.00 | 0.00 | 0.50 | | | |
| 271 | B | 568757.19 | 574961.89 | 8.00 | 267.00 | 0.00 | 0.00 | 0.50 | | | |
| 272 | B | 568779.62 | 574966.24 | 8.00 | 76.00 | 0.00 | 0.00 | 0.50 | | | |
| 273 | B | 568771.70 | 574930.53 | 8.00 | 153.00 | 0.00 | 0.00 | 0.50 | | | |
| 274 | B | 568781.55 | 574951.05 | 8.00 | 341.00 | 0.00 | 0.00 | 0.50 | | | |
| 275 | B | 568803.32 | 574953.50 | 8.00 | 201.00 | 0.00 | 0.00 | 0.50 | | | |
| 276 | B | 568786.17 | 574924.78 | 8.00 | 152.00 | 0.00 | 0.00 | 0.50 | | | |
| 277 | B | 568954.62 | 575045.91 | 8.00 | 185.00 | 0.00 | 0.00 | 0.50 | | | |
| 278 | B | 568947.86 | 575025.21 | 8.00 | 308.00 | 0.00 | 0.00 | 0.50 | | | |
| 279 | B | 568922.82 | 574951.23 | 8.00 | 308.00 | 0.00 | 0.00 | 0.50 | | | |
| 280 | B | 568942.62 | 574977.25 | 8.00 | 169.00 | 0.00 | 0.00 | 0.50 | | | |
| 281 | B | 568955.38 | 575012.71 | 8.00 | 312.00 | 0.00 | 0.00 | 0.50 | | | |
| 282 | B | 568990.58 | 575026.79 | 8.00 | 108.00 | 0.00 | 0.00 | 0.50 | | | |
| 283 | B | 569036.22 | 575374.03 | 8.00 | 206.00 | 0.00 | 0.00 | 0.50 | | | |
| 284 | B | 569234.31 | 575366.84 | 8.00 | 317.00 | 0.00 | 0.00 | 0.50 | | | |
| 285 | B | 569025.37 | 575388.66 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 286 | B | 569166.49 | 575276.15 | 8.00 | 140.00 | 0.00 | 0.00 | 0.50 | | | |
| 287 | B | 569059.02 | 575406.63 | 8.00 | 153.00 | 0.00 | 0.00 | 1.00 | | | |
| 288 | B | 569061.87 | 575440.48 | 8.00 | 325.00 | 0.00 | 0.00 | 0.50 | | | |
| 289 | B | 569086.04 | 575465.05 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 290 | B | 569161.43 | 575310.47 | 8.00 | 342.00 | 0.00 | 0.00 | 0.50 | | | |
| 291 | B | 569191.88 | 575318.76 | 8.00 | 72.00 | 0.00 | 0.00 | 0.50 | | | |
| 292 | B | 569216.64 | 575342.39 | 8.00 | 339.00 | 0.00 | 0.00 | 0.50 | | | |
| 293 | B | 569339.43 | 575263.97 | 8.00 | 258.00 | 0.00 | 0.00 | 0.50 | | | |
| 294 | B | 569369.40 | 575252.01 | 8.00 | 175.00 | 0.00 | 0.00 | 0.50 | | | |
| 295 | B | 569355.34 | 575269.48 | 8.00 | 62.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|-----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 296 | B | 569333.97 | 575275.12 | 8.00 | 95.00 | 0.00 | 0.00 | 0.50 | | | |
| 297 | B | 569420.62 | 575247.31 | 8.00 | 177.00 | 0.00 | 0.00 | 0.50 | | | |
| 298 | B | 569418.21 | 575268.34 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 299 | B | 569413.58 | 575288.20 | 8.00 | 213.00 | 0.00 | 0.00 | 0.50 | | | |
| 300 | B | 569384.99 | 575296.02 | 8.00 | 243.00 | 0.00 | 0.00 | 0.50 | | | |
| 301 | B | 569307.93 | 575261.75 | 8.00 | 142.00 | 0.00 | 0.00 | 0.50 | | | |
| 302 | B | 569337.37 | 575312.46 | 8.00 | 58.00 | 0.00 | 0.00 | 0.50 | | | |
| 303 | B | 569381.95 | 575267.11 | 8.00 | 272.00 | 0.00 | 0.00 | 0.50 | | | |
| 304 | B | 569588.16 | 575064.33 | 8.00 | 218.00 | 0.00 | 0.00 | 0.50 | | | |
| 305 | B | 569624.13 | 575072.20 | 8.00 | 0.00 | 0.00 | 0.00 | 0.50 | | | |
| 306 | B | 569546.70 | 574885.44 | 8.00 | 105.00 | 0.00 | 0.00 | 0.50 | | | |
| 307 | B | 569597.74 | 574901.45 | 8.00 | 122.00 | 0.00 | 0.00 | 0.50 | | | |
| 308 | B | 569646.50 | 574925.48 | 8.00 | 113.00 | 0.00 | 0.00 | 0.50 | | | |

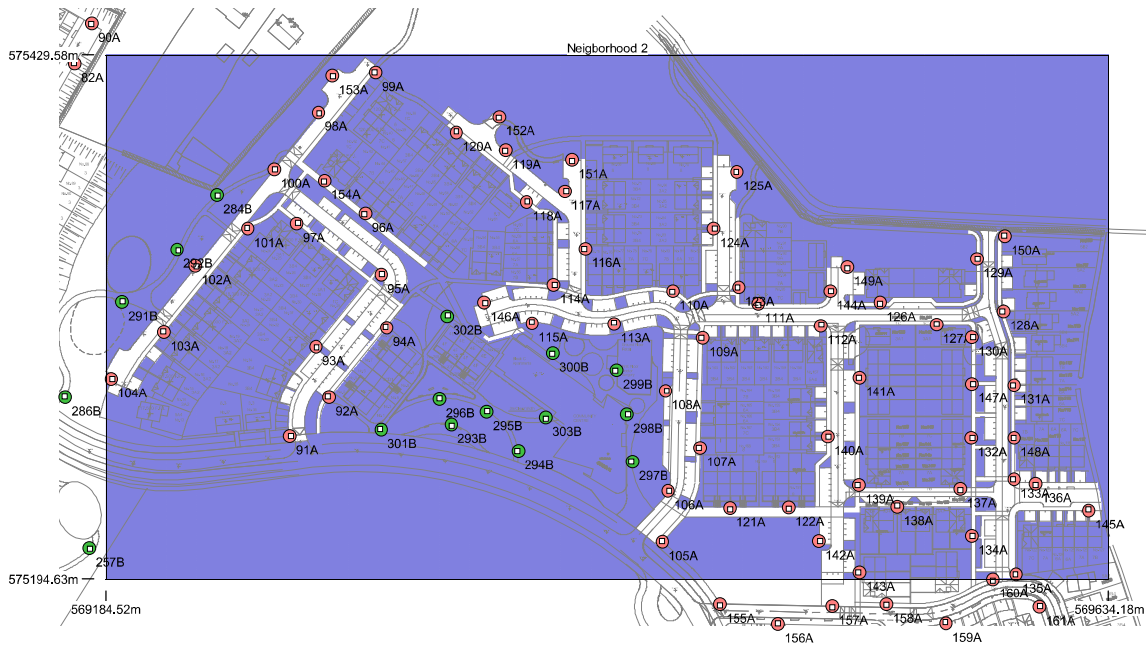
Horizontal Illuminance (lux)

Neighborhood 1



Horizontal Illuminance (lux)

Neighborhood 2

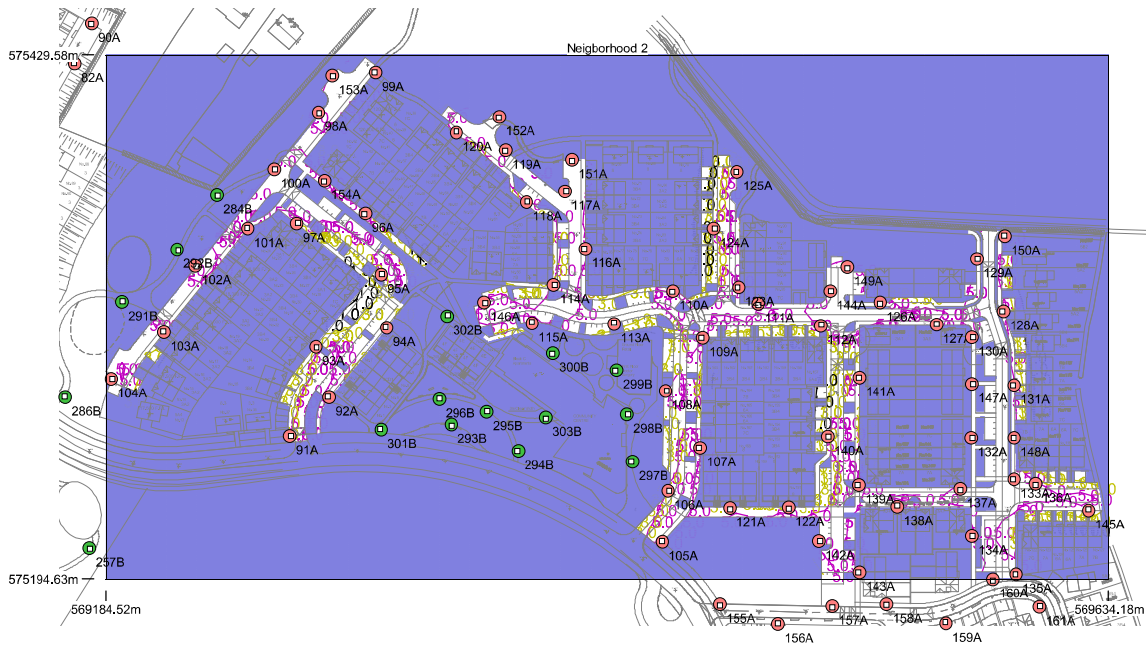


Results

| | |
|-----------|------|
| Eav | 5.07 |
| Emin | 1.08 |
| Emax | 9.95 |
| Emin/Emax | 0.11 |
| Emin/Eav | 0.21 |

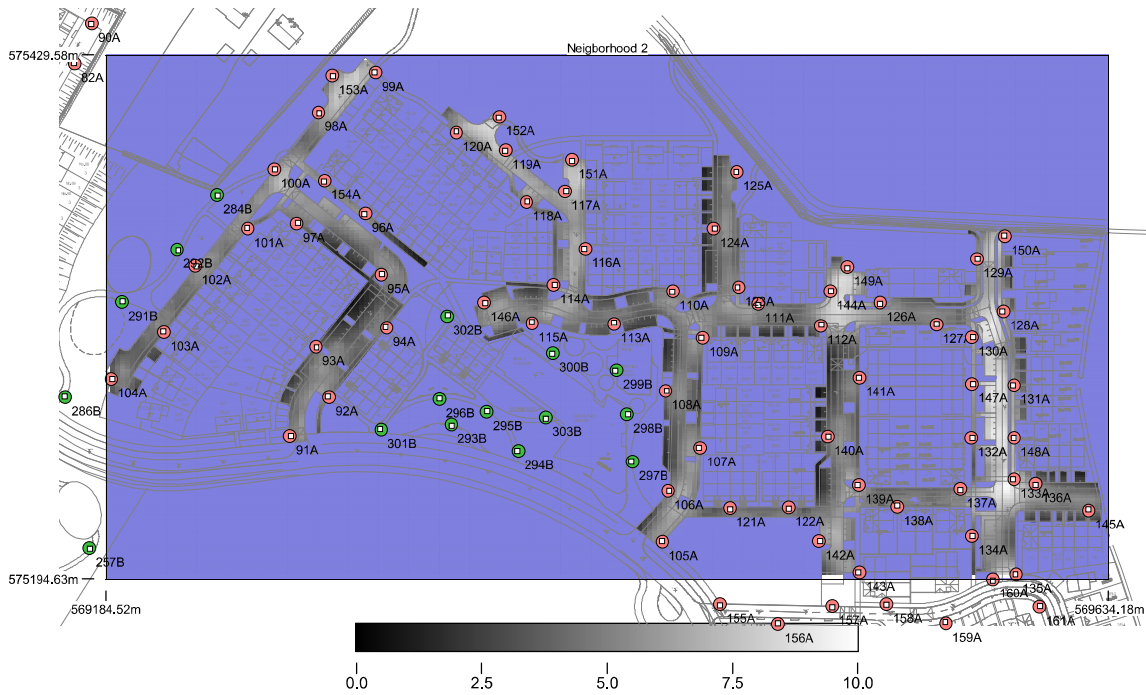
Horizontal Illuminance (lux)

Neighborhood 2



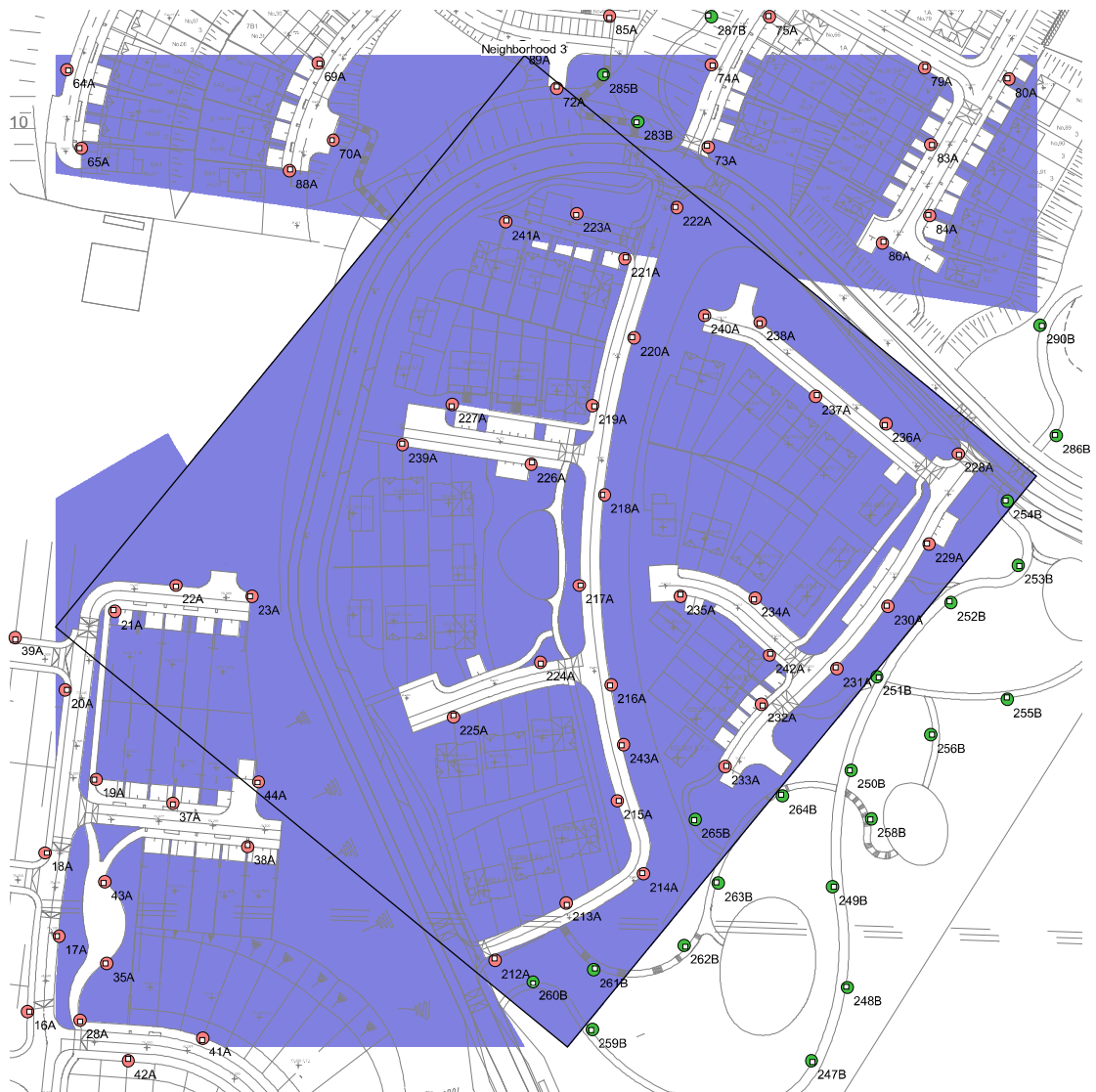
Horizontal Illuminance (lux)

Neighborhood 2



Horizontal Illuminance (lux)

Neighborhood 3

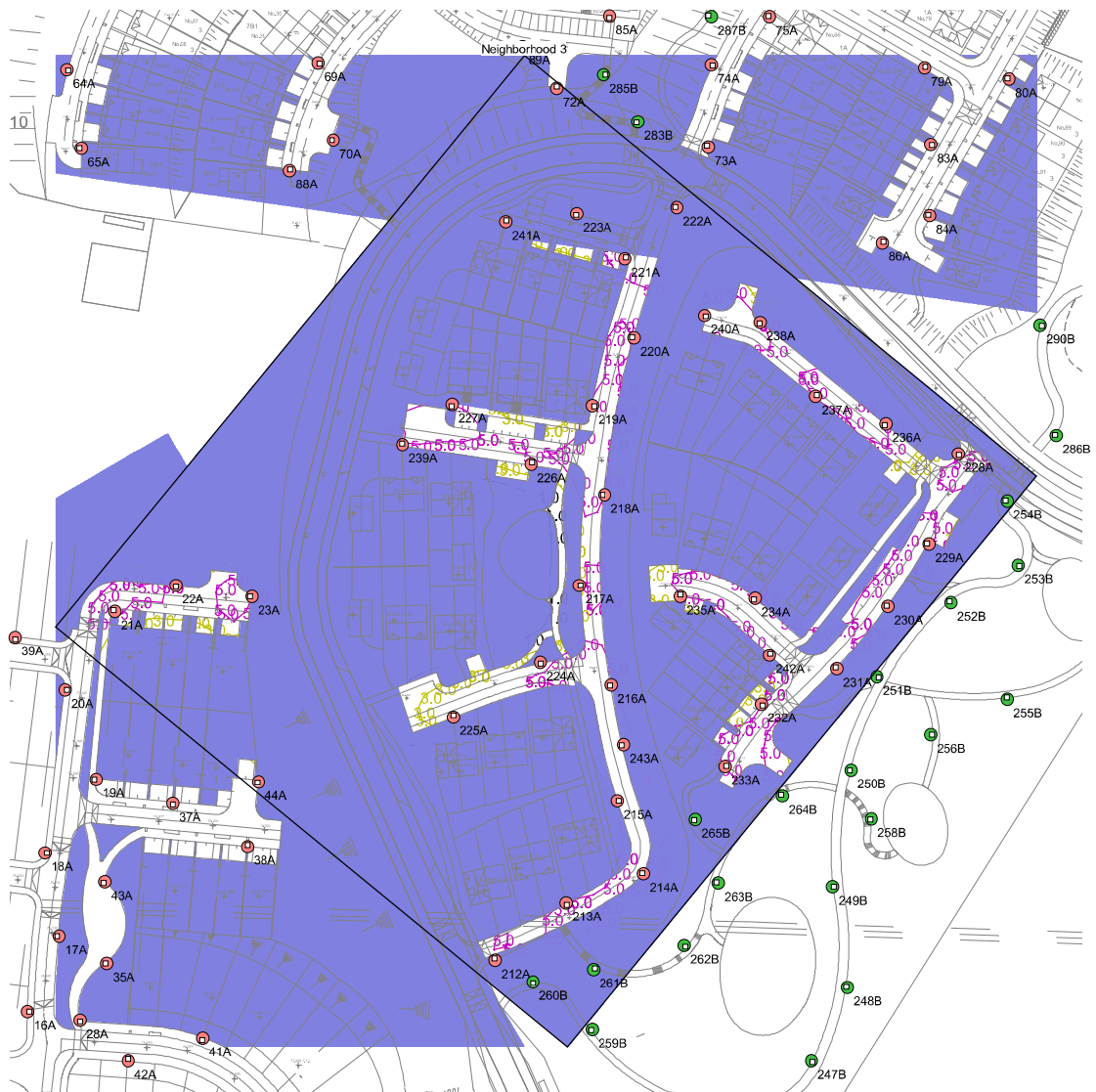


Results

| | |
|------------------------------------|------|
| Eav | 5.15 |
| Emin | 1.29 |
| E _{max} | 8.88 |
| E _{min} /E _{max} | 0.15 |
| E _{min} /E _{av} | 0.25 |

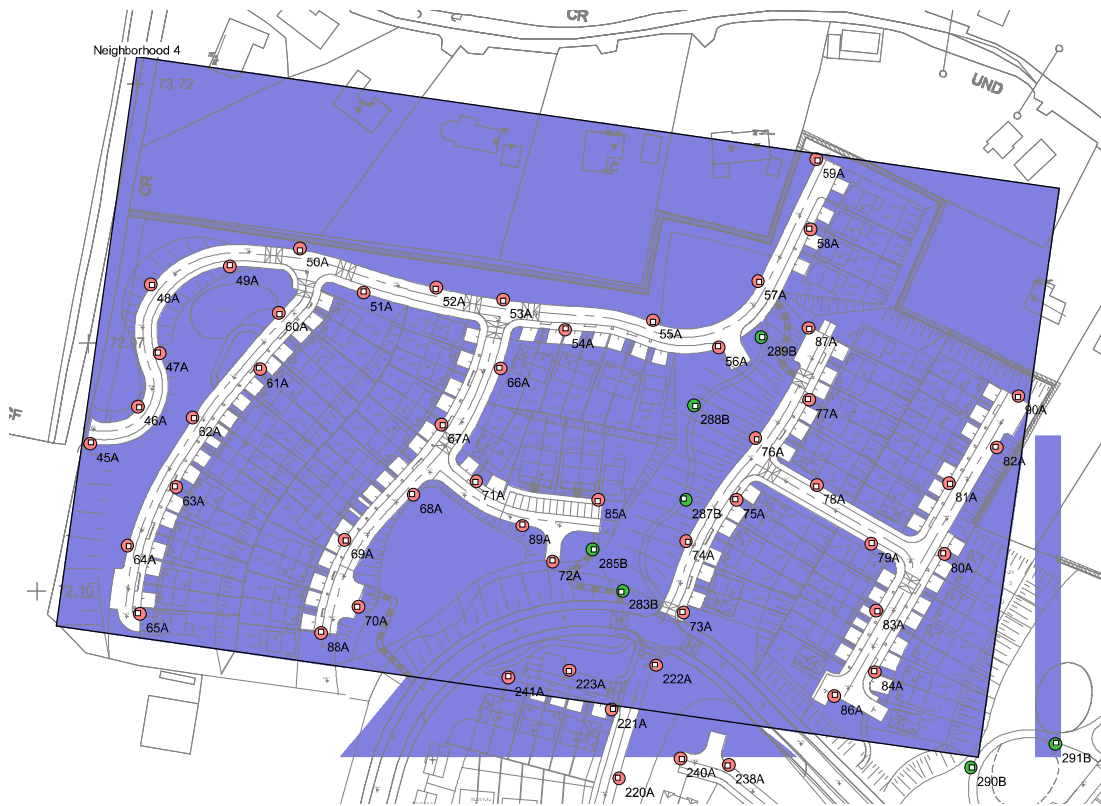
Horizontal Illuminance (lux)

Neighborhood 3



Horizontal Illuminance (lux)

Neighborhood 4



Results

| | |
|------------------------------------|------|
| Eav | 5.09 |
| Emin | 1.65 |
| E _{max} | 8.43 |
| E _{min} /E _{max} | 0.20 |
| E _{min} /E _{av} | 0.32 |

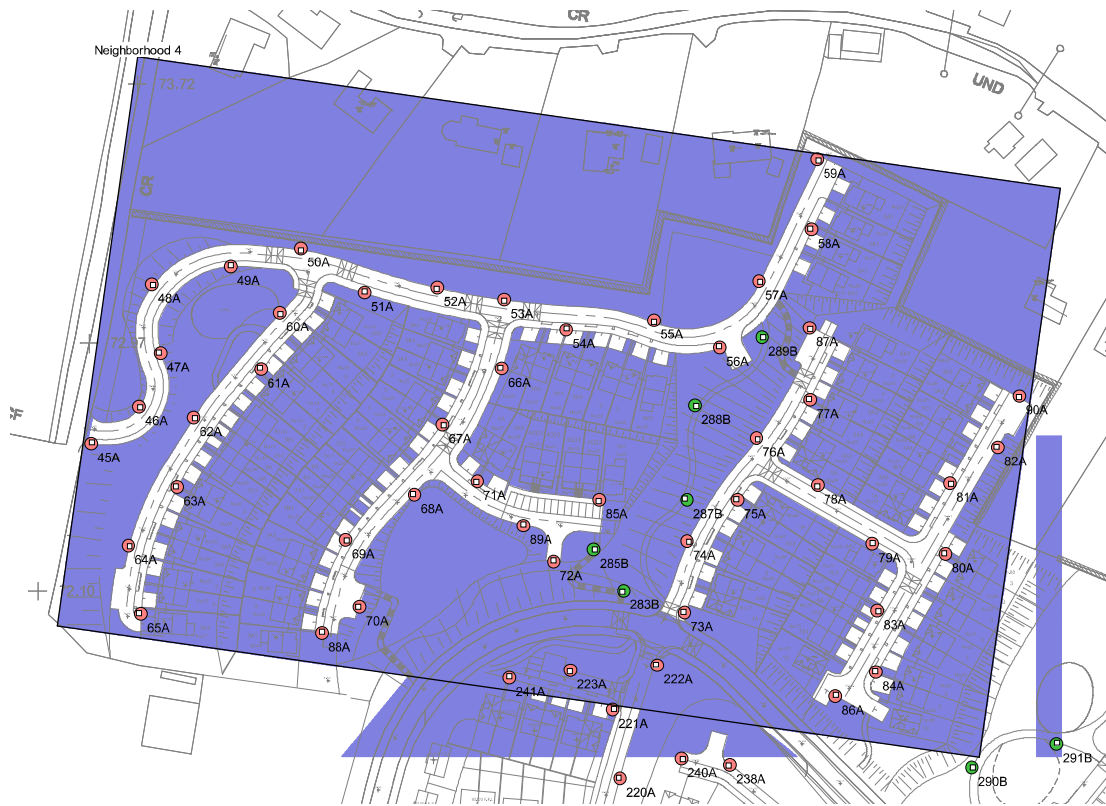
Horizontal Illuminance (lux)

Neighborhood 4



Horizontal Illuminance (lux)

Neighborhood 4



Horizontal Illuminance (lux)

Neighborhood 5



Results

| | |
|-----------|-------|
| Eav | 5.20 |
| Emin | 1.12 |
| Emax | 10.94 |
| Emin/Emax | 0.10 |
| Emin/Eav | 0.21 |

Horizontal Illuminance (lux)

Neighborhood 5



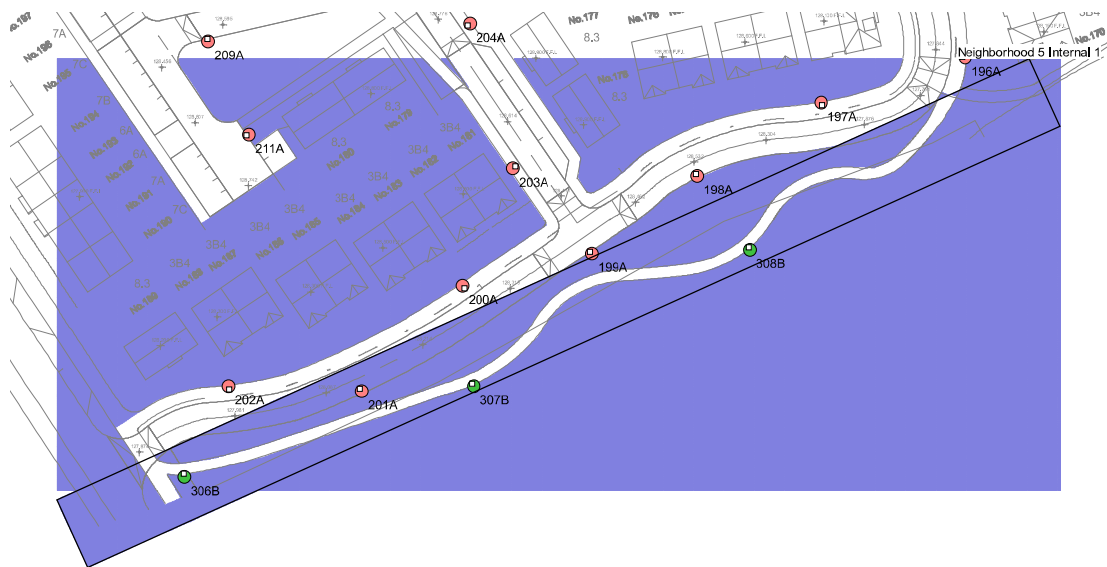
Horizontal Illuminance (lux)

Neighborhood 5



Horizontal Illuminance (lux)

Neighborhood 5 Internal 1

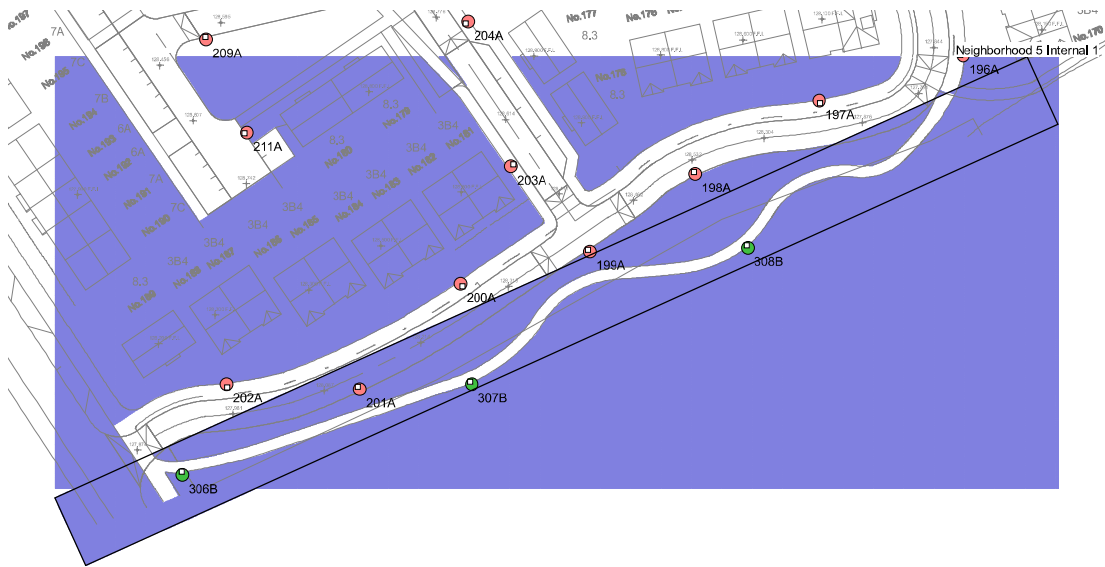


Results

| | |
|-----------|------|
| Eav | 2.99 |
| Emin | 1.65 |
| Emax | 4.32 |
| Emin/Emax | 0.38 |
| Emin/Eav | 0.55 |

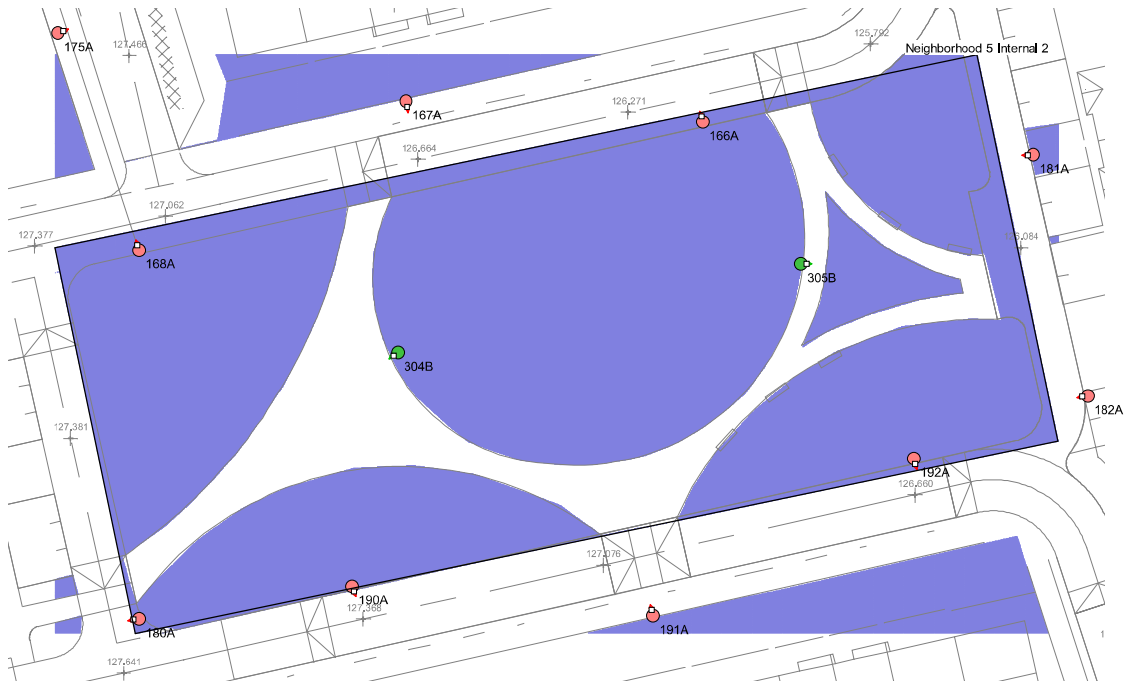
Horizontal Illuminance (lux)

Neighborhood 5 Internal 1



Horizontal Illuminance (lux)

Neighborhood 5 Internal 2

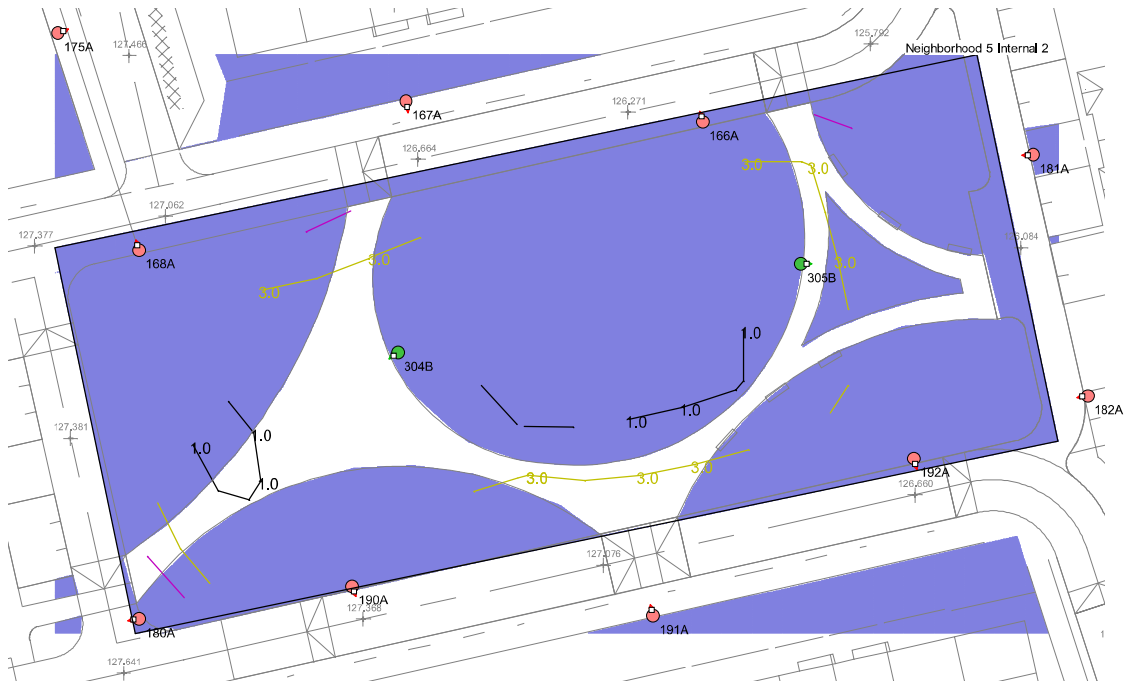


Results

| | |
|------------------------------------|------|
| Eav | 2.66 |
| Emin | 0.87 |
| E _{max} | 4.98 |
| E _{min} /E _{max} | 0.17 |
| E _{min} /E _{av} | 0.33 |

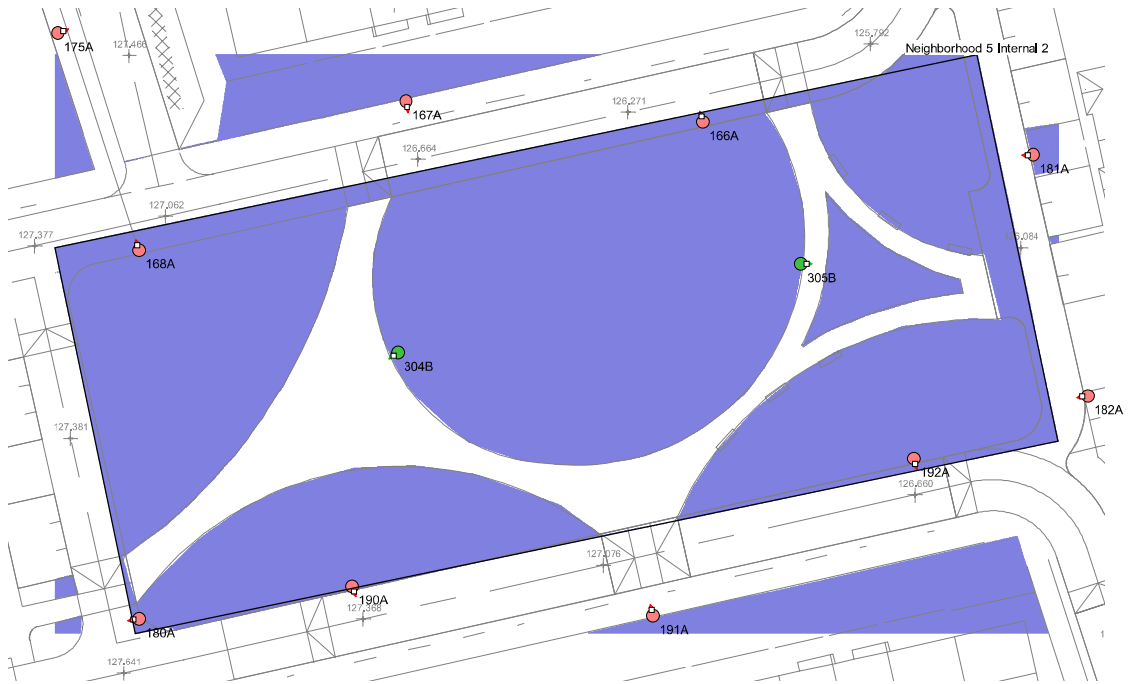
Horizontal Illuminance (lux)

Neighborhood 5 Internal 2



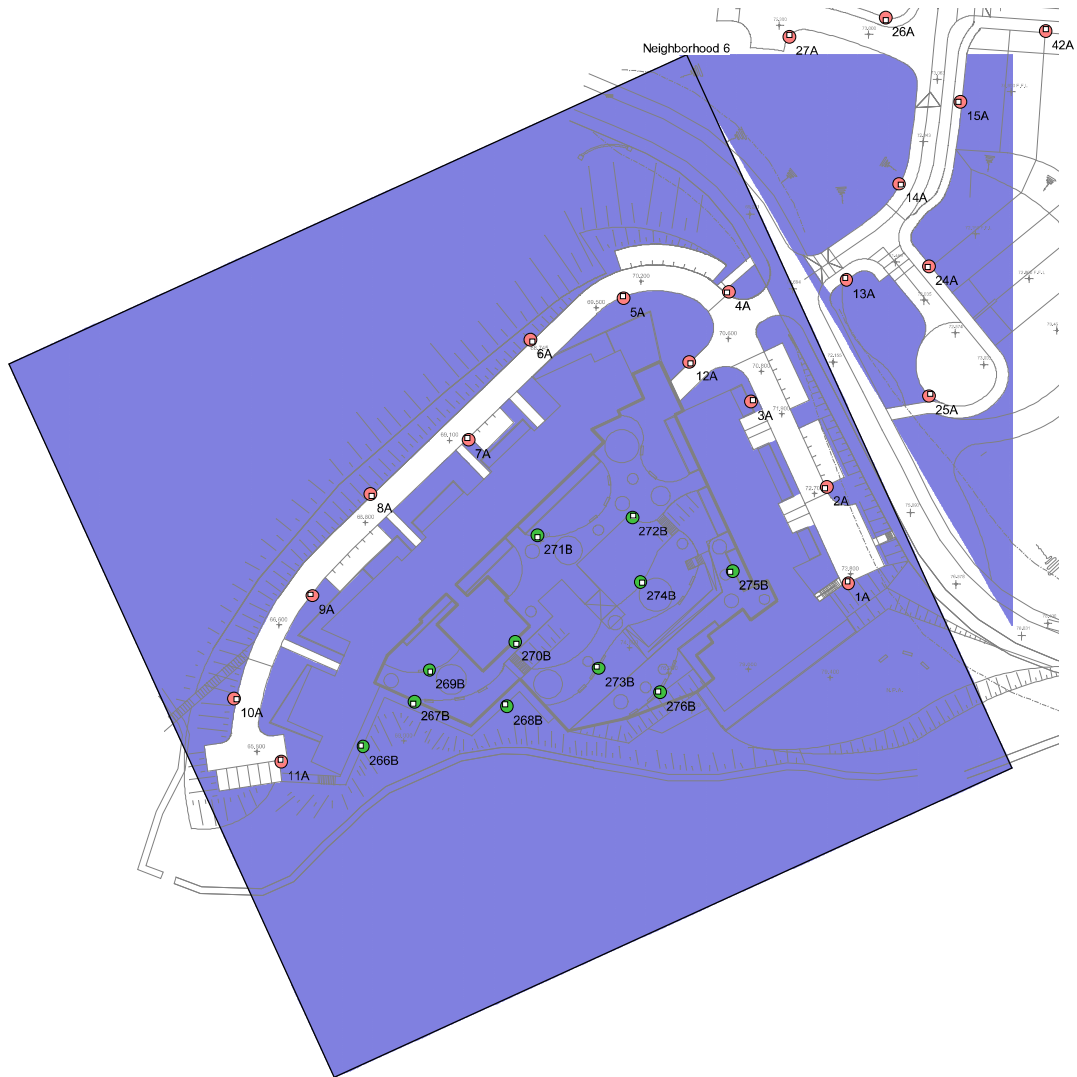
Horizontal Illuminance (lux)

Neighborhood 5 Internal 2



Horizontal Illuminance (lux)

Neighborhood 6

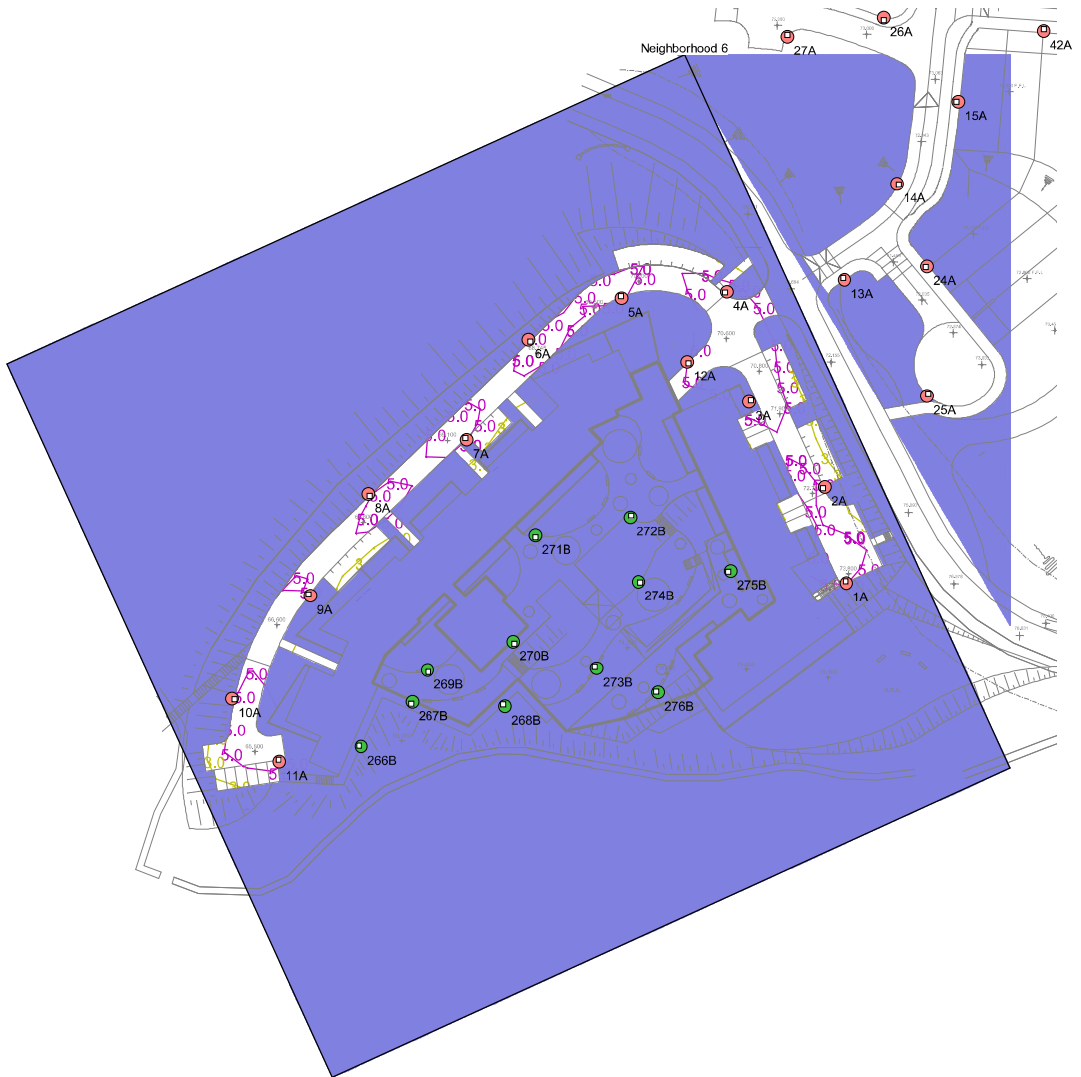


Results

| | |
|------------------------------------|------|
| Eav | 5.11 |
| Emin | 1.98 |
| E _{max} | 8.38 |
| E _{min} /E _{max} | 0.24 |
| E _{min} /E _{av} | 0.39 |

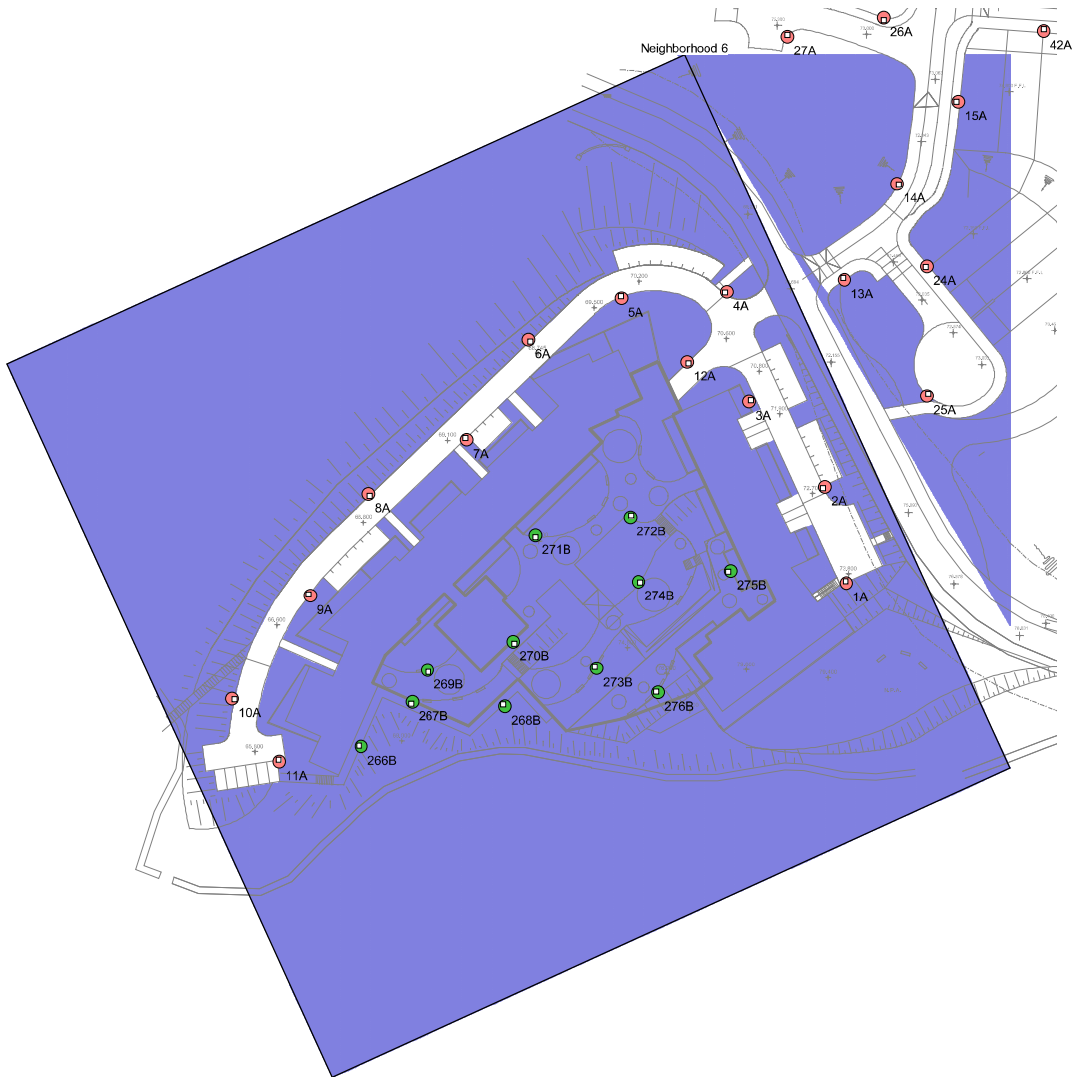
Horizontal Illuminance (lux)

Neighborhood 6



Horizontal Illuminance (lux)

Neighborhood 6



Horizontal Illuminance (lux)

Neighborhood 6 Internal Paths



Results

| | |
|------------------------------------|------|
| Eav | 2.36 |
| Emin | 0.87 |
| E _{max} | 3.99 |
| E _{min} /E _{max} | 0.22 |
| E _{min} /E _{av} | 0.37 |

Horizontal Illuminance (lux)

Neighborhood 6 Internal Paths



Horizontal Illuminance (lux)

Neighborhood 6 Internal Paths



Horizontal Illuminance (lux)

Isolated Paths

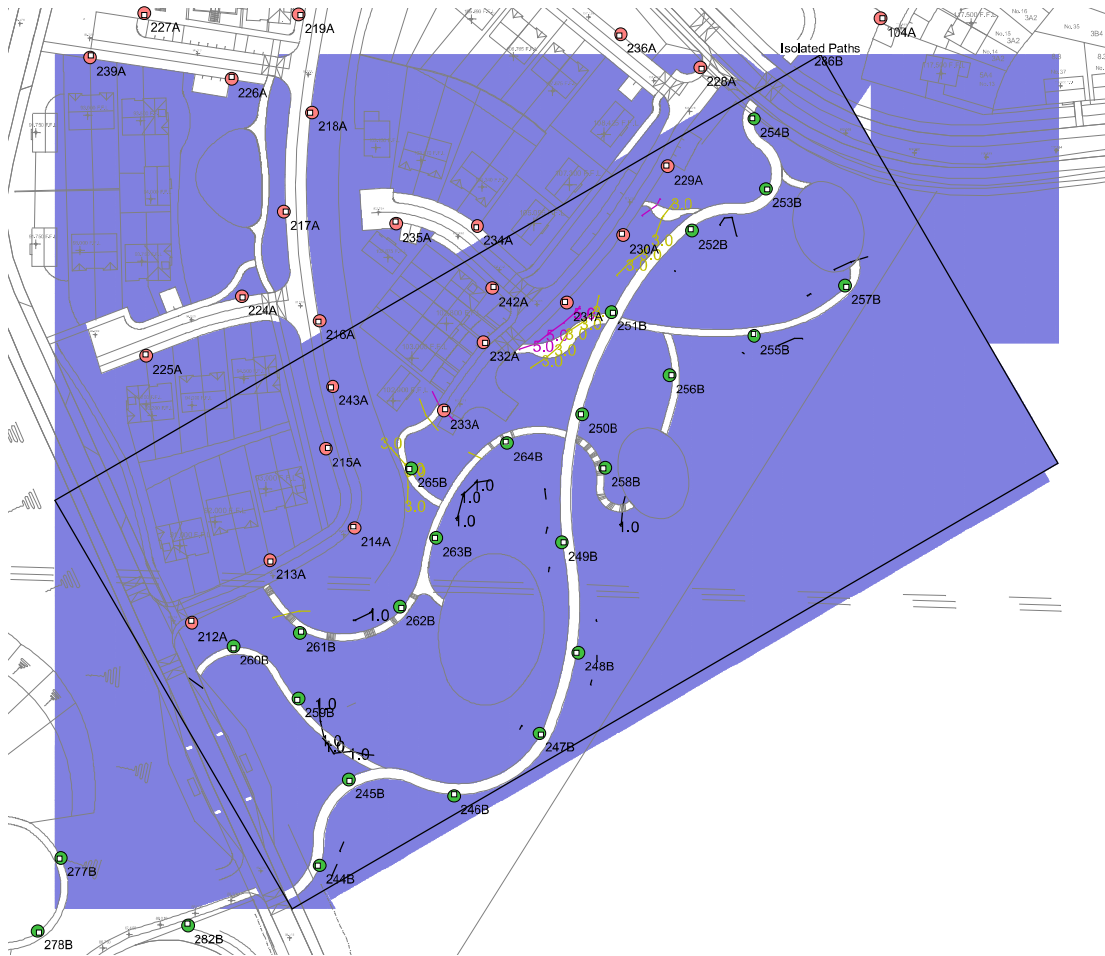


Results

| | |
|------------------------------------|------|
| Eav | 2.07 |
| Emin | 1.00 |
| E _{max} | 4.59 |
| E _{min} /E _{max} | 0.22 |
| E _{min} /E _{av} | 0.48 |

Horizontal Illuminance (lux)

Isolated Paths



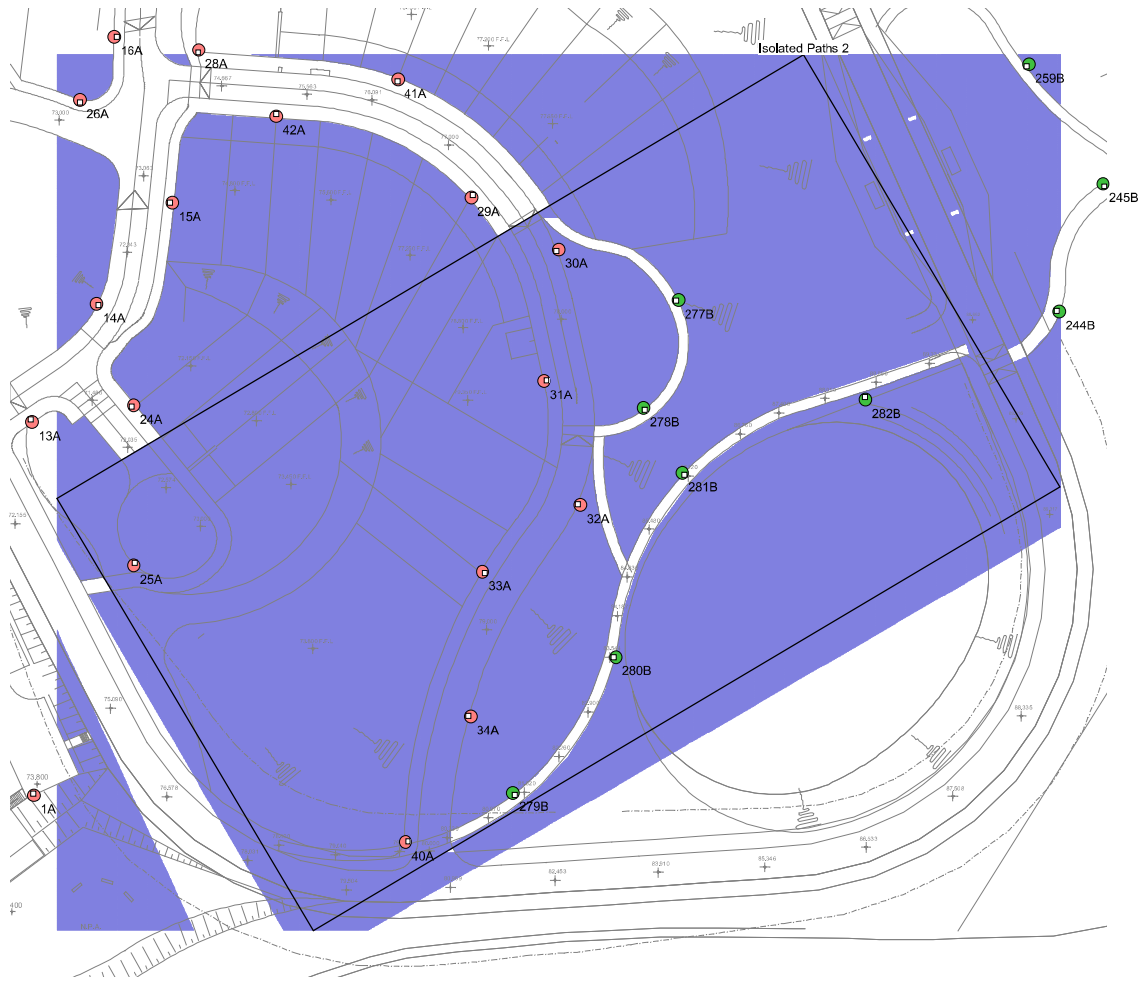
Horizontal Illuminance (lux)

Isolated Paths



Horizontal Illuminance (lux)

Isolated Paths 2

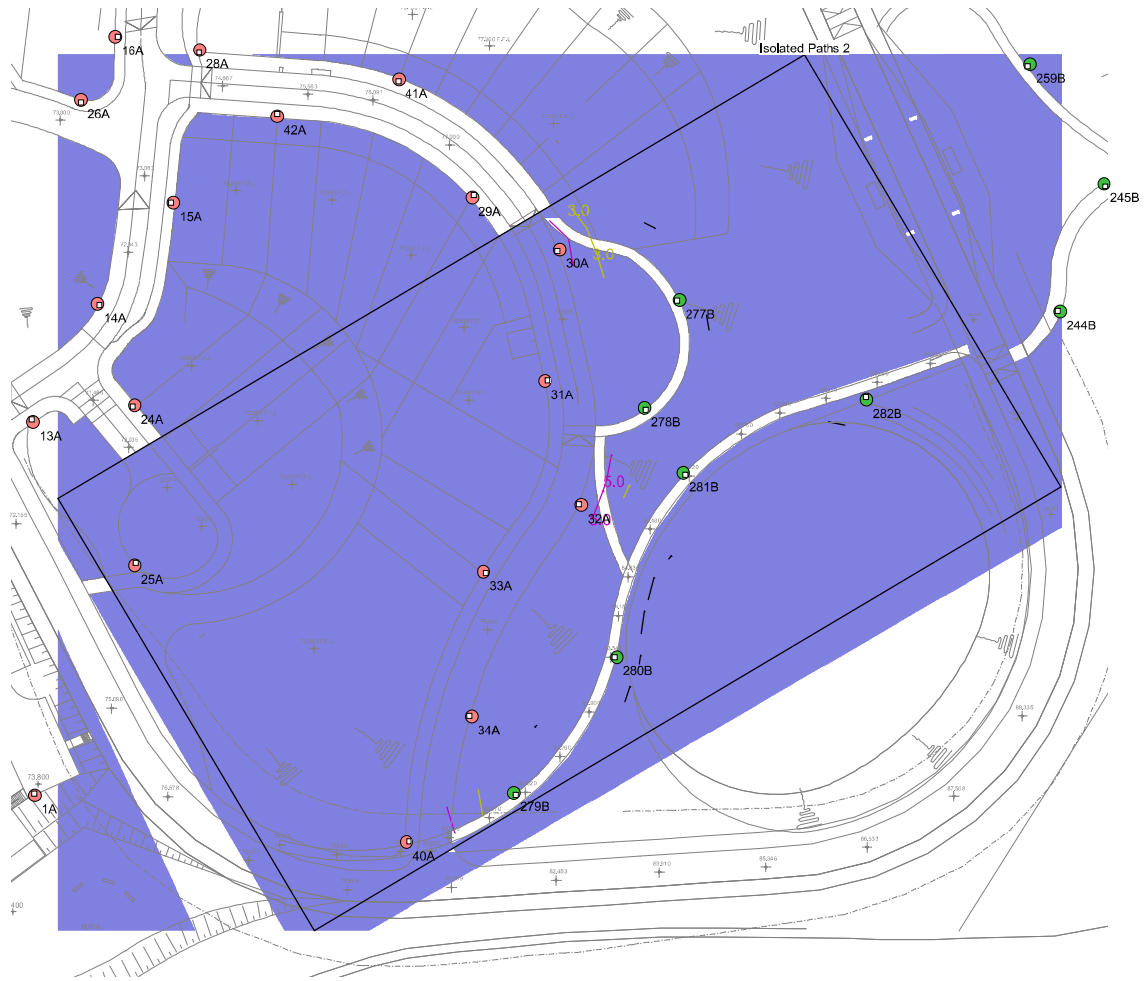


Results

| | |
|------------------------------------|------|
| Eav | 2.10 |
| Emin | 0.80 |
| E _{max} | 5.67 |
| E _{min} /E _{max} | 0.14 |
| E _{min} /E _{av} | 0.38 |

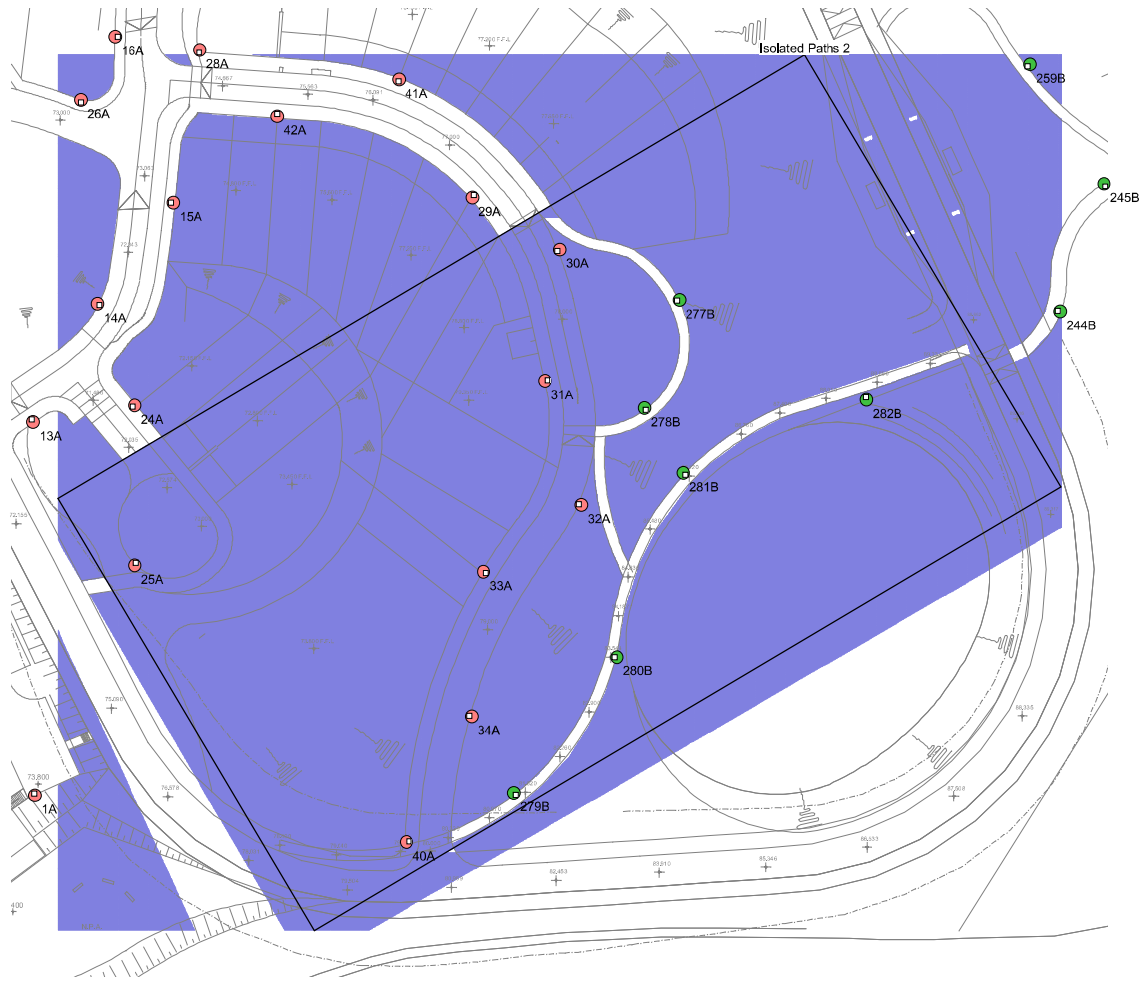
Horizontal Illuminance (lux)

Isolated Paths 2



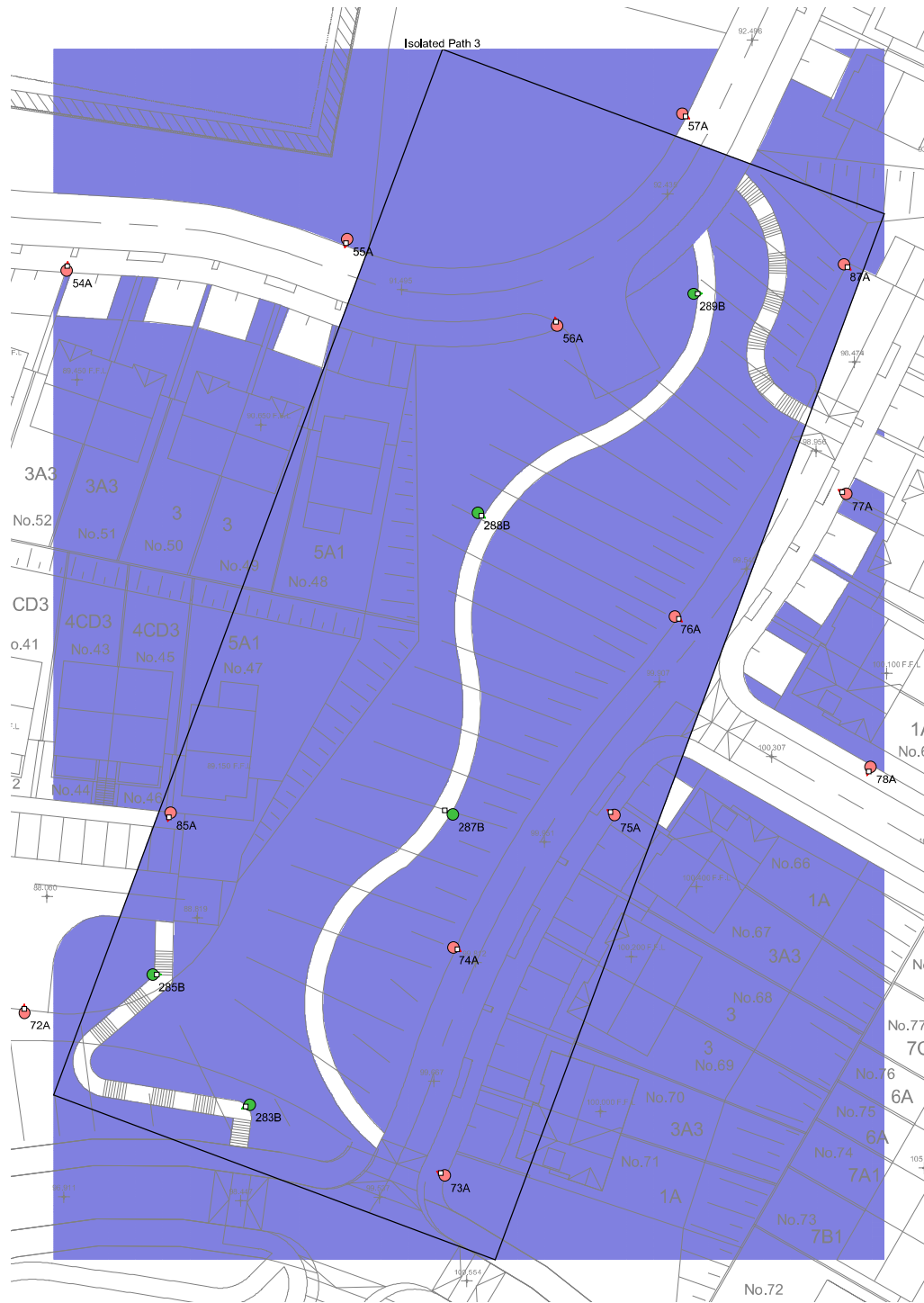
Horizontal Illuminance (lux)

Isolated Paths 2



Horizontal Illuminance (lux)

Isolated Path 3

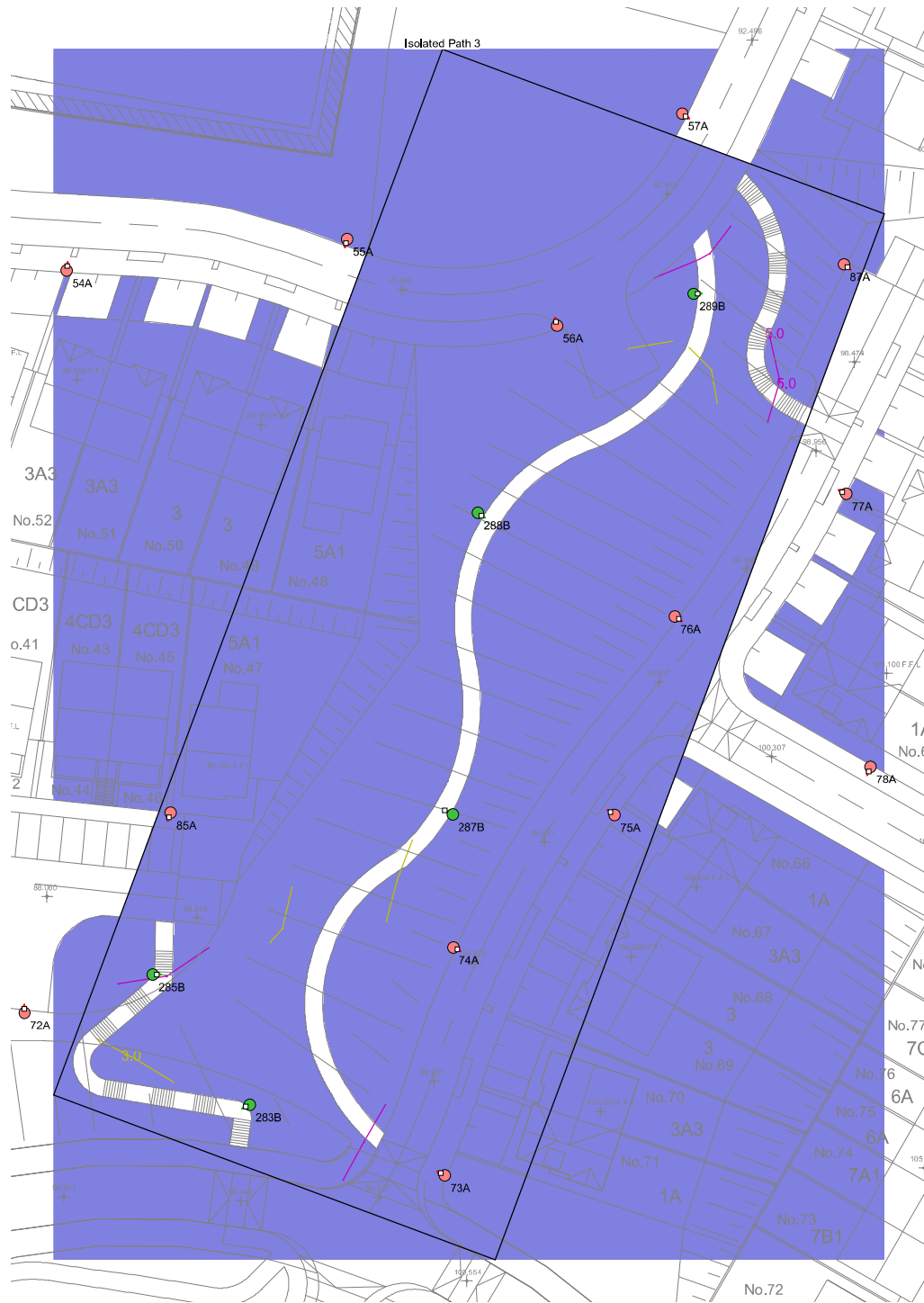


Results

| | |
|-----------|------|
| Eav | 2.85 |
| Emin | 1.21 |
| Emax | 5.70 |
| Emin/Emax | 0.21 |
| Emin/Eav | 0.43 |

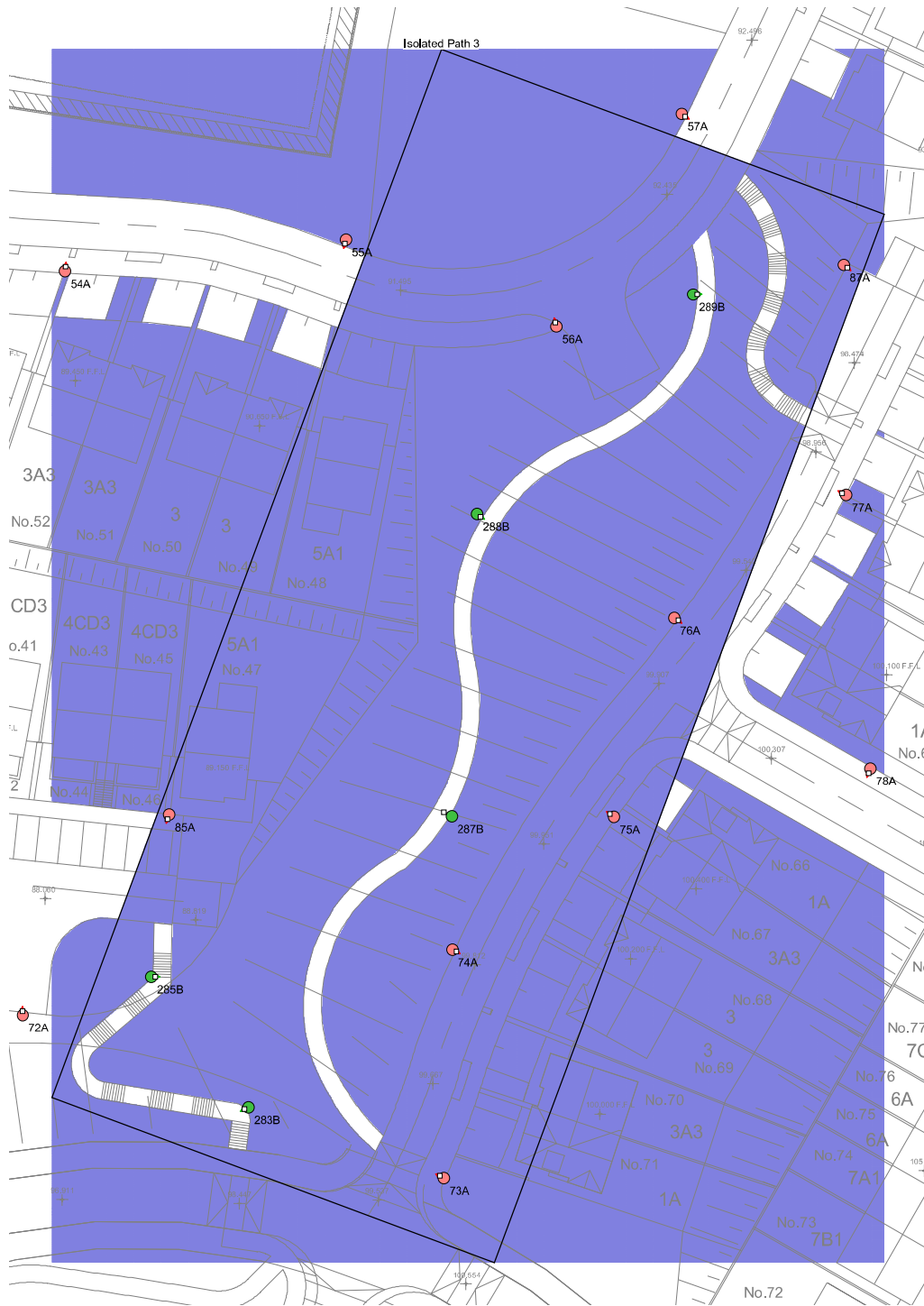
Horizontal Illuminance (lux)

Isolated Path 3



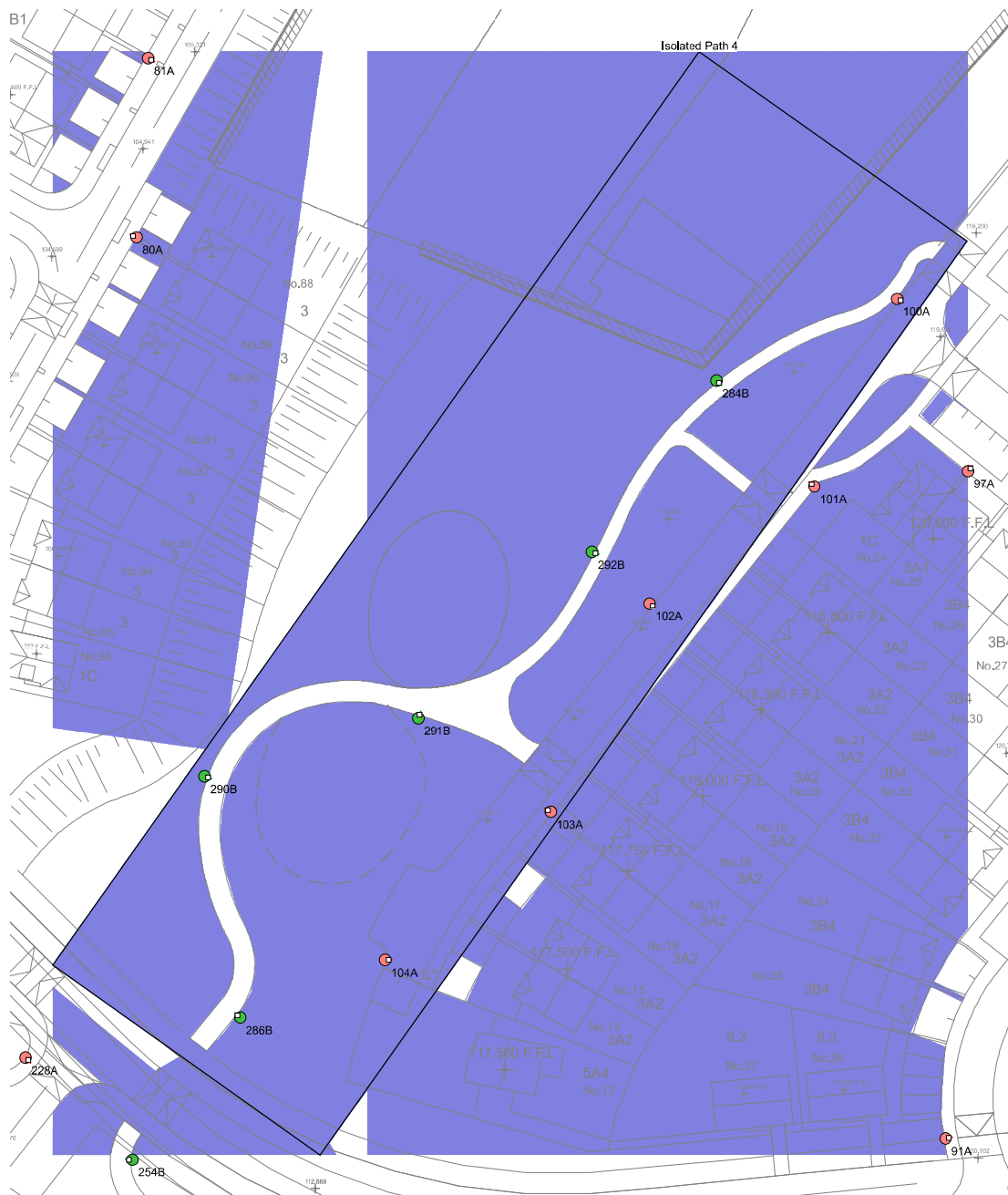
Horizontal Illuminance (lux)

Isolated Path 3



Horizontal Illuminance (lux)

Isolated Path 4

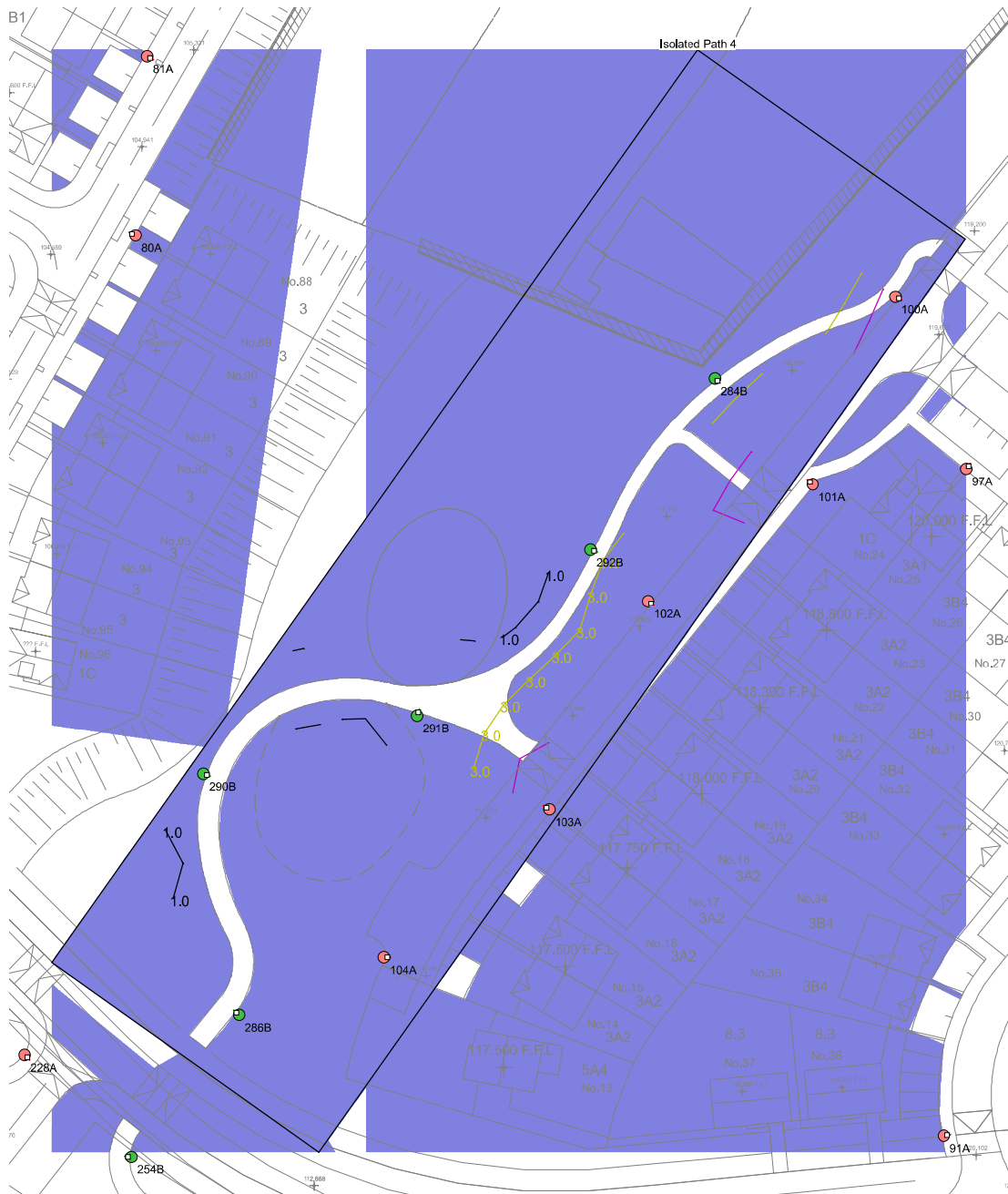


Results

| | |
|------------------------------------|------|
| Eav | 2.28 |
| Emin | 1.26 |
| E _{max} | 5.14 |
| E _{min} /E _{max} | 0.24 |
| E _{min} /E _{av} | 0.55 |

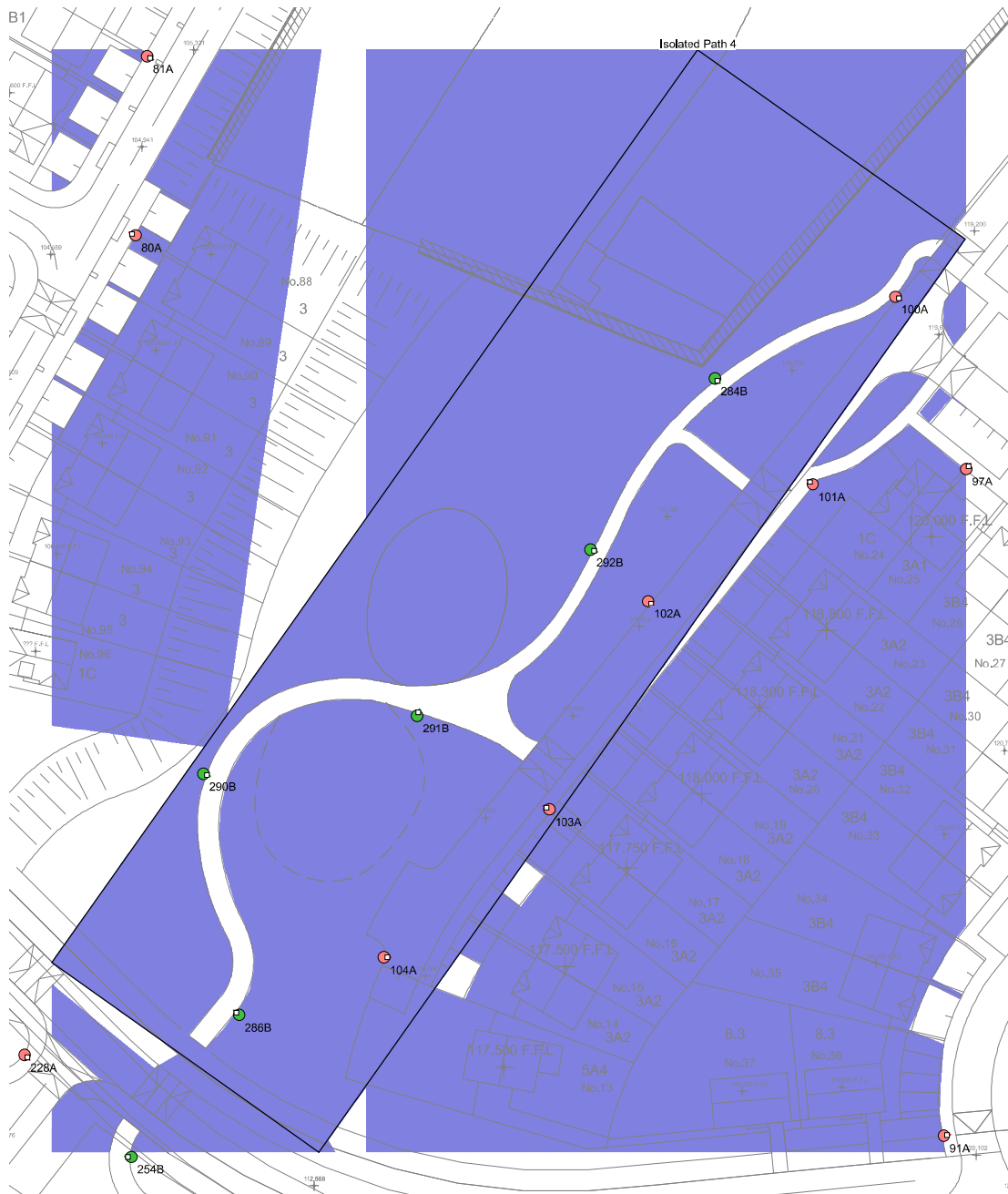
Horizontal Illuminance (lux)

Isolated Path 4



Horizontal Illuminance (lux)

Isolated Path 4



Horizontal Illuminance (lux)

Isolated Path 5

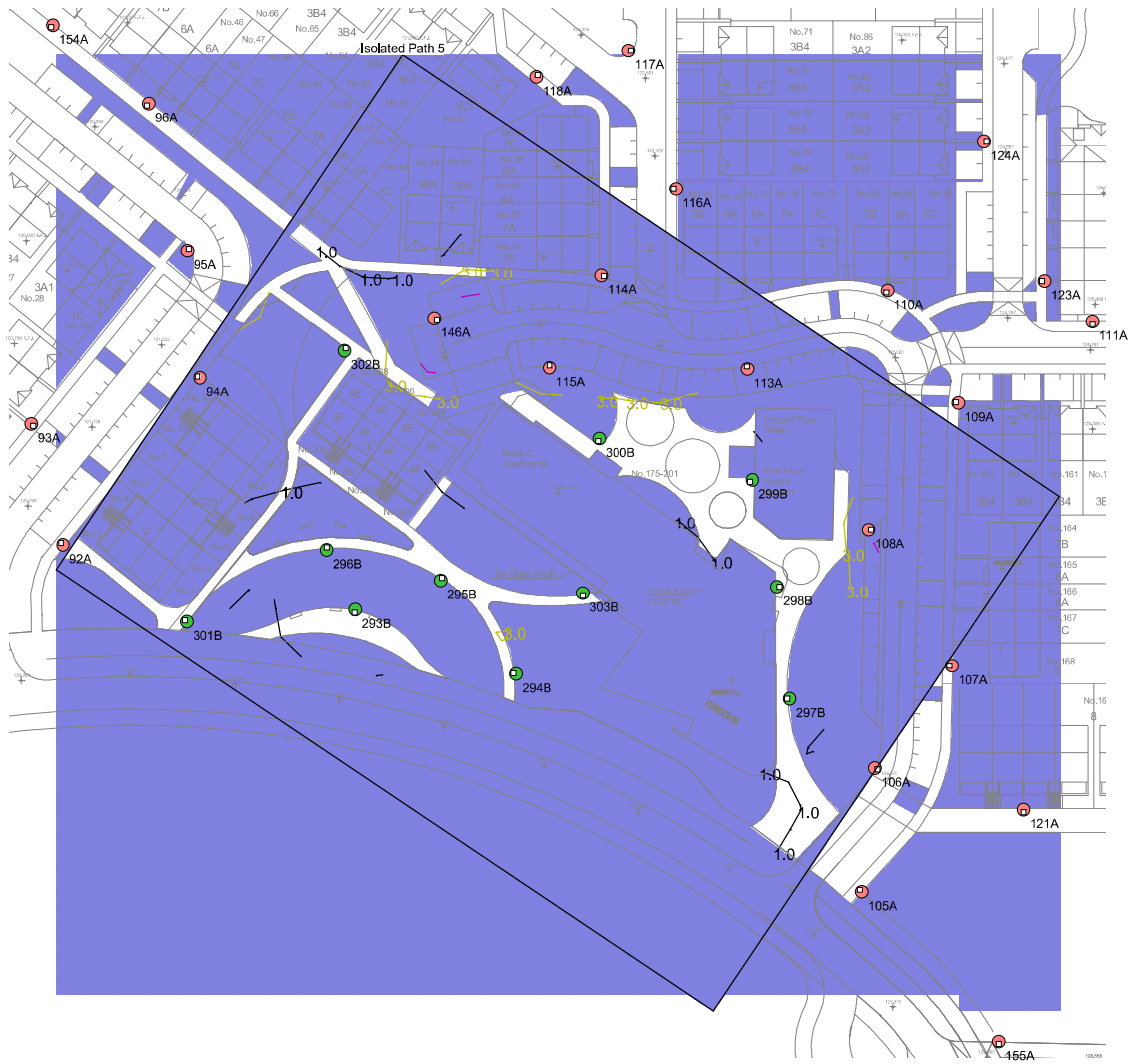


Results

| | |
|------------------------------------|------|
| Eav | 2.00 |
| Emin | 0.56 |
| E _{max} | 4.10 |
| E _{min} /E _{max} | 0.14 |
| E _{min} /E _{av} | 0.28 |

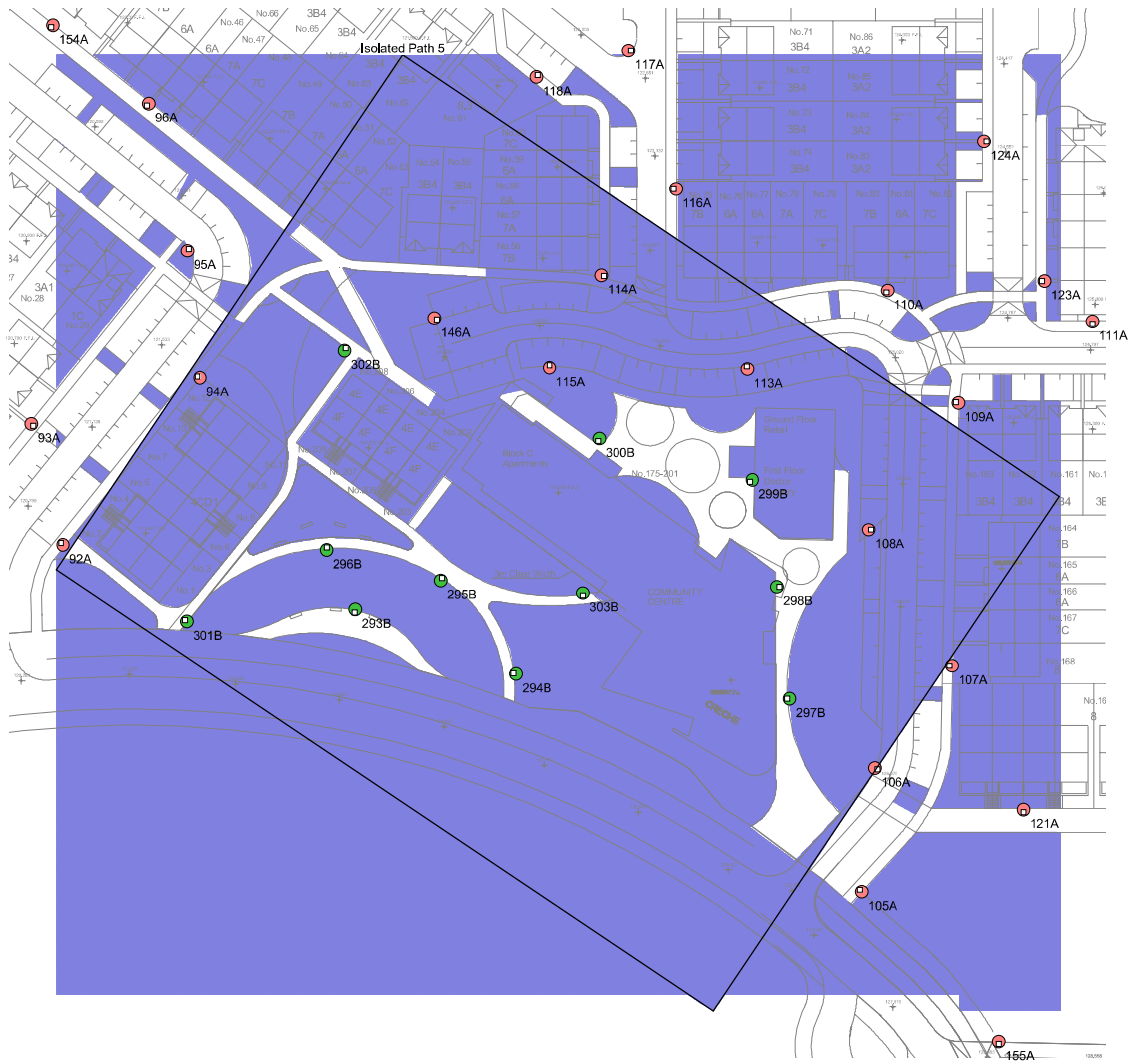
Horizontal Illuminance (lux)

Isolated Path 5



Horizontal Illuminance (lux)

Isolated Path 5



DATE: 8 November 2019
DESIGNER: MHL & Associates
PROJECT No: 17066HD
PROJECT NAME: Ballyhooly Road Public Lighting



Outdoor Lighting Report

PREPARED BY: MHL & Associates Ltd
Carraig Mor House,
Douglas Road,
Cork

Layout Report

General Data

Dimensions in Metres Angles in Degrees

Calculation Grids

| ID | Grid Name | X | Y | X' Length | Y' Length | X' Spacing | Y' Spacing |
|----|-------------------------------|-----------|-----------|-----------|-----------|------------|------------|
| 1 | Ballyhooly Road | 568607.98 | 574412.19 | 341.44 | 1203.74 | 4.95 | 4.99 |
| 2 | Ballyhooly Link Road Junct... | 568613.05 | 574780.68 | 36.90 | 46.70 | 4.61 | 4.67 |
| 3 | Site Entrance 1 | 568742.29 | 575046.56 | 25.15 | 58.55 | 4.19 | 4.88 |
| 4 | Site Entrance 2 | 568822.43 | 575421.35 | 31.19 | 39.79 | 4.46 | 4.97 |

Luminaires



Luminaire C Data

| | |
|----------------------|--|
| Supplier | Philips |
| Type | BGP621_DW50_8000_40LED_5.1S_CLO_L90_NW |
| Lamp(s) | LED-HB 5.1S NW |
| Lamp Flux (klm) | 8.00 |
| File Name | Luma Mini_BGP621_DW50_8000_40LED_5.1S_CLO_L90_NW.ies |
| Maintenance Factor | 0.85 |
| Imax70,80,90(cd/klm) | 616.7, 39.5, 0.0 |
| No. in Project | 42 |



Luminaire E Data

| | |
|----------------------|---|
| Supplier | Philips |
| Type | BGP621_DW50_12000_40LED_5.1S_CLO_L90_NW |
| Lamp(s) | LED-HB 5.1S NW |
| Lamp Flux (klm) | 12.00 |
| File Name | Luma Mini_BGP621_DW50_12000_40LED_5.1S_CLO_L90_NW.ies |
| Maintenance Factor | 0.85 |
| Imax70,80,90(cd/klm) | 616.7, 39.5, 0.0 |
| No. in Project | 7 |

Layout

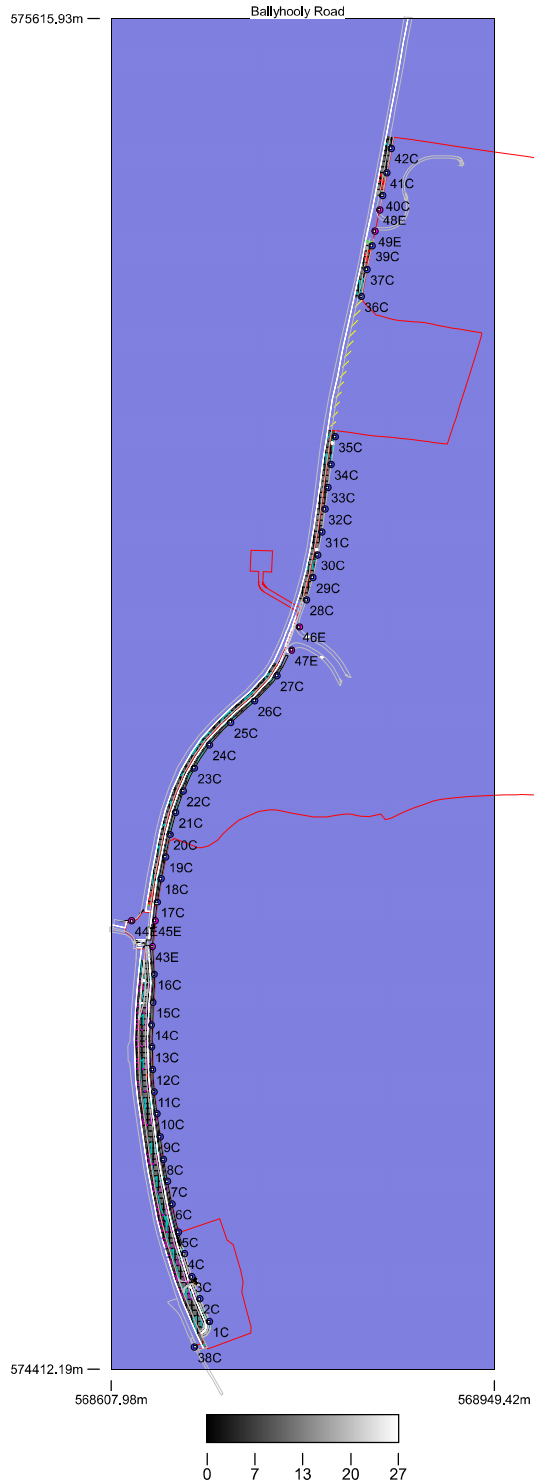
| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 1 | C | 568695.19 | 574454.60 | 9.00 | 205.00 | 0.00 | 0.00 | 0.50 | | | |
| 2 | C | 568686.80 | 574475.14 | 9.00 | 194.00 | 0.00 | 0.00 | 0.50 | | | |
| 3 | C | 568679.67 | 574494.62 | 9.00 | 191.00 | 0.00 | 0.00 | 0.50 | | | |
| 4 | C | 568673.28 | 574515.01 | 9.00 | 195.00 | 0.00 | 0.00 | 0.50 | | | |
| 5 | C | 568667.85 | 574534.49 | 9.00 | 186.00 | 0.00 | 0.00 | 0.50 | | | |
| 6 | C | 568662.19 | 574559.36 | 9.00 | 191.00 | 0.00 | 0.00 | 0.50 | | | |
| 7 | C | 568658.18 | 574579.64 | 9.00 | 186.00 | 0.00 | 0.00 | 0.50 | | | |
| 8 | C | 568654.76 | 574599.36 | 9.00 | 186.00 | 0.00 | 0.00 | 0.50 | | | |
| 9 | C | 568651.72 | 574619.50 | 9.00 | 184.00 | 0.00 | 0.00 | 0.50 | | | |
| 10 | C | 568649.10 | 574639.70 | 9.00 | 175.00 | 0.00 | 0.00 | 0.50 | | | |
| 11 | C | 568646.43 | 574659.57 | 9.00 | 169.00 | 0.00 | 0.00 | 0.50 | | | |
| 12 | C | 568644.93 | 574679.20 | 9.00 | 177.00 | 0.00 | 0.00 | 0.50 | | | |
| 13 | C | 568644.12 | 574699.22 | 9.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 14 | C | 568643.85 | 574718.99 | 9.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 15 | C | 568645.37 | 574739.23 | 9.00 | 166.00 | 0.00 | 0.00 | 0.50 | | | |
| 16 | C | 568646.32 | 574764.12 | 9.00 | 186.00 | 0.00 | 0.00 | 0.50 | | | |
| 17 | C | 568649.28 | 574828.57 | 9.00 | 168.00 | 0.00 | 0.00 | 0.50 | | | |

Layout Continued

| ID | Type | X | Y | Height | Angle | Tilt | Cant | Out-reach | Target X | Target Y | Target Z |
|----|------|-----------|-----------|--------|--------|------|------|-----------|----------|----------|----------|
| 18 | C | 568652.51 | 574849.39 | 9.00 | 169.00 | 0.00 | 0.00 | 0.50 | | | |
| 19 | C | 568656.54 | 574868.53 | 9.00 | 148.00 | 0.00 | 0.00 | 0.50 | | | |
| 20 | C | 568660.57 | 574888.79 | 9.00 | 152.00 | 0.00 | 0.00 | 0.50 | | | |
| 21 | C | 568665.49 | 574908.49 | 9.00 | 147.00 | 0.00 | 0.00 | 0.50 | | | |
| 22 | C | 568672.23 | 574927.45 | 9.00 | 142.00 | 0.00 | 0.00 | 0.50 | | | |
| 23 | C | 568682.02 | 574947.91 | 9.00 | 149.00 | 0.00 | 0.00 | 0.50 | | | |
| 24 | C | 568695.39 | 574968.77 | 9.00 | 146.00 | 0.00 | 0.00 | 0.50 | | | |
| 25 | C | 568714.67 | 574988.61 | 9.00 | 138.00 | 0.00 | 0.00 | 0.50 | | | |
| 26 | C | 568735.67 | 575007.57 | 9.00 | 134.00 | 0.00 | 0.00 | 0.50 | | | |
| 27 | C | 568755.55 | 575030.17 | 9.00 | 144.00 | 0.00 | 0.00 | 0.50 | | | |
| 28 | C | 568782.19 | 575097.77 | 9.00 | 153.00 | 0.00 | 0.00 | 0.50 | | | |
| 29 | C | 568787.69 | 575117.74 | 9.00 | 159.00 | 0.00 | 0.00 | 0.50 | | | |
| 30 | C | 568791.96 | 575138.09 | 9.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 31 | C | 568795.63 | 575158.45 | 9.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 32 | C | 568798.49 | 575178.71 | 9.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 33 | C | 568800.98 | 575198.18 | 9.00 | 172.00 | 0.00 | 0.00 | 0.50 | | | |
| 34 | C | 568803.78 | 575218.54 | 9.00 | 165.00 | 0.00 | 0.00 | 0.50 | | | |
| 35 | C | 568807.49 | 575243.03 | 9.00 | 170.00 | 0.00 | 0.00 | 0.50 | | | |
| 36 | C | 568830.98 | 575367.97 | 9.00 | 163.00 | 0.00 | 0.00 | 0.50 | | | |
| 37 | C | 568835.99 | 575392.48 | 9.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 38 | C | 568682.12 | 574432.06 | 9.00 | 19.00 | 0.00 | 0.00 | 0.50 | | | |
| 39 | C | 568840.54 | 575413.29 | 9.00 | 157.00 | 0.00 | 0.00 | 0.50 | | | |
| 40 | C | 568849.84 | 575458.26 | 9.00 | 163.00 | 0.00 | 0.00 | 0.50 | | | |
| 41 | C | 568853.70 | 575478.25 | 9.00 | 171.00 | 0.00 | 0.00 | 0.50 | | | |
| 42 | C | 568857.57 | 575500.33 | 9.00 | 163.00 | 0.00 | 0.00 | 0.50 | | | |
| 43 | E | 568644.79 | 574788.89 | 9.00 | 176.00 | 0.00 | 0.00 | 0.50 | | | |
| 44 | E | 568625.93 | 574811.94 | 9.00 | 301.00 | 0.00 | 0.00 | 0.50 | | | |
| 45 | E | 568647.25 | 574811.94 | 9.00 | 167.00 | 0.00 | 0.00 | 0.50 | | | |
| 46 | E | 568775.86 | 575073.76 | 9.00 | 165.00 | 0.00 | 0.00 | 0.50 | | | |
| 47 | E | 568768.80 | 575052.95 | 9.00 | 158.00 | 0.00 | 0.00 | 0.50 | | | |
| 48 | E | 568847.31 | 575445.62 | 9.00 | 166.00 | 0.00 | 0.00 | 0.50 | | | |
| 49 | E | 568843.17 | 575426.19 | 9.00 | 165.00 | 0.00 | 0.00 | 0.50 | | | |

Horizontal Illuminance (lux)

Ballyhooly Road

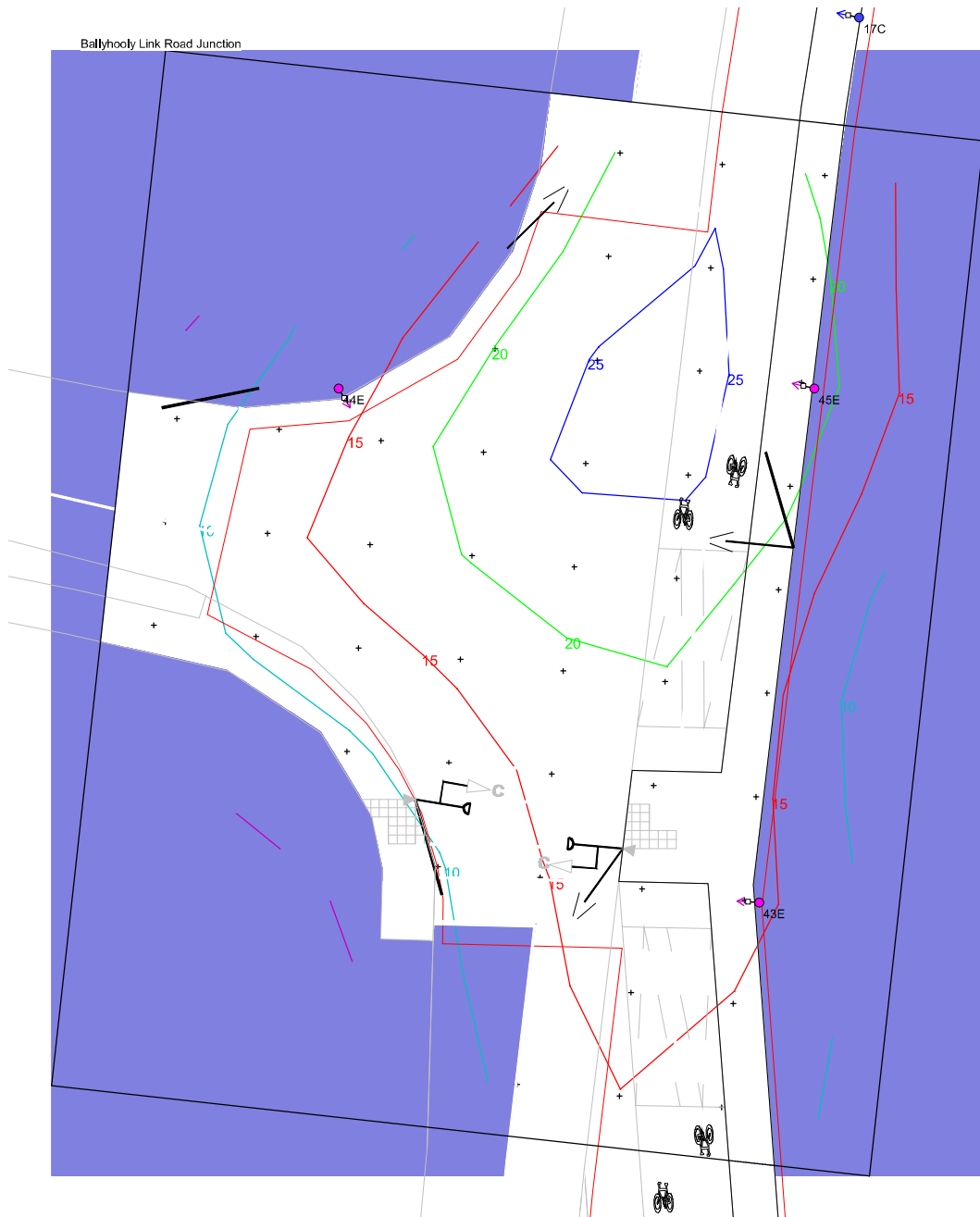


Results

| | |
|-----------|-------|
| Eav | 11.70 |
| Emin | 5.07 |
| Emax | 22.19 |
| Emin/Emax | 0.23 |
| Emin/Eav | 0.43 |

Horizontal Illuminance (lux)

Ballyhooly Link Road Junction

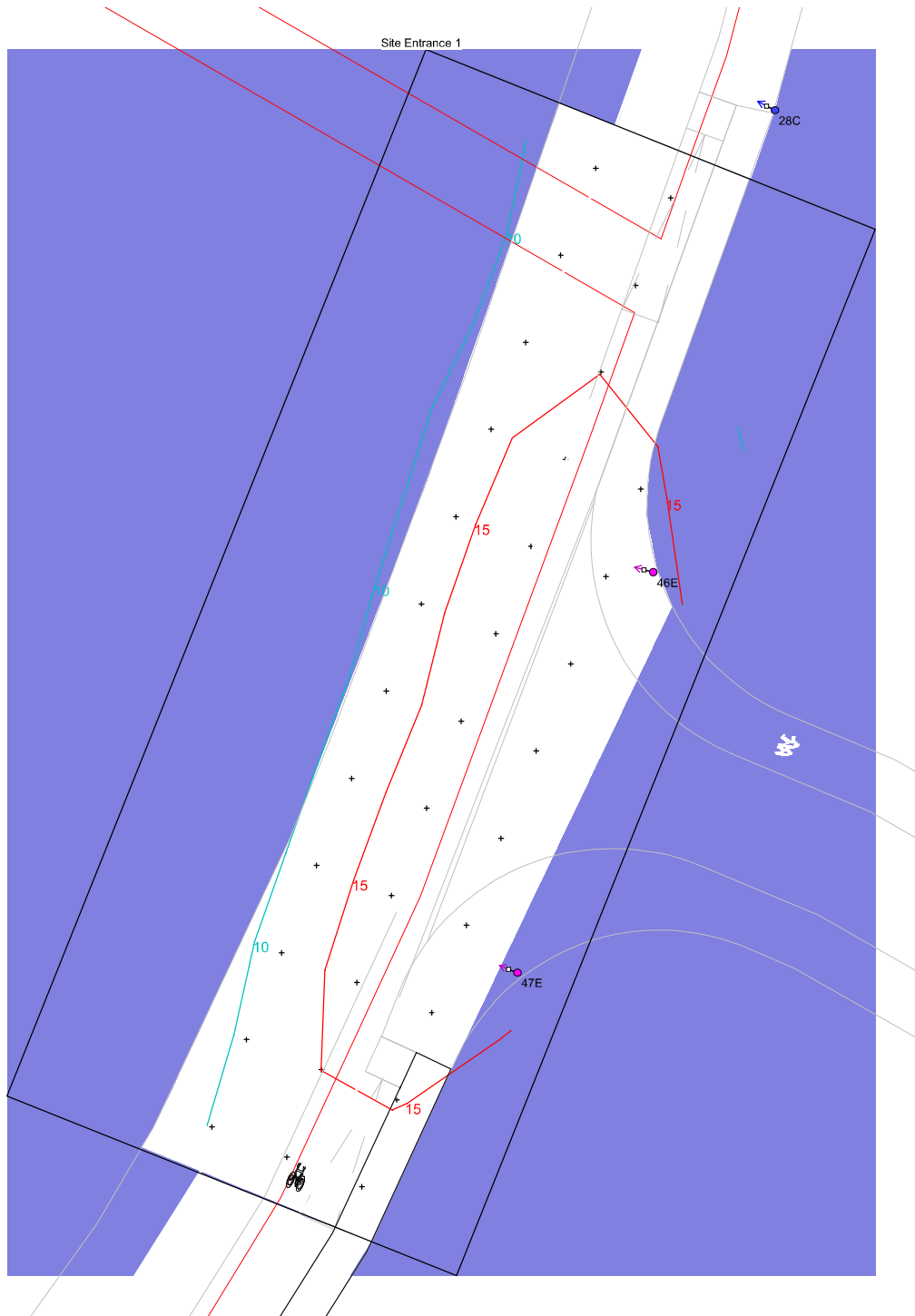


Results

| | |
|------------------------------------|-------|
| Eav | 17.52 |
| Emin | 8.05 |
| E _{max} | 25.89 |
| E _{min} /E _{max} | 0.31 |
| E _{min} /E _{av} | 0.46 |

Horizontal Illuminance (lux)

Site Entrance 1

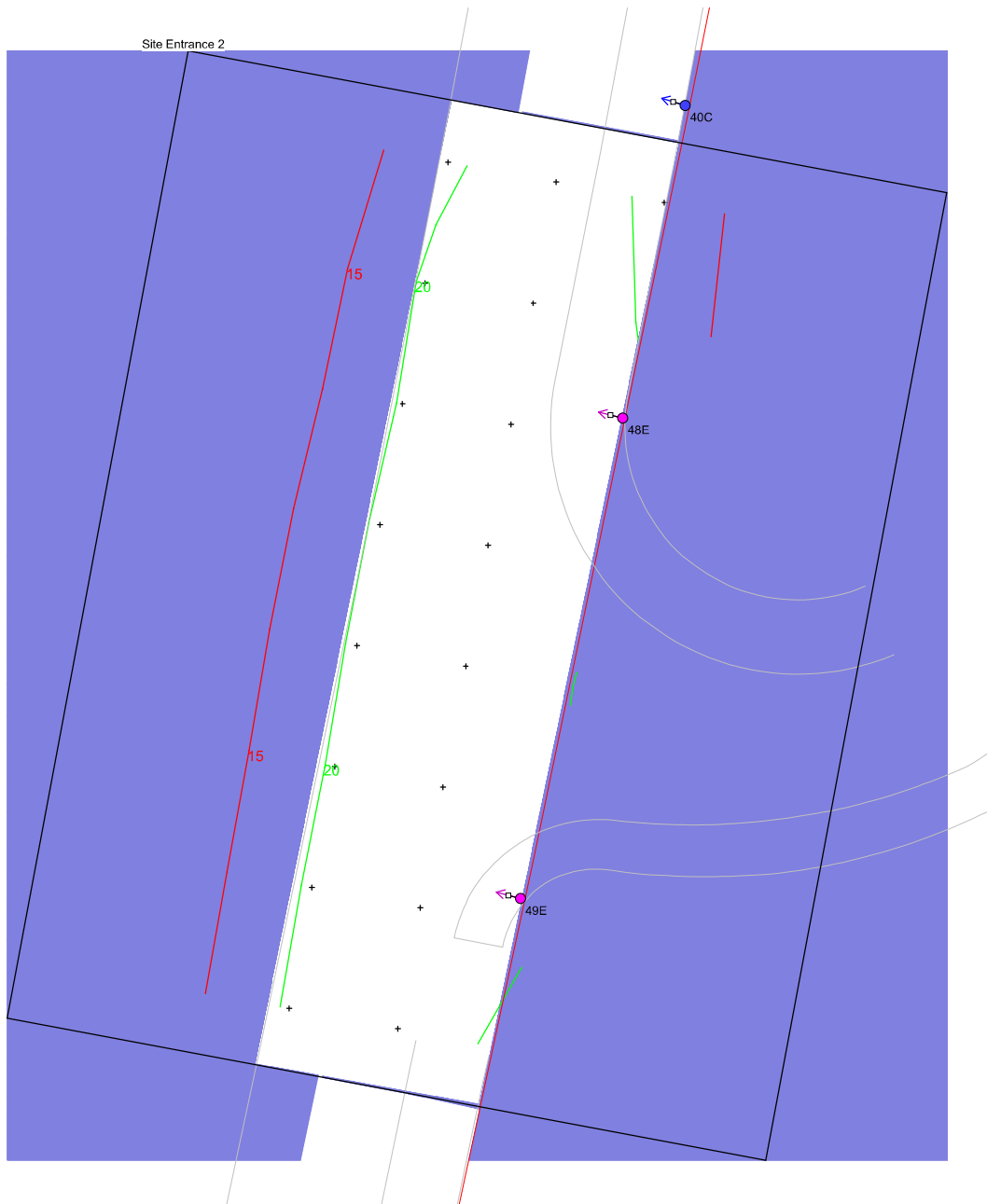


Results

| | |
|-----------|-------|
| Eav | 15.01 |
| Emin | 10.25 |
| Emax | 18.81 |
| Emin/Emax | 0.55 |
| Emin/Eav | 0.68 |

Horizontal Illuminance (lux)

Site Entrance 2



Results

| | |
|------------------------------------|-------|
| Eav | 21.78 |
| Emin | 18.63 |
| E _{max} | 24.09 |
| E _{min} /E _{max} | 0.77 |
| E _{min} /E _{av} | 0.86 |