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Proposed Strategic Housing Development
St Teresa's
Temple Hill
Monkstown
Blackrock
Co. Dublin

Main Drainage Planning Report

Job No: 2011-07
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Contents

1.0 Site Location and Proposal

1.1 Site Location

The site is approximately 5km South East of Dublin City Centre and 2.4km North West of Dun Laoghaire. The entrance junction at Temple Hill, circa 0.59Ha is inside the red boundary line but is not included in the area for the drainage calculations for the development.

The overall lands are bound to the North by established residential development along Temple Hill with St Vincent's housing neighbouring to the East and The Alzheimer's Society of Ireland to the West. The Southern edge of the site is characterised by rich woodland park area which adjoins to the public park facility and network trails known as Rockfield Park.

Access to St Teresa's is from the Avenue that starts at Temple Hill Road, the avenue is also the access for St Catherine's Provincial House to the South.

1.2 Proposal

Oval Target Limited intend to apply to An Bord Pleanála for planning permission for a Strategic Housing Development on a site of c. 3.9 ha at 'St. Teresa's House' (A Protected Structure) and 'St. Teresa's Lodge' (A Protected Structure) Temple Hill, Monkstown, Blackrock, Co. Dublin.

The development will consist of a new residential and mixed use scheme of 493 residential units and associated residential amenities, a childcare facility and café in the form of (a) a combination of new apartment buildings (A1-C2 and D1 – E2); (b) the subdivision, conversion and re-use of 'St. Teresa's House' (Block H); and (c) the dismantling, relocation and change of use from residential to café of 'St. Teresa's Lodge' (Block G) within the site development area. A detailed development description is now set out as follows:

The proposal provides for the demolition (total c. 207 sq m GFA) of (a) a single storey return (approx. 20 sq m) along the boundary with The Alzheimer's Society of Ireland; (b) the ground floor switch room (approx. 24.9sq.m.), (c) ground floor structures northwest of St. Teresa's House (26.8sq.m), (d) basement boiler room northwest of St. Teresa's House (17.0 sq.m), (e) ground floor structures northeast of St. Teresa's house (22.0sq.m.) (f) basement stores northeast of St. Teresa's house (67.8 sq.m.) and (g) a non - original ground floor rear extension (approx. 28.5 sq m) associated with the Gate Lodge.

The new development will provide for the construction of a new mixed use scheme of 487 no. apartment units in the form of 11 no. new residential development blocks (Blocks A1-C2 and D1 – E2) as follows:

- Block A1 (5 storeys) comprising 37 no. apartments (33 no. 1 bed units and 4 no. 2 bed units)
- Block B1 (10 storeys) comprising 55 no. apartments (37 no. 1 bed units, 10 no. 2 bed units, 8 no. 3 bed units)
- Block B2 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B3 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B4 (5 storeys) comprising 41 no. apartments (4 no. studio units, 4 no. 1 bed units, 27 no. 2 bed units and 6 no. 3 bed units)
- Block C1 (3 storeys) comprising 10 no. apartments (1 no. studio units, 3 no. 1 bed units and 6 no. 2 beds)
- Block C2 (3 storeys) comprising 6 no. apartments (2 no. 1 bed units and 4 no. 2 bed units) together with a creche facility of 392 sq m at ground floor level and outdoor play area space of 302 sq m.
- Block C3 (1 storey over basement level) comprising residential amenity space of 451 sq m.
- Block D1 (6 storeys) comprising 134 no. apartments (12 no. studio units, 22 no. 1 bed units, 90 no. 2 bed units and 10 no. 3 bed units).
- Block E1 (6 storeys) comprising 70 no. apartment units (34 no. 1 bed units, 26 no. 2 bed units and 10 no. 3 bed units).
- Block E2 (6 storeys) comprising 50 units (1 no. studio units, 29 no. 1 bed units, 18 no. 2 bed units and 2 no. 3 bed units).

Each new residential unit has associated private open space in the form of a terrace / balcony.

The development also provides for Block H, which relates to the subdivision and conversion of 'St. Teresa's House' (3 storeys) into 6 no. apartments (5 no. 2 bed units and 1 no. 3 bed unit) including the demolition of non-original additions and partitions, removal and relocation of existing doors, re-instatement of blocked up windows, replacement of windows, repair and refurbishment of joinery throughout and the upgrade of roof finishes and rainwater goods where appropriate.

It is also proposed to dismantle and relocate 'St. Teresa's Lodge' (1 storey) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa's Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate.

It is also proposed to dismantle and relocate ‘St. Teresa’s Lodge’ (1 storey - gross floor area 69.63sq m) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa’s Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate. A non - original extension (approx. 28.5 sq m) is proposed for demolition. The current proposal seeks a new extension of this building (approx. 26.8 sq m) and a change of use from residential to café use to deliver a Part M compliant single storey building of approx. 67.4 sq m

Total Open space (approx. 15,099.7 sq m) is proposed as follows: (a) public open space (approx. 11,572.3 sq m) in the form of a central parkland, garden link, woodland parkland (incorporating an existing folly), a tree belt; and (b) residential communal open space (approx. 3,527.4 sq m) in the form of entrance gardens, plazas, terraces, gardens and roof terraces for Blocks B2 and B3. Provision is also made for new pedestrian connections to Rockfield Park on the southern site boundary and Temple Hill along the northern site boundary.

Basement areas are proposed below Blocks A1, B1 to B4 and D1 (c. 7,295 sq. m GFA). A total of 252 residential car parking spaces (161 at basement level and 91 at surface level); 1056 bicycle spaces (656 at basement level and 400 at surface level); and 20 motorcycle spaces at basement level are proposed. 8 no. car spaces for creche use are proposed at surface level.

The proposal also provides for further Bin Storage areas, Bike Storage areas, ESB substations and switch rooms with a combined floor area of 356.2 sq m at surface level.

The development also comprises works to the existing entrance to St. Teresa’s; the adjoining property at ‘Carmond’; and residential development at St. Vincent’s Park from Temple Hill (N31/R113). Works include the realignment and upgrade of the existing signalised junction and associated footpaths to provide for improved and safer vehicular access/egress to the site and improved and safer access/egress for vehicular traffic to/from the property at ‘Carmond’ and the adjoining residential development at St Vincent’s Park.

Emergency vehicular access and pedestrian/cyclist access is also proposed via a secondary long established existing access point along Temple Hill. There are no works proposed to the existing gates (Protected Structure) at this location.

The associated site and infrastructural works include provision for water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works including tree protection; green roofs; boundary treatment; internal roads and footpaths; and electrical services including solar panels at roof level above Blocks A1, B1 - B4, C1-C3, D1, E1, E2.

Figure 1 – Proposed 493 Units

2.0 Existing Drainage Network

2.1 Site Survey and CCTV

Surface water from St Teresa’s is currently conveyed through the combined sewer network within the site boundary. The public surface water drainage network on Temple Hill Road conveys storm water West to discharge onto the culverted Carysfort-Maremtimo stream. The site generally drains South-East to North West.

Foul water from St Teresa’s is currently conveyed through the combined sewer network within the site boundary. Temple Hill Road is served by a 1200mmØ combined sewer. The combined sewers within St Teresa’s Lands discharges to the 1200mmØ combined sewer in Temple Hill Road. This trunk main is routed to the Dun Laoghaire West Pier pumping station where it is pumped to Ringsend Waste Water Treatment Works.

There is an existing 900Ø combined sewer running along the west boundary of the site, it will be diverted locally on the North West corner of the site to avoid the new basement under block A1.

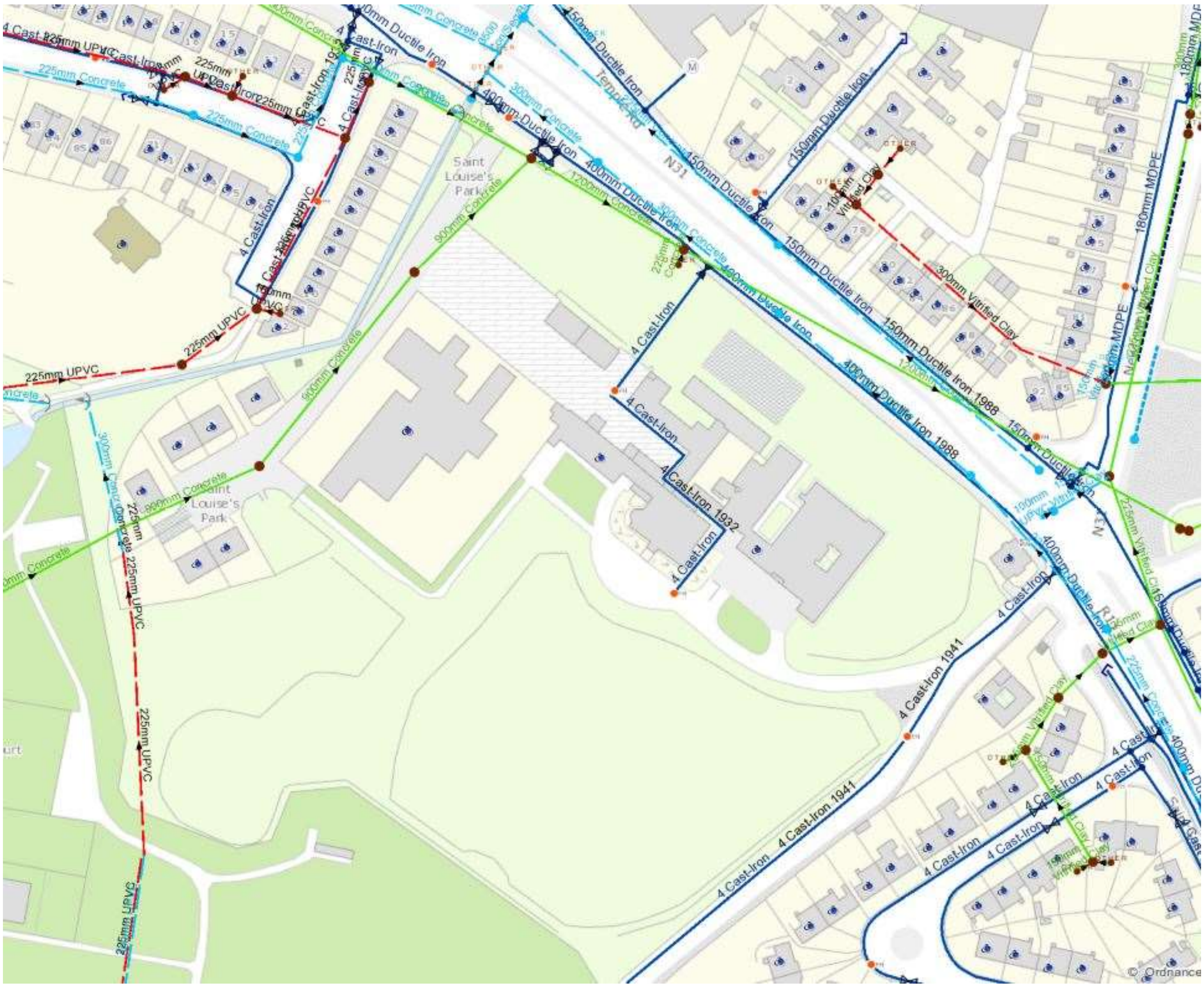


Figure 2 Existing Drainage Network (Irish Water records 16.01.2018)

3.0 Foul Effluent

3.1 Existing Foul Drains

Three existing drainage pipe runs were identified as originating outside the site and possibly serving areas or buildings outside the site.

The first is a 225mm diameter uPVC pipe which runs south to north along the western boundary of the site. This pipe is indicated on Irish Water records as Foul or Surface water along different lengths of the pipe and probably discharges to the Maretimo stream. It is not proposed to interfere with this pipe as part of this proposed development.

The second pipe is a 150mm diameter foul drain that runs south west to north east from the south eastern boundary of the site. This pipe probably serves the adjoining St. Catherines House and it appears to connect to the drainage systems serving the existing buildings on the St Teresa’s site. This pipe is not on Irish Water record drawings and it is not known if it serves buildings outside the subject site. Provision has been made in the foul water drainage design to route any flows from this pipe through the proposed development to the local authority sewer in Temple Road. There is also a 900mm diameter combined sewer which flows south to north along the entrance to St. Louise’s and The Alzheimer’s Society and then joins a 900mm diameter pipe flowing southeast parallel to Temple Road at the north entrance to the site. This pipe flows through the proposed footprint of building A1. It is proposed to divert this pipe away from building A1. These existing pipes are indicated on J.J.Campbell & Assoc. drawing numbers C2-0 – overall site plan, C2-1, C2-3 and C2-5 partial site plans.

Any other drains encountered during construction will be traced to source to discover if they are live; if they are live, they will be connected into the proposed drainage system in order to conduct the existing flows to the public sewer in Temple Road. If the pipes prove to be redundant, they will be grubbed up and removed from under buildings and structures and any remaining pipes left in the ground will be stopped and allowed remain in place.

3.2 Proposed Foul Effluent

The proposed St. Teresa's SHD comprises of 493 units in residential units total and conversion of gate lodge into a small Café.
Adopting the loading provided in the Irish Water guidance document Code of Practise for Wastewater Infrastructure (Ref: IW-CDS-5030-03 Dec 2016) section 3.6 the foul effluent discharging from the site is estimated at:

Block A1 – 5 Story - 37 Units:
(447L/D/day x 37 Units x 6DWF) / (24x60x60): 1.2L/Sec

Block B1 - 10 Story - 55 Units
(447L/D/day x 57 Units x 6DWF) / (24x60x60): 1.8L/Sec

Block B2 - 8 Story - 42 Units
(447L/D/day x 42 Units x 6DWF) / (24x60x60): 1.3L/Sec

Block B3 - 8 Story - 42 Units
(447L/D/day x 42 Units x 6DWF) / (24x60x60): 1.3L/Sec

Block B4 - 5 Story - 41 Units
(447L/D/day x 41 Units x 6DWF) / (24x60x60): 1.3L/Sec

Block C1 - 3 Story - 10 Units
(447L/D/day x 10 Units x 6DWF) / (24x60x60): 0.31L/Sec

Block C2 - 3 Story - 6 Units
(447L/D/day x 6 Units x 6DWF) / (24x60x60): 0.18L/Sec

Block C3 - 2 Story - Amenity
(447L/D/day x say 6 Units x 6DWF) / (24x60x60): 0.18L/Sec

Block D1 - 6 Story - 134 Units
(447L/D/day x 134 Units x 6DWF) / (24x60x60): 4.2L/Sec

Block E1 - 6 Story - 70 Units
(447L/D/day x 70 Units x 6DWF) / (24x60x60): 2.2L/Sec

Block E2 - 6 Story - 50 Units
(447L/D/day x 50 Units x 6DWF) / (24x60x60): 1.6L/Sec

St Teresa House 6 Units
(447L/D/day x 6 Units x 6DWF) / (24x60x60): 0.18L/Sec

Gate Lodge: Café
2 staff @ 15L/person/day: 30L/day
150 patrons @ 60L/person/day: 9000L/day
Total: (30 + 9000) x 6DWF / 24x60x60: 0.63L/Sec

Total discharge to public sewer: 16.38L/Sec

Sewers within the development will be typically be laid at;

Main collector Sewer:	DN225 not flatter than 1:80
Secondary Sewers:	DN225 not flatter than 1:60

Design falls are called up on longitudinal section drawings C2-10 and C2-11. Invert and cover levels are called up on drawings C2-0 to C2-6.

Self-Cleansing Velocity

See ISEN 7524 (1998) Part 4. - Drain and sewer systems outside buildings
Hydraulic Design Clause 8 Self Cleansing Velocity.

For small diameter drains and sewers less than DN 300, self-cleansing can generally be achieved by ensuring that a velocity of at least 0.7 m/s occurs daily or that a gradient of 1:DN is specified

Outfall Connection

The foul drain will connect to the existing 300Ø combined sewer located within the site boundary on Temple Road, it then discharges to an existing manhole on the public 1200Ø public combined public sewer.

4.0 Proposed Storm Water Proposals

It is proposed to separate the storm runoff from the existing and proposed buildings and to use SuDS techniques, as per the Greater Dublin Strategic Drainage Study (GDSDS), to control stormwater discharge from the site. The proposals are set out in detail below. A storm water carrier pipe will be provided around the site to intercept runoff and, where located within filter drains, will be perforated pipe.

Because of the sloping topography of the site, it is proposed to make two surface water connections serving two zones each comprising approximately 50% of the site area.

Surface Water Connection No 1 is for Zone 1 and connects to the existing public sewer 9002 on the North East side of the site.

Surface Water Connection No 2 is for Zone 2, 50% of the propose development and connects to the existing public sewer manhole on the North corner of the site.

The collection system has been assessed with a view to minimizing excavation depths, in circumstances where, due to the nature of the site, some deep pipe runs are necessary. Invert levels have been set to minimize trench depths while maintaining pipe velocities.

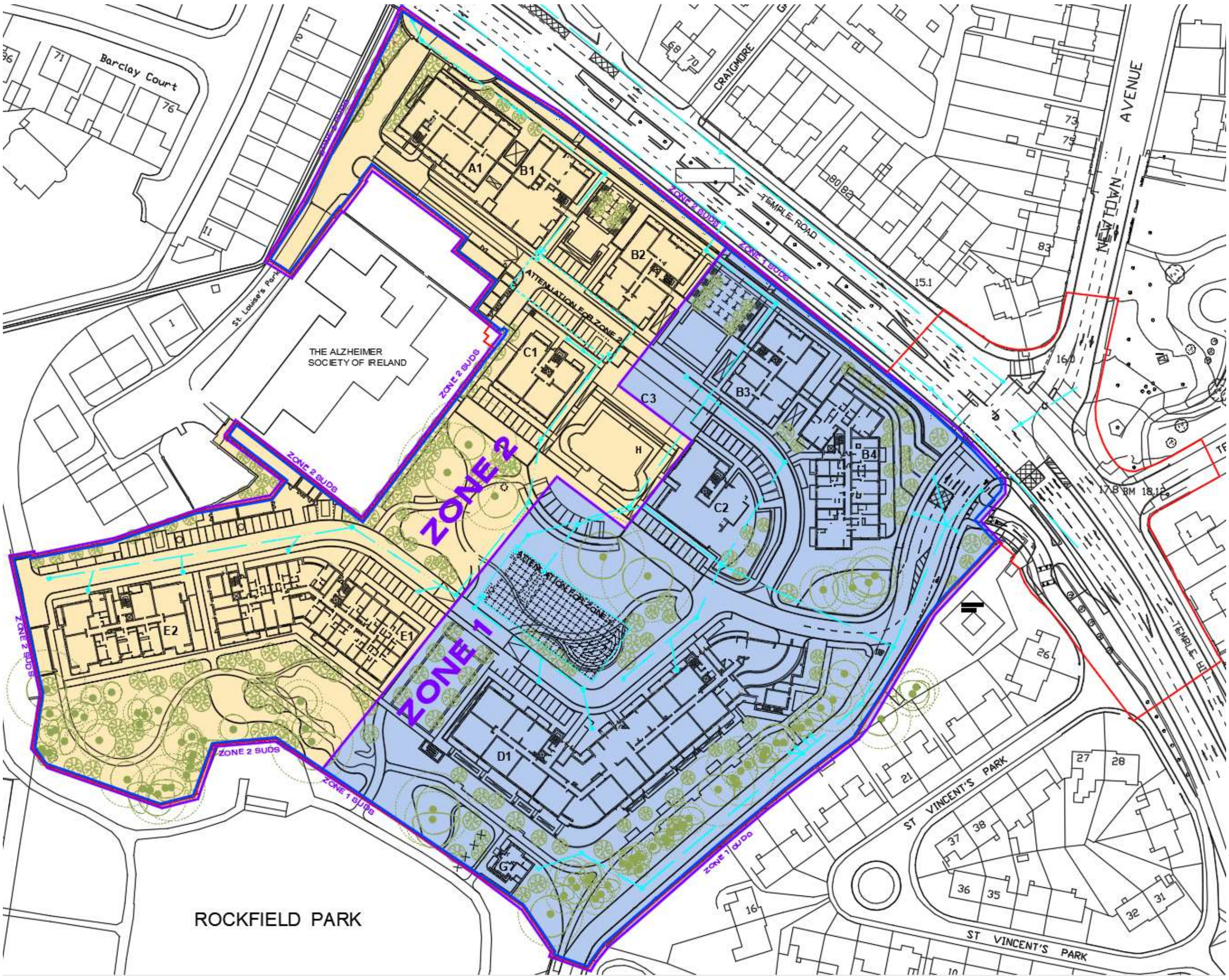


Figure 3 Surface water drainage zones.

4.1 Soil Type

The UkSuds web site tool for estimating the Greenfield run rate was used to check for the soil type, which it gave as Soil Type 4. However, the Site Investigation Report, included as Appendix M, showed that 50% of the soakaway tests passed and 50% had poor / failed, and on a conservative basis, a worse case soil Type 3 has been assumed for this project and an SPR (Standard Percentage Runoff) of 0.37.

4.2 Qbar and Flow Control

At the request of DLRCC Drainage Department, Qbar (net) and not Qbar (whole site) was used to calculate the allowable discharge from the positivity drained areas such as roads, roof's, etc, see drawing C3 for area calculations.

As recommended by DLRCC, Q_{bar} was assessed using the UK Suds online tool. Soil type 3, SAAR (Average Annual Rainfall) 900mm and an area of 2.1189Ha giving an allowable discharge for the positively drained areas of 8.17 l/s, see Appendix A.

Storage volume was calculated using rainfall data provided by MET Eireann for the site. This data is reproduced as Appendix C in this report.

An attenuation volume of 1600m^3 is provided for the whole site. This storage is divided between a "stormtech" below-ground attenuation structure, situated adjacent to buildings E1 and E2, providing 800m^3 of storage and a reinforced concrete tank beside B2 under the road, also providing 800m^3 of storage. As these storage systems are connected independently to the local authority collection system, each connection is provided with a flow limiting device (Hydro-brake) set at 4.1 l/s so that the total flow from the site is 8.2 l/s.

Utilising the on-line Hydro International design tool for assessing hydro-brakes and assuming a maximum head of 1.4m for the Stormtech and 2.11m for the concrete tank, the appropriate hydro-brake has been designed as set out in Appendix G. The Hydro International drawings show a bypass valve but the hydro-brake shall be ordered without a bypass which is specified on attenuation drawings C6-2 and C6-3.

4.3 SuDS Proposals

The design proposals are based on the GDSDS guideline document and on the Development Plan 2016-2022 policy requirements, and in particular policy E18 in Section 5: Sustainable Drainage Systems;

- A **green roof** is proposed on the apartment blocks, at a minimum of 60% of the flat roof surface area, and will be installed as per Appendix 16 in Dun Laoghaire Rathdown Development Plan 2016 – 2022. See drawing C11 for calculation of areas. The green roof will be the Bauder system, or similar, details of which are included in Appendix B to this report. This system allows for the installation of photovoltaic panels above the green roof without loss of effective area of the roof. The green roof will be connected to the new surface water system.

  Access to the roofs for maintenance will be via the automatic opening vents at the top of the stairwells in each building. Secondary access to the roofs will be by a cherry picker from the adjoining roads for maintenance.

- **Dry swales / infiltration trenches** are a useful and natural means of surface water collection and treatment of the first 5mm of runoff. The application of swales / infiltration trenches was examined as part of the design process. Because of the mature trees, to be retained as part of the development, the widespread use of swales cannot be implemented as the necessary trenches would damage the tree root systems, but swales / infiltration trenches shall be installed where they do not damage existing mature trees, see C2 and C7 for locations.

  Similar issues could potentially arise regarding traditional pipe drainage in trenches, however, the piped drainage system for the development site has been designed to avoid heavily rooted areas, particularly along the main access avenue. It is anticipated that the road surface along the access avenue will be replaced as part of the development. As part of the surface replacement works, a cross-fall will be incorporated into the road surface so that rainwater will be directed onto landscaped areas and thereby flow overland to the drainage system. This ensures that low intensity rainfall on the avenue will not reach the drainage system as it will be infiltrated directly into the soil and that any water reaching the drainage system will have a degree of pre-treatment before entering the drainage system. Provision has been made at two key points along the avenue to collect water from the road surface in order to prevent flooding on the avenue from significant rainfall events.

- **Permeable paving** will intercept the first 5mm of runoff from all impermeable areas of the site. 50% of the onsite soakaways passed and 50% had poor / failed infiltration, a high level perforated overflow pipe will be provided from the permeable pavements and will connect to the new gravity storm network, some infiltration will take place in the stone below the areas with poor / failed infiltration and the overflow pipe will retain flow which will slowly infiltrate or evaporate.

- Because of the sloping topography of the site, Suds / attenuation has been divided into 2 separate Zones:
  Zone 1, south end of the site has 50% coverage, Stormtech or similar below-ground attenuation structures will be used to attenuate the 100yr storm event.
  Zone 2,northern end of the site has 50% coverage, attenuation tank located beside building B2 will be used to attenuate the 100yr storm event.

- 20% increase in rainfall rates, as provided by Met Eireann, will be incorporated into the design to allow for climate change. See Appendix C for rainfall data

In accordance with the GDSDS the criterion requirements as set out in Table 6.3 are to be complied with in the following manner;

- **Criterion 1** – River Water Quality Protection:
  Criterion 1 is achieved by the interception storage of at least 5mm of rainfall where runoff to the receiving water can be prevented.
  CIRIA Report C753 defines Interception as the capture and retention on site of the first 5mm of the majority of all rainfall events.

  Interception areas are broken down into Zone 1 and Zone 1 and are further broken down into 13 separate areas on drawing C7.

  As the interception volume is provided, no further treatment volume, Vt is necessary for this development (ref. GDSDS volume 2, chapter 6, table 6.3).

  Extensive Geen Roofs (Bauder):
  CIRIA Report C753, Table 24.6 states that all surfaces that have green roofs meet Criterion 1. All new building within the development have minimum 60% green roofs, the non-green element of the green roof shall discharge to the green roof areas. Bike sheds, bin store sheds, ancillary buildings etc. all have 100% green roofs, see drawing C11.

The green roofs also have a storage of:

60% Green Roof (See drawing C11):	3955m²
Soil:	0.029m³/m²
DSE60 Drainage Layer:	0.013m³/m²
Fleece:	0.003m³/m²
Total Storage: 0.045m³/m² x 3955m² =	**178m³**

Permeable Paving:

CIRIA Report C753, Table 24.6 states that all permeable paving, whether lined or not can be assumed to comply, provided there is no extra area drained to the permeable pavement.

Where the pavement also drains an adjacent impermeable area, compliance can be assumed for all soil types where the pavement is unlined, as long as the extra paved area is no greater than the permeable pavement area.

Where the infiltration capacity of the ground below the pavement is greater than $1x10^{-6}$ m/s, up to 5 times the permeable pavement area can be added as extra contributing area.

Drawing C7, Interception Areas, shows the interception areas broken down into 13 areas. The maximum ratio of impermeable pavement to permeable paving is 1:5 where the infiltration capacity of the ground below the permeable paving is greater than $1x10^{-6}$ m/s.

50% of the soakaway tests passed and 50% of the soakaways had poor / failed infiltration. The locations where infiltration is poor, some infiltration will take place along with evotranspiration. The ratio of impermeable paving to permeable paving ranges from 1:0.25 to 1:3.5, see drawing C7 which also gives storage in the permeable paving.

Permeable paving also has storage of:

Area, See drawing C2:	1409m²
350 stone sub-base:	30% voids
Total Storage: 1409m² x 0.35m x 30% voids =	**148m³**

Dry Swale / Infiltration Trench

CIRIA Report C753, Table 24.6 states that areas up to 25 times the base plan of the basin can be assumed to meet interception requirements where infiltration rates are greater than $1x10^{-6}$ m/s.

Where the infiltration is poor, some infiltration along with evotranspiration will take place in the infiltration trench which is filled with stone with 30% voids. The ratio of impermeable paving to base plan of swale ranges from 1:6.2 to 1:23.4, see drawing C7.

Dry swales / infiltration trenches also have storage of
See drawing C2, C2-7 and C7 126m
Total Storage: 126m x 1m x 0.6m x 30% voids = **23m^3**

Interception storage provision will be for 5mm rainfall over 80% of hard standing areas on the site. Landscaped areas, Green roofs and permeable paving satisfy this requirement for those paved or green areas.
Interception storage will be provided equivalent to the first 5mm of rainfall falling on remaining impervious areas.

Interception volume is required to cater for 5mm rainfall on 80% of paved (impervious) surfaces.

Roofs / incl. balconies:	12,489 m^2
Roads:	5,200m^2
Parking:	1332m^2
Paths:	2300m^2
Total contributing area =	21,321m^2
Interception volume required = 21,321 * 0.8 *.005 =	85.3m^3 < 349m^3 provided.

- **Criterion 2** – Storage/attenuation volumes will be assessed using Criterion 4.3

- **Criterion 3 -** there will be no flooding on site for the 30 year storm and no property flooding for the 1 in 100 year storm. FFL levels will be a minimum of 500mm above TWL;

- **Criterion 4** – Criterion 4.3 is used assessing attenuation for all storage using the pass forward control of Qbar of 8.17l/s for the whole site.

4.4 Attenuation Proposal

The overall storage requirement for the development is 1600m³ for the 100yr storm event, see attached calculations in Appendix D.

For the sake of completeness, it should be noted that the possibility of attenuating the storm water greater than the 30 year volume in attenuation ponds has been examined. However, having considered the possibility, attenuation ponds are not proposed because the site geometry is not conductive to the hydraulic design of such ponds. If attenuation ponds were to be used, it would be necessary to pump stormwater into any attenuation pond on the site and consequently control the release of waters when the drainage system has capacity to receive them, if the pumps fail or there is a power cut during a storm event it would cause extensive flooding.

Thus, the chosen option if that the stormwater volume from a 100 year event will be stored in underground attenuation structures on the site. The attenuation structures have been checked for flotation and for structural integrity under the loads that are predicted in service and during construction.

Because of the topography of the site it has been divided into 2 separate Zones, see 4.3 above.

Zone 1:

Below ground attenuation structure

50% of Site and 100 yr storage required: 800m³

Zone 2:

Attenuation tank below building B1

50% of Site and 100 yr storage required: 800m³

<u>Pass forward Q = 8.17l/s/2 for whole site = 4.1l/s for Z1 and 4.1l/s for Z2</u>

The storage calculation is attached in Appendix D and allows for 20% climate change for the 100 year storm return.

4.5 Other SUDS features.

The alternative of normally dry attenuation ponds was examined for retention of exceptional rainfall. These ponds would be designed to begin to fill when the below ground attenuation storage required for the 30 year rainfall event had reached and would provide attenuation storage at surface level for events up 100 year return period. However, in order for these ponds to function effectively, the drainage system must be able to overflow into them before it overflows anywhere else; the system is allowed to flood into the dry basin before flooding occurs elsewhere. For this to happen, the basin/pond must be situated at the low point of the site. As the available area for such a pond is at the high point of the site, flooding could occur in low lying areas before the attenuation pond would activate. For this reason dry attenuation basins were not adopted in the design.

Issues arise regarding traditional pipe drainage in trenches similar to the inclusion of swales, however, the piped drainage system is designed to avoid heavily rooted areas, particularly along the main access avenue. It is anticipated that the road surface along the access avenue will be replaced as part of the development. As part of the surface replacement works, a cross-fall will be incorporated into the road surface so that rainwater will be directed onto landscaped areas and thus by overland flow to the drainage system. This ensures that low intensity rainfall on the avenue will not reach the drainage system as it will be infiltrated directly into the soil and that any water reaching the drainage system will have a degree of pre-treatment before entering the drainage system. Provision has been made at two key points along the avenue to collect water from the road surface in order to prevent flooding on the avenue from significant rainfall events.

4.6 Blockages and Flood routing.

The effect of blockages occurring at critical points in the system was examined in order to ensure that any flood flows will be away from buildings. The locations chosen and consequential flows are listed below.

Event	**Consequence**
1. The outlet hydrobrake at the attenuation tank for drainage zone 2 blocks.	Outlet manhole cover will rise due to water pressure, causing flooding and overland flows from the manhole towards the Maretimo stream. Ground levels and kerbs direct overland flow away from buildings A1 and B1.
2. The inlet manhole to the attenuation tank for drainage zone 2 blocks.	The inlet manhole cover and the manhole adjacent to building E1 are most vulnerable to rising due to water pressure due to site levels. Overland flow from these manholes will be

	away from buildings and towards watercourses.
3. The inlet or outlet manholes serving the stormtech attenuation structure for drainage zone 1 blocks.	The most vulnerable manholes, those with lowest cover levels, are those adjacent to building B4 and that at the Main entrance to the development. If water backs up sufficiently for any of these manhole covers to leak, the overland flow will be away from building B4, towards Temple Hill road.
4. A 50% blockage of the hydrobrake serving zone 1 was modelled using Causeway software.	The analysis indicates that the collection system will surcharge for a number of storm criteria, however a minimum of 300mm freeboard will be maintained at all manholes and there is no risk of flooding indicated by the analysis.
5. A 50% blockage of the hydrobrake serving zone 1 was modelled using Causeway software.	The analysis indicates that the collection system will surcharge for a number of storm criteria, however a minimum of 300mm freeboard will be maintained at all manholes and there is no risk of flooding indicated by the analysis.

Drainage analysis results for zones 1 and 2 are presented in Appendix E and F.

4.7 Surface Water Audit

An independent audit of the surface water design was carried out by JBA Consulting Engineers, see Appendix I.

5.0 Water Supply

The site is served by 2 No. 100Ø water main spurs which are connected to an existing 400Ø watermain in the path that runs along Temple Road – see Figure 5.1 below.

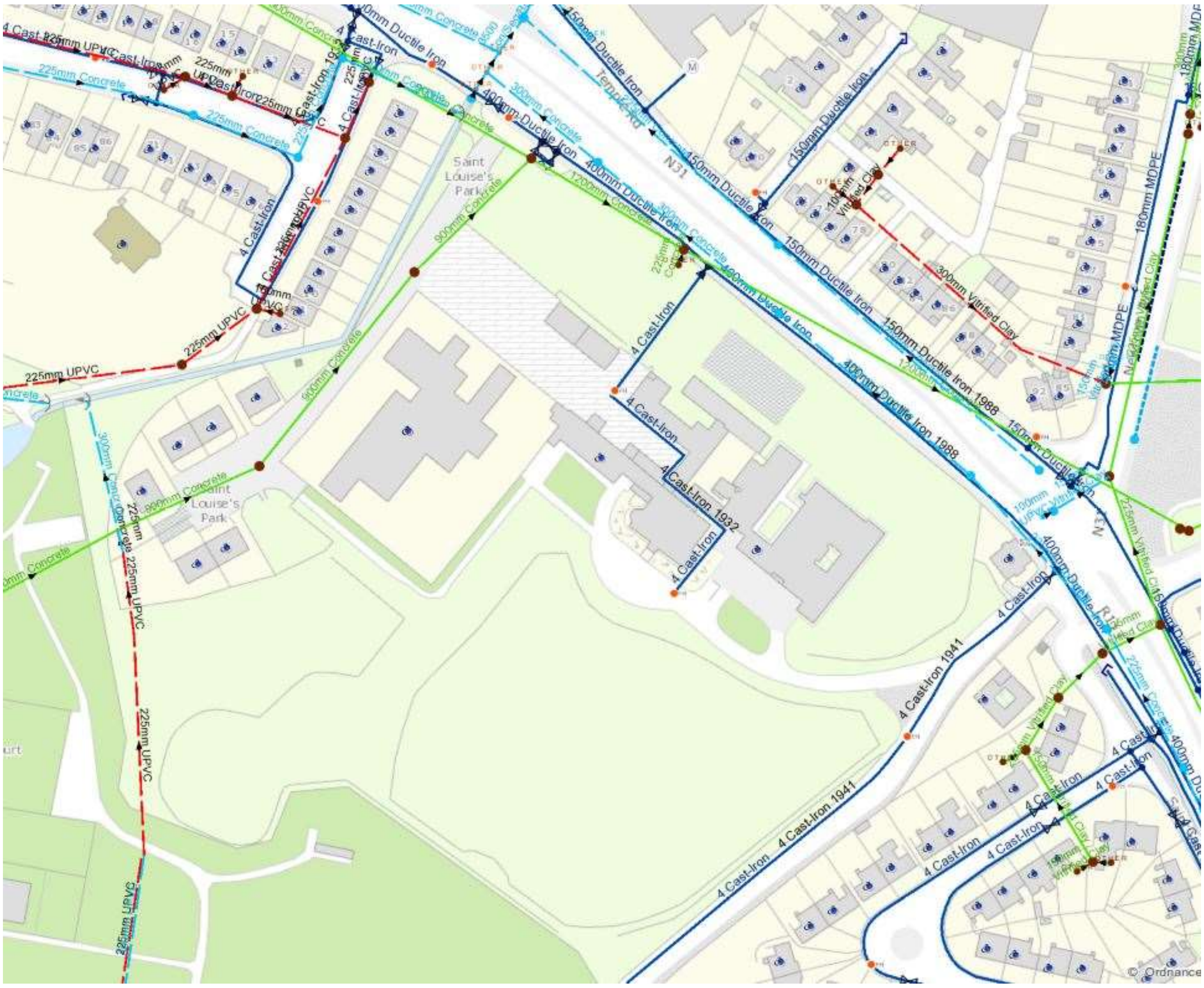


Figure 4 Existing water main.

A 200mm I.D. MDPE pipe (type PE 80 and SDR 11) will be provided, looped around the development to serve each unit. Fire hydrants will be provided to ensure that no unit is more than 46m away from an accessible hydrant.

The average domestic daily demand is 150l/hd/day and 2.7 persons/dwelling gives a demand of 199,665/day. The peak demand is 1.25 x average = 249,581 l/d

In accordance with Irish Water Code of Practise for Water Infrastructure s2.6.7, where flow is more than 20m³ per day there is a requirement to fit a bulk meter to measure the water demand of the development

6.0 Pre-application interactions

6.1 Irish Water

Proposed 493 Unit Scheme

A new pre-connection enquiry for 521 Units was issued to Irish Water on 17th April 2020 and acknowledgement email received on 20th April 2020, reference number 0883622. A confirmation of feasibility, letter reference CDS20002536, dated 10th June 2020 has been received and is included herewith as Appendix J.

An application for a "Statement of Design Acceptance" was made to IW on the 25th February 2021 and confirmation of acceptance was received on the 8th August 2021, reference number CDS20002536, see Appendix K.

6.2 Dun Laoghaire Rathdown County Council (DLRCC)

An online, pre-application meeting was held in relation to the 493 unit proposed development.

7.0 Flood Risk Assessment

A Flood Risk Assessment has been carried out by JBA for the 493 unit scheme, see Appendix H.

Summary:
In 2011 the North West corner of the site flooded to a depth 0.25m, 40m into the site of the proposed development.

The recently installed concrete flood defence wall along the Carysford – Maretimo now gives flood protection for the 1:100 year storm event.

The flood risk assessment predicts a level of 12.75m o.d. for the 1:1000 year flood event. The ground floor level of the lowest building, Building A1, has been set at 13.15m o.d., i.e. 400mm above predicted flood level. All other ventilation openings to the basement of building A1 will also be set at 13.15m o.d., or higher.
The entrance level to the basement carpark has also been set at this level. All drainage from the carpark will be pumped in order to prevent any backflow from flooding the basement.

Vehicular access to the residential units is from the new entrance on the North East corner of the site and not from the existing entrance in flood zone A. Pedestrians can also access the residential units from the East and do not have to cross flood zone A. In the unlikely event of flooding vehicles and pedestrian can safely access all the residential units and underground car parks.

8.0 Slope stabilisation and root protection.

8.1 Slope stabilisation.

The stepped landscaped area at block B4 and Temple Hill Road will be set out as grassed terraces. The average slope of the area is about 1m fall in 10m, however, as the area will be terraced, there will be local slopes in the region of 1m fall in four. In order to stabilise the soil in this area and to prevent erosion, a geogrid product, Terram Geocell, or similar, will be used to stabilise the surface.

8.2 Root protection.

The main access avenue and the access route through the site to lands to the south of the site are to be constructed adjacent to the root systems of mature trees. The roots under these roadways will be protected from traffic loads by constructing a relatively thin concrete slab, (in the region of 225mm), supported on insitu mass concrete columns or piles at close centres, see drawing C5 for details. The loads will be transferred through the slab to the piles and thus to the soils below the root zone.

A number of footpaths and jogging routes are proposed through existing wooded areas. These paths will also accommodate light maintenance traffic. The existing root zones will be protected by using proprietary products such as Terram Geocell to bind the base materials, thereby providing an all-weather surface that is not prone to rutting or heave under light wheel loads. The relevant areas are indicated below.

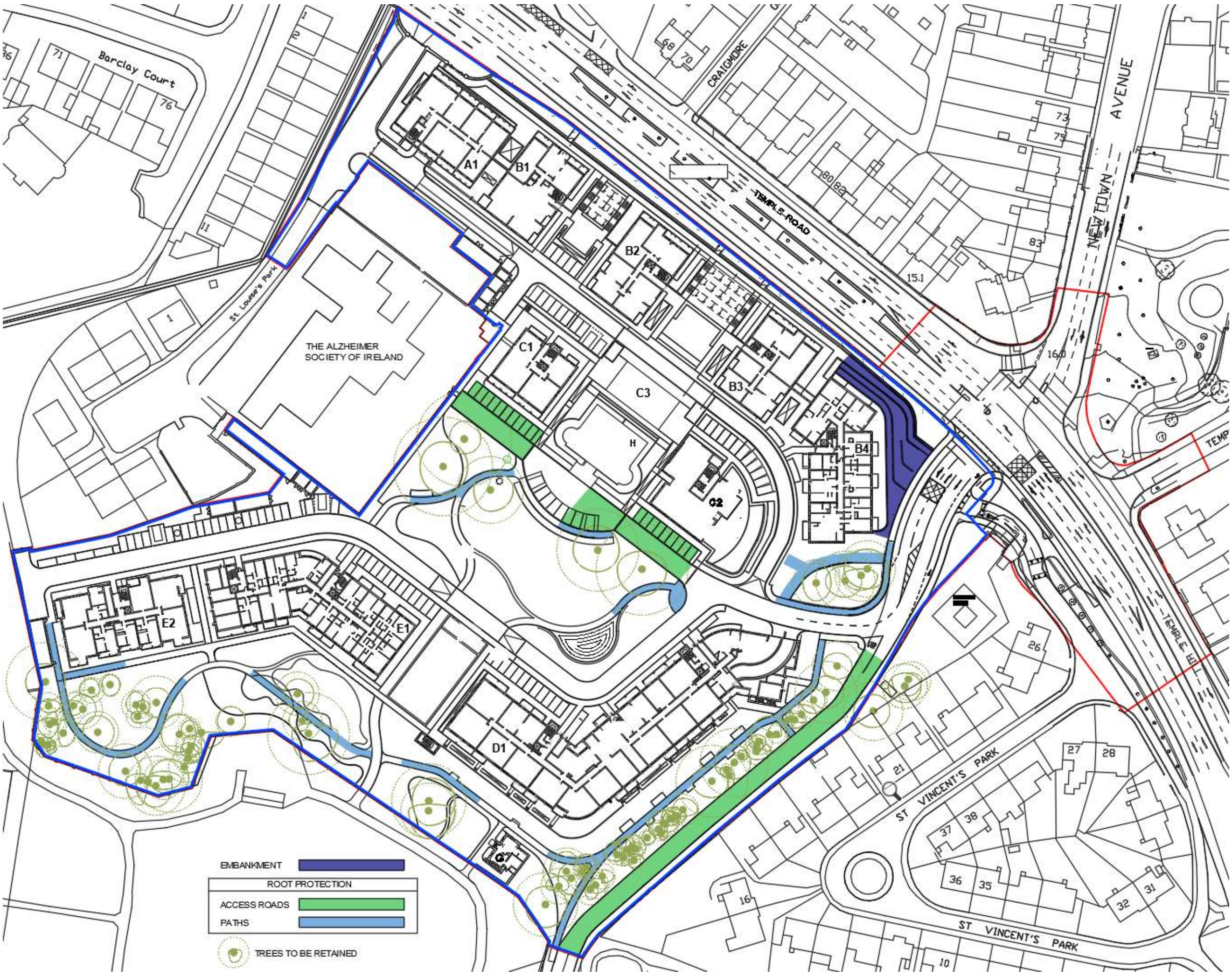


Figure 5 Protection in roads shown green, root protection in paths shown blue, embankment stabilisation shown purple.

Appendices

Appendix A – Greenfield Runoff Q_{bar} – UKSuds.com Website

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Marcus Wallace

Site name: Temple Hill

Site location: Blackrock

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude: 53.29696° N

Longitude: 6.17362° W

Reference: 253983227

Date: Sep 27 2021 15:47

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 2.1189

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	900	900
Hydrological region:	12	12
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.13	2.13
Growth curve factor 100 years:	2.61	2.61
Growth curve factor 200 years:	2.86	2.86

Notes

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

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

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

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

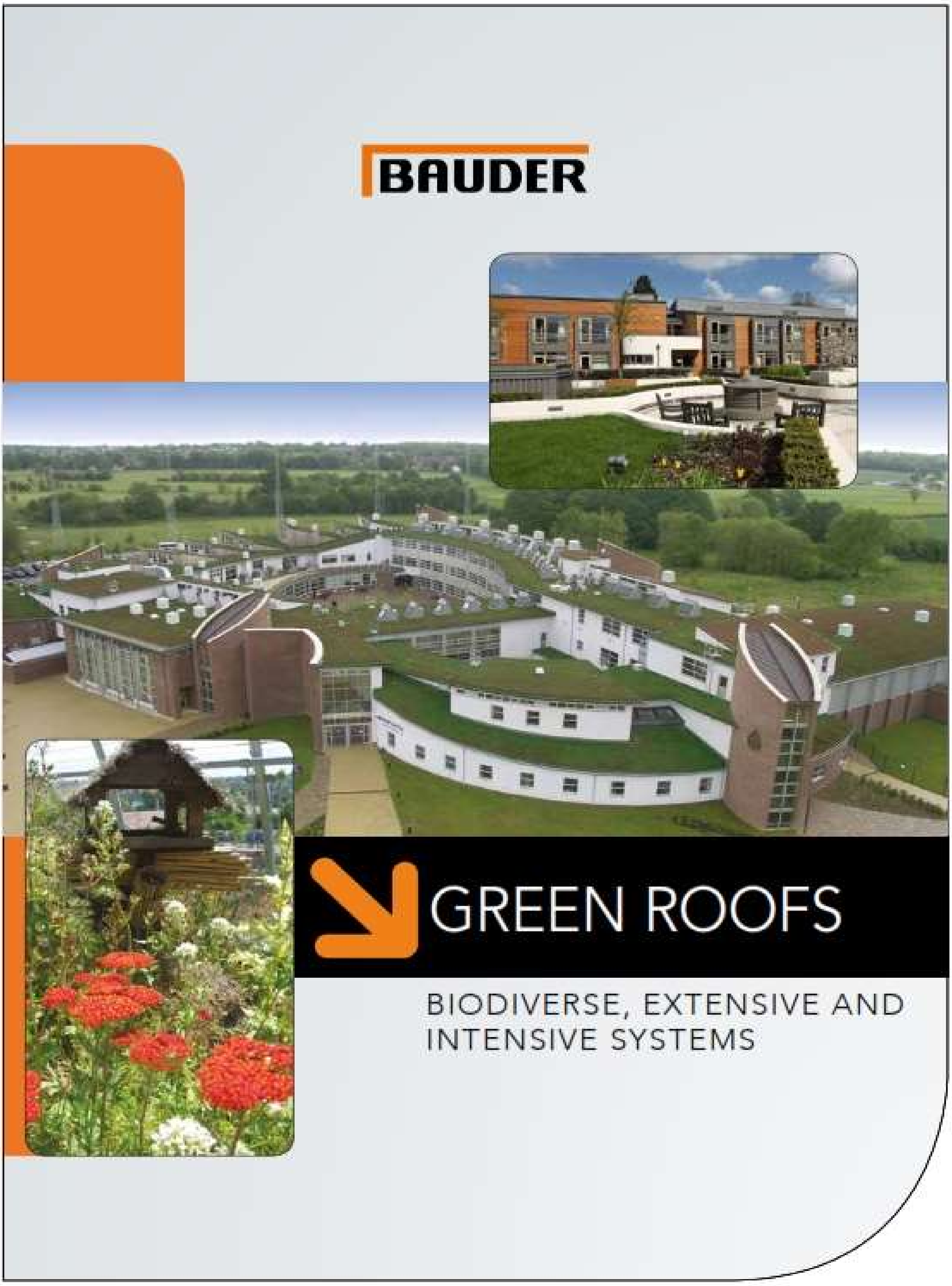
(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	13.73	8.17
1 in 1 year (l/s):	11.67	6.94
1 in 30 years (l/s):	29.24	17.4
1 in 100 year (l/s):	35.83	21.32
1 in 200 years (l/s):	39.26	23.36

Appendix B – Green Roof – Bauder Manufacturers Details



BAUDER

GREEN ROOFS

BIODIVERSE, EXTENSIVE AND INTENSIVE SYSTEMS

OUR COMPANY

Who We Are

Bauder is one of Europe's leading manufacturers of flat roof waterproofing membranes and insulation products that has been owner-operated for over 150 years across 13 countries. We have an enviable reputation and track record for delivering the highest quality materials and service through supplying and project managing the installation of premier flat roof systems.

Our comprehensive portfolio of flat roof waterproofing systems, green roofs and photovoltaic energy delivers an extensive range of solutions to meet individual project needs without compromise.

"Manufacturing the highest quality roofing materials is one thing, but here at Bauder it is our total commitment and passion to work closely together with our clients to successfully deliver every product to the highest possible standard, that sets us above the rest."

Andrew Mackenzie
Managing Director
Bauder Ltd

What We Do

Bauder is fully committed to providing a complete service with an unrivalled level of support on all roofing projects, whether it's for a new build project or the refurbishment of an existing building.

Technical Expertise

Our large team of regionally based technical managers and site technicians will be on hand throughout the process, from specification design through to inspection of the installation and project completion to ensure a defect free finish.

Our technical department is the envy of the industry, providing a comprehensive and superior service with bespoke specifications individual to each project. Our support services ensure that products and materials all arrive on site when required providing an efficiency that all our clients demand.

Assured Quality

To ensure a consistent and proficient service, Bauder approved contractors are the only people fully trained and certified to install our products. We only approve contracting companies that possess the technical expertise and the organisational capacity to maintain an efficient and well-run site.

We have always operated a policy where we train and approve the individual installer and not just the company they work for. By taking installers with proven experience and demonstrating the techniques particular to our system, we can ensure the quality of workmanship that meets our clients' expectations.

Every operative receives an identity badge providing proof of competence, which is available for inspection at all times.

Guaranteed Satisfaction

Bauder is noted throughout the industry for the range of guarantees we offer that can cover design, products and installation. We unreservedly issue our guarantees on all projects because we monitor quality every step of the way from manufacture to finished installation.

GREEN ROOF SYSTEMS

Committed to utilising the very latest manufacturing technology, Bauder invests in a programme of continuous research and development to ensure every product and installation is ahead of industry standards, and that the needs of the environment are always kept in focus.

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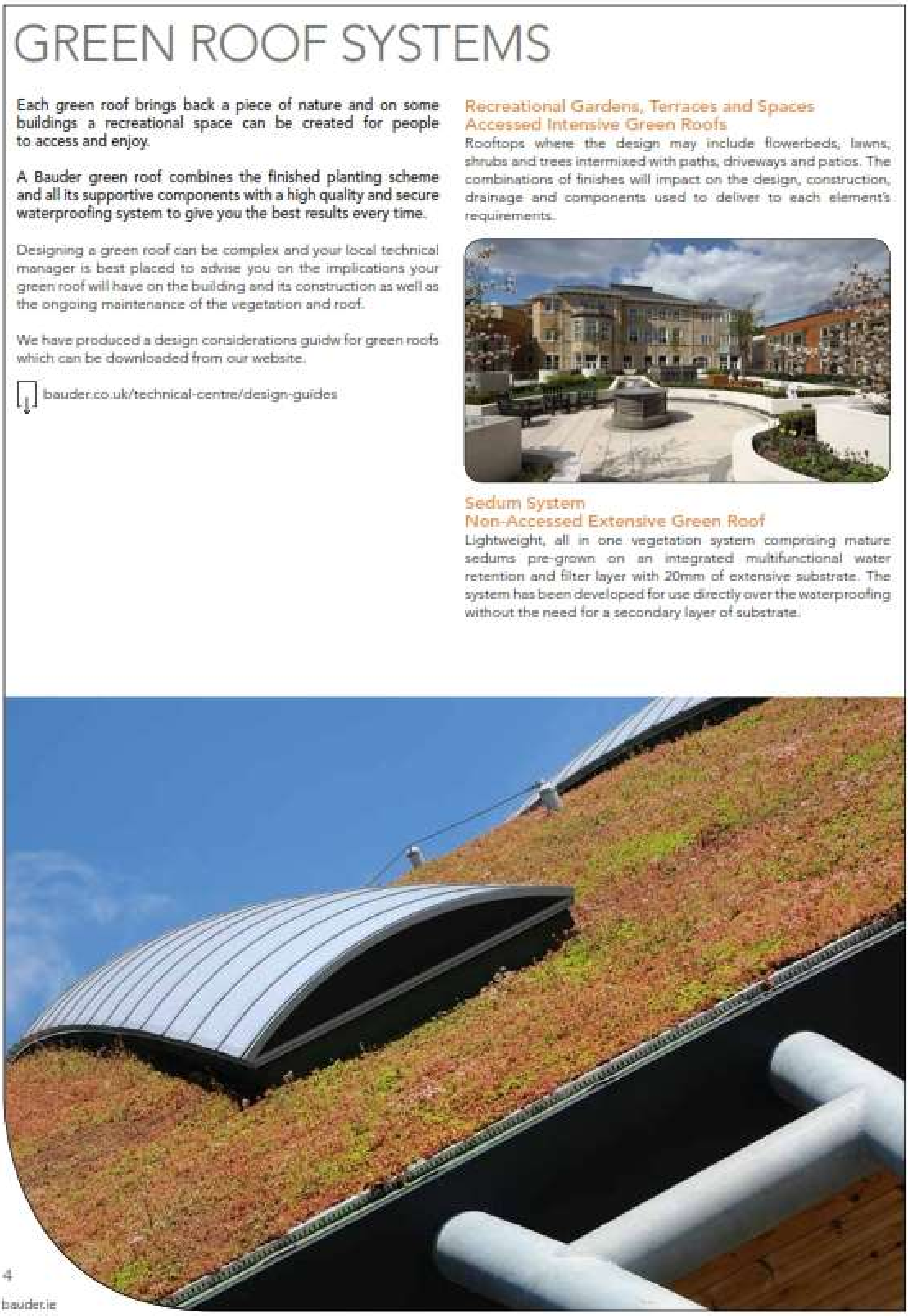

GREEN ROOF SYSTEMS

Each green roof brings back a piece of nature and on some buildings a recreational space can be created for people to access and enjoy.

A Bauder green roof combines the finished planting scheme and all its supportive components with a high quality and secure waterproofing system to give you the best results every time.

Designing a green roof can be complex and your local technical manager is best placed to advise you on the implications your green roof will have on the building and its construction as well as the ongoing maintenance of the vegetation and roof.

We have produced a design considerations guidw for green roofs which can be downloaded from our website.

bauder.co.uk/technical-centre/design-guides

Recreational Gardens, Terraces and Spaces Accessed Intensive Green Roofs

Rooftops where the design may include flowerbeds, lawns, shrubs and trees intermixed with paths, driveways and patios. The combinations of finishes will impact on the design, construction, drainage and components used to deliver to each element's requirements.

Sedum System Non-Accessed Extensive Green Roof

Lightweight, all in one vegetation system comprising mature sedums pre-grown on an integrated multifunctional water retention and filter layer with 20mm of extensive substrate. The system has been developed for use directly over the waterproofing without the need for a secondary layer of substrate.

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Substrate Roofs
Non-Accessed Extensive Green Roofs

Substrate green roofs are designed to be comparatively lightweight, work towards providing some storm water mitigation and support a wide variety of low maintenance plant species which are generally self-sustaining, and wind, frost and drought tolerant. They are primarily used for their ecological benefits and not intended for general access or for leisure purposes.

Biodiverse Habitats

A natural living habitat to encourage a wider spread of birds, insects and plant species into the area and generally replicates the ecological environment of the site upon which construction development is taking place, particularly if a Biodiversity Action Plan (BAP) is to be met with priority species.

Precultivated Vegetation Blankets

Lightweight option with precultivated vegetation for instant planting of the roof. Two options are available; XF118 wildflower blanket contains a mixture of 24 species of annual and perennial native wildflowers and XF300 incorporates perennial sedums with some grasses and mosses.

Plug Planted Systems

Individually planted roof usually incorporating sedums, grasses, herbs, succulents and wildflowers. These can be planted to accommodate location and expected weather conditions, colour or layout designs to the client's preference.

Seeded Roofs

The vegetation is grown and colonised entirely on the roof from seed with full plant establishment taking between 18-24 months. The plant selection can incorporate native and priority species to gain BREEAM points and meet a BAP.

BioSOLAR Roofs

Combining a substrate green roof with a solar PV array where the substrate and vegetation provide the ballast for the installation. The mounting system raises the modules above the substrate to allow liberal growing room for the plants, which are specified explicitly so that their maximum height does not block light to the array that would otherwise reduce the efficiency of the panels.

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ENVIRONMENTAL CREDENTIALS

Aiding Biodiversity and Meeting a Biodiversity Action Plan (BAP)

A green roof can provide a natural habitat specifically designed to support a particular species of plant or wildlife. Created for the local ecology, in which vegetation will establish and provide a home for smaller elements of wildlife as well as insects and invertebrates. The provision of a healthy habitat in a place that could otherwise be empty encourages wildlife to remain in the area, provides support for the natural colonisation of locally arising plants, birds and small animals, boosting a wider spread of species in the area.

Our vegetation options include our XF118 wildflower blanket and Flora Seed Mixes, which are all specifically devised to meet BAP criteria through their inclusion of species within the RHS 'Perfect for Pollinators' and Flora Locale 'native origins criteria'.

flora LOCALE

RHS PERFECT FOR POLLINATORS

Storm Water Management

Green roofs are one method of retaining rainwater by inception storage in the substrate, drainage/reservoir board and plants. This water is then used by the vegetation or evaporates back into the atmosphere.

Improving Air Quality of Local Surroundings

Localised air quality is improved as the vegetation assists in reducing both gaseous pollutants and dust particles by removing a proportion of them from the immediate environment, effectively purifying the air.

Urban Heat Island Effect

The urban heat island effect is reduced because the substrate of a green roof will absorb some of this heat and the natural evaporation of water from both the plants and soil helps to cool and humidify the air, thus lowering the ambient air temperature.

Recycled Content of Green Roof Components

Many recycled or waste materials are used within our green roof build ups to enable us to provide environmental solutions to the industry.

Water Retention and Drainage Layers

Our DSE 20, 40 and 60 boards are manufactured from recycled high density polyethylene.

Protection Layers

Our protection layers FSM600 and FSM1100 for extensive green roofs are made from a mixture of two recycled materials, reground polyester and polypropylene fibre.

Our ProMat for intensive green roofs is made of granulate from recycled shredded tyres.

Our Ecomat product is created from mechanically bonded recycled Polyester clothing and fabric.

Substrates and Growing Mediums

Our substrates are based around recycled crushed brick and composted organic material.

Separation and Slip Layer

Our PE Foil is manufactured from recycled polyethylene granulate.

cradletocradle SILVER

Recycling and Reusing Green Roof Components

The level of recycled content within our components clearly demonstrates that these products are then easily returned to the conventional recycling processes at the end of their required lifespan.

breeam

BREEAM 2014 Accreditation

The BREEAM assessment method evaluates the sustainability of built environments through the different stages of their life cycle. The schemes include:

Our green roofs have the potential to count towards these sections of BREEAM:

Land Use and Ecology

LE 03 Mitigating Ecological Impact.
Criteria 1&2
Potential credit 1

LE 04 Enhancing Site Ecology.
Criteria 1&2
Potential credit 1

LE 05 Long Term Impact on Biodiversity
Criteria 8
Potential credit 1

Our green roofs can be specified with our XF118 native species wildflower blanket or Bauder Flora seed mixes 3,5,7,9,11 which are accredited by the RHS as 'Perfect for Pollinators' and certified by Flora Locale.

Health and Wellbeing

Hea 05 Acoustic performance
Criteria 2
Potential credit 1

Our XF301 sedum system on a metal deck has been tested in accordance with BS EN ISO 140-18: 2006. The sedum plants intercept the impact of rainfall and mitigate the noise so that a figure of 33.5 dB was achieved.

Management

Man 04 Stakeholder Participation
Criteria 12
Potential credits 1

Green roofs for fully accessible recreational use provide facilities that can be shared by the relevant parties.

Energy

Ene 04 Low and Zero Carbon Technologies
Compliance CN10
Potential credits 2

A Bauder BioSOLAR Green Roof PV array creates local energy generation from renewable sources which can supply a compliant

TECHNICAL CREDENTIALS

Adopting Standards

Throughout Europe, the standards most widely recognised as comprehensively covering green roofs are those of the Forschungsgesllschaft Landschaftsentwicklung Landschafttsbau (FLL), which is a research society for the development of the landscape.

We have adopted these well respected standards, which cover all aspects of waterproofing, root protection, landscaping, installation and maintenance and we will continue to do so whilst also working in conjunction with the GRO Code of Best Practice for the UK.

Protection of the Waterproofing

A green roof protects the waterproofing from UV damage and thermal movement. Research has shown that the life expectancy of the waterproofing is significantly extended and in many cases may last the estimated design life of the building, which can eliminate future replacement costs.

Fire Testing

Bauder XF301 was the first sedum blanket in the UK to be awarded an EXT. F.AA fire rating by the Building Research Establishment.

The full XF 301 sedum system, including the vegetation waterproofing, and insulation was tested, and awarded an EXT. F.AA.

The same system was tested in a sloped orientation to ensure that the fire behaviour is not affected by roof slope and is also classified EXT.S.AA.

Increased Efficiency and Output of a BioSOLAR PV Array

A green roof helps to maximise solar energy generation as the vegetation preserves ambient rooftop temperatures, keeping the modules at optimal output. The cooling effect increases panel output by up to 5-7%.

Productivity in the Workplace

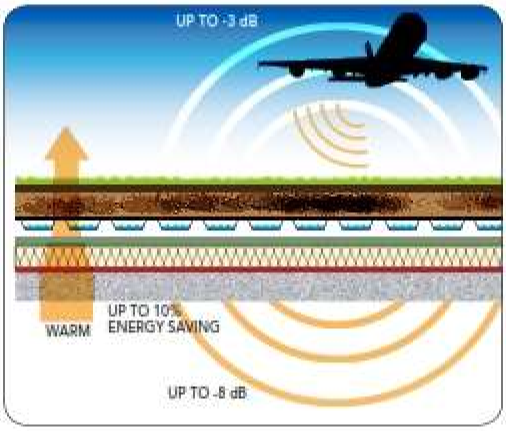
Research has shown that people working in offices that overlook green spaces have a higher productivity and a reduction in stress levels than those with a poorer outlook on a hard, impervious buildings.

Health

Hospitals are greening overlooked roofs or incorporating rooftop garden areas for the benefit of patients as they find that this speeds recovery.

Reduction of external noise within the building

Green roofs have excellent acoustic qualities for both external sound (up to 3dB) and internal noise (up to 8dB). This can prove to be both economically and environmentally effective when used on structures close to airports or industrial developments.



Reduced Building Running Costs

The enhanced thermal performance provided by a green roof provides a more balanced temperature within the building. This reduces heating costs in the winter and air conditioning expenses during the summer.

Reduced Lifecycle Costs

The main reduction in lifecycle costs comes from the green roof providing protection from the damaging effects of the weather, which effectively 'ages' the waterproofing, thus the time span between replacement is extended significantly, and in many cases replacement will become unnecessary.

Aid to Planning Consent

Many local authorities favour planning proposals that incorporate green roofs within the application, particularly if it meets their policies towards a sustainable environment or supports priority species.

Offset Construction Costs

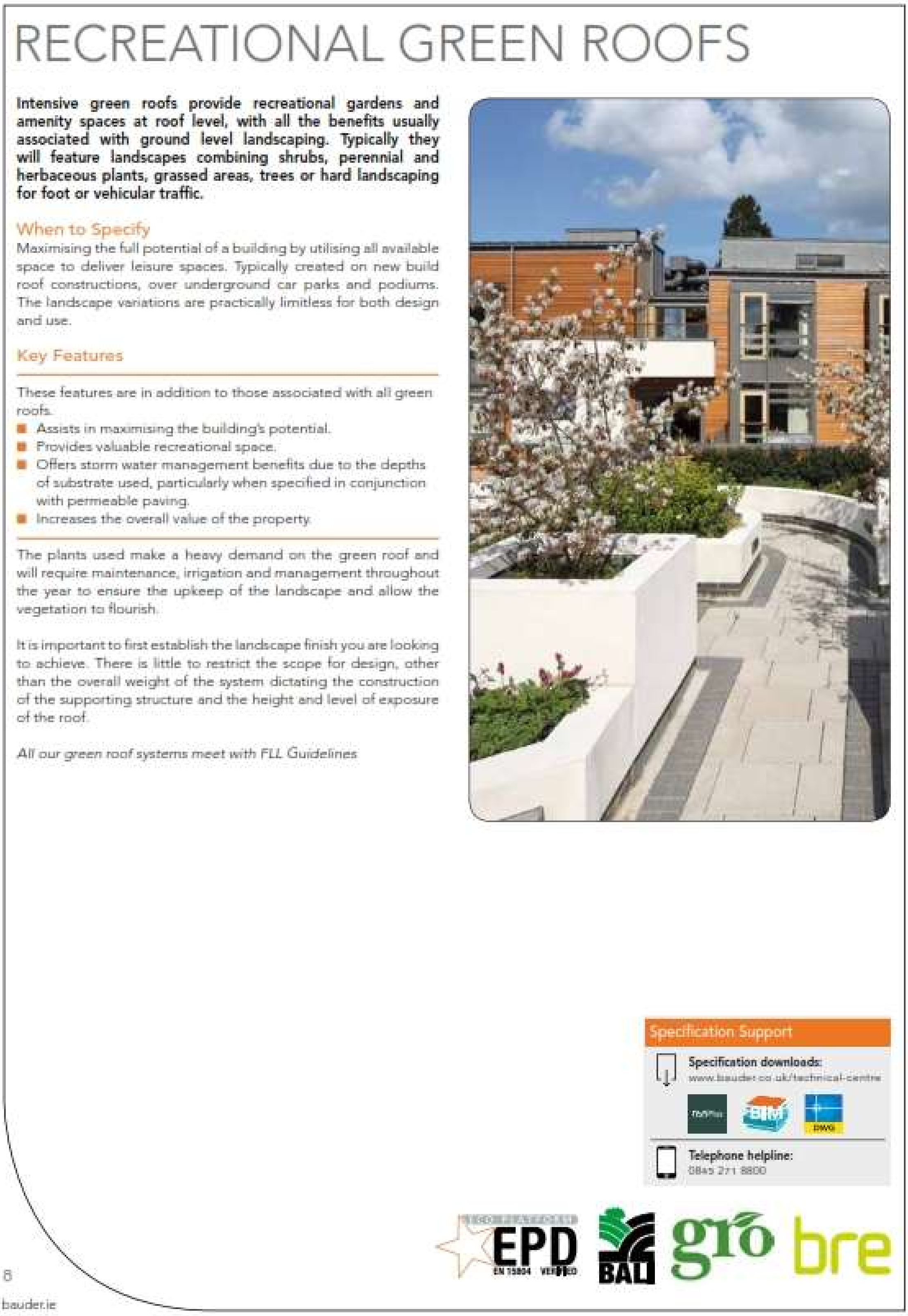
In large construction projects a green roof can mean that storm water holding tanks are reduced in size or no longer required, as the roof itself will retain a proportion of the rainfall.

Creates an Amenity Space

The roof is often an under utilised asset of a building, as it offers the unique potential to replace the land lost to the construction as reusable space. Large roof areas covering underground car parks can provide parkland or sports facilities.

Increases Property Value

As an additional dimension is created, the property will maximise the potential available for the sites, and so increase the value.



RECREATIONAL GREEN ROOFS

Intensive green roofs provide recreational gardens and amenity spaces at roof level, with all the benefits usually associated with ground level landscaping. Typically they will feature landscapes combining shrubs, perennial and herbaceous plants, grassed areas, trees or hard landscaping for foot or vehicular traffic.

When to Specify

Maximising the full potential of a building by utilising all available space to deliver leisure spaces. Typically created on new build roof constructions, over underground car parks and podiums. The landscape variations are practically limitless for both design and use.

Key Features

These features are in addition to those associated with all green roofs.

- Assists in maximising the building's potential.
- Provides valuable recreational space.
- Offers storm water management benefits due to the depths of substrate used, particularly when specified in conjunction with permeable paving.
- Increases the overall value of the property.

The plants used make a heavy demand on the green roof and will require maintenance, irrigation and management throughout the year to ensure the upkeep of the landscape and allow the vegetation to flourish.

It is important to first establish the landscape finish you are looking to achieve. There is little to restrict the scope for design, other than the overall weight of the system dictating the construction of the supporting structure and the height and level of exposure of the roof.

All our green roof systems meet with FLL Guidelines

Specification Support

Specification downloads:
www.bauder.co.uk/technical-centre

Telephone helpline:
0845 271 8800

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Example System Configuration

Our lightweight substrates combined with specially developed water storage and drainage components all ensure that the modern green roof can replicate a traditional landscape at roof level at only a fraction of the weight and with a substantially shallower build up.

It is crucial that an integrated approach is taken to the design and specification of both the waterproofing and landscaping components, so that the desired outcomes are achieved. We can work with you from the earliest design stage to ensure that your green roof project is successful.

Paving/Pebble Ballast

Granite Chipping Base

Vegetation
specifically selected for each individual roof, from turf to trees.

Bauder Intensive Substrate
lightweight growing medium manufactured to meet FLL guidelines.

Bauder Filter Fleece
filtration layer that prevents substrate fines from washing into the drainage layer.

Bauder DSE60
60mm thick, water storage and drainage layer, infilled with Bauder Mineral Drain for structural stability.

Bauder FSM 1100 Protection Mat
recycled polyester and polythene fibre mix.

Bauder PE Foil
polythene foil separation and slip layer manufactured from recycled granules.

Bauder Plant E or AP2
root resistant, SBS modified bitumen membrane reinforced with 250g/m^2 recycled spunbond polyester.

SUBSTRATE GREEN ROOFS

These extensive green roof systems are primarily used for their ecological benefits or aesthetic appearance rather than for general access or for leisure purposes.

A traditional extensive substrate green roof system provides a depth of growing medium usually around 80-120mm to allow for the specification of a broader range of species and planting schemes. The plants are generally low maintenance, wind, frost and drought resistant and can be installed by different methods, including plug planting, vegetation mat and seeding.

When to Specify

The system is lightweight and offers the advantage of a bespoke vegetation finish with a substrate depth to support the plants, suitable for new build construction and retrofit or refurbishment projects.

Key Features

- Comparatively lightweight.
- Plants chosen to suit the project and location.
- Significant scope for creating a natural habitat to encourage plants and small wildlife to remain, so aiding biodiversity.
- Can be designed specifically to support particular flora and fauna.
- Aid to planning consent as biodiversity roofs help to meet local authority policies towards a sustainable environment.
- Aid to meeting BREEAM requirements of a development through points secured by the use of accredited native species plants.
- Develop another dimension through a unique opportunity to maximise the potential of the building to support the environment.
- Good levels of rainwater attenuation, depending on substrate depth.
- Cost effective on large roof areas.

Creating a Biodiverse Roof

This specific type of green or 'living' roof typically either tries to replicate as closely as is practical the ecological environment of the site where construction has taken place or sets out to create a natural habitat to support a variety of flora and fauna so aiding biodiversity.

When to Specify

Biodiverse roofs can be created on new build construction and refurbishment or retrofit projects. Ideal for meeting biodiversity action plans (BAP) and delivering to BREEAM and planning requirements.

All our green roof systems comply with FLL Guidelines.

Specification Support

Specification downloads:
www.bauder.co.uk/technical-centre

Telephone helpline:
0845 271 8800

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Example System Configuration

Substrate-based extensive green roofs can incorporate a variety of vegetation finishes.

Vegetation Mats

The installation of a precultivated vegetation mat allows instant coverage of the roof. Native species wildflower blanket XF118 meets the growing demand to satisfy the requirements of BREEAM and to meet a biodiversity action plan for the site.

Sedum Blanket XF300 provides dense sedum foliage featuring up to 11 species of sedum with some mosses and grasses for plant diversity.

Plug Planting

This method gives the client both a much greater choice of plant species and the opportunity to plan the layout. The individual immature plants or 'plugs' are planted out into the substrate by hand, which can then grow on to give good cover over the next two full growing seasons.

Seeding

This is an economical and practical method for vegetating larger roof areas. Plant establishment and full coverage will take between 18-24 months, depending upon the time of year sowing takes place and the weather conditions during the period of establishment.

Vegetation Mat

Seeded Roof

Plug Plants

Biodiverse Habitat

Bauder Filter Fleece
filtration layer that prevents substrate fines from washing into the drainage layer.

Bauder DSE40
40mm water storage layer that provides multi directional drainage.

Bauder FSM600 Protection Mat
recycled polyester and polypropylene fibre mix.

Bauder PE Foil
polyethylene foil separation and slip layer manufactured from recycled granules.

Bauder Plant E or AP2
root resistant, SBS modified bitumen membrane reinforced with $250g/m^2$ recycled spunbond polyester.

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Substrate Pitch Roof Systems - Configurations Over 10°

An extensive substrate system on a pitch greater than 10° requires a water retention and storage board that will hold the substrate firmly in place and be sufficiently rigid to prevent board flexure and manage the imposed sheer load.

The extensive or biodiverse substrate is applied directly to the profiled surface of the board so that the green roof is stabilised whilst retaining sufficient levels of water to support the vegetation.

Sedum Vegetation on Bauder Extensive Substrate
variety of sedum species with some grasses and moss.

Vegetation on Bauder Biodiverse Substrate
generally provided through plug planting, vegetation mat or seeding. Selected species can be chosen to suit the project and location.

Bauder Substrate
applied directly to the profiled surface of the reservoir board.

Bauder Reservoir Board
lightweight rigid expanded polystyrene water storage and drainage layer.

Bauder FSM600 Protection Mat
polyester and polypropylene fibre mix.

Bauder PE Foil
polyethylene foil separation and slip layer manufactured from recycled granules.

Bauder Plant E or AP2
root resistant, SBS modified bitumen membrane reinforced with $250g/m^2$ recycled spunbond polyester.

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BioSOLAR Green Roof System

Bauder BioSOLAR is a revolutionary solar PV mounting system for biodiverse or extensive green roofs. Well suited to new build applications where environmentally friendly solutions are required to meet planning and BREEAM requirements. Our BioSOLAR system can also be retrofitted on many existing roofs without the need for any structural modification to the building.

A key element is that the front edge of the PV panel is set 300mm above the level of the substrate, which allows liberal growing room for the vegetation without blocking light to the array that would otherwise reduce the efficiency of the panels. This height setting also enables light and moisture to reach beneath the panel to support the plants below.

Vegetation Mats

Native Species Wildflower Blanket XF118 meets the growing demand for a native species vegetation blanket to satisfy the requirements of BREEAM and to meet a biodiversity action plan for the site.

Sedum Blanket XF300 provides dense sedum foliage cover featuring up to 11 species of sedum with some mosses and grasses for plant diversity.

Plug Planting

Individual immature plants or 'plugs' are planted out into the substrate by hand to give a variety of species, which can then grow on to give good cover over the next two full growing seasons.

Bauder Flora 3 Seed Mix

Ideal for vegetating large roof areas with species selected for their maximum growing height that meet BREEAM requirements.

Seed Mix

Plug Plants

Vegetation Mat

Bauder FSM600 Protection Mat
recycled polyester and polypropylene fibre mix.

Bauder PE Foil
polyethylene foil separation and slip layer manufactured from recycled granules.

Bauder Plant E or AP2
root resistant, SBS modified bitumen membrane reinforced with 250g/m^2 recycled spunbond polyester.

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LIGHTWEIGHT SEDUM SYSTEM

Bauder XF301 extensive sedum blanket system is constructed using low maintenance planting (succulents) that provide excellent cover and increased protection to the waterproofing system.

When to Specify

The Xero Flor sedum blanket is a very versatile green roof system and is suitable for both new build and refurbishment projects. It is ideal for buildings where weight loading is a consideration or planning requirements stipulate the inclusion of a green roof.

Key Features

- The Xero Flor sedum blanket is installed as a complete system
- The most lightweight green roof system available, making it ideal for retrofitting or refurbishment projects
- Delivers instant greening of a roof with sedums and other species able to flourish in our climate
- Ideal solution where a green roof needs to be specified to meet planning requirements
- Cost effective
- Sedum blankets are grown on our farm in the UK and delivered to site within 24 hours of harvesting
- Blanket features up to 11 species of sedums, some mosses and grasses to ensure plant diversity

The plants are grown on a 'blanket' that is harvested like turf and installed by rolling out on top of the waterproofing and any other landscaping components required. The blankets are very lightweight, easy to maintain and provide instant greening to the roof.

All our green roof systems comply with FLL guidelines.

Specification Support

Specification downloads:
www.bauder.co.uk/technical-centre

Telephone helpline:
0845 271 8800

System Configuration

The multi-functional XF301 sedum system combines the vegetation support layer with a moisture retention fleece to provide the perfect base for all roofing scenarios with a labour efficient installation.

Our patented geo-textile carrier fleece with its ultraviolet resistant nylon loops provides a support base for the specially developed substrate growing medium and gives stability to the established vegetation whether on a low pitch flat roof or a 25° slope.

The pre-attached fleece is a unique feature of our XF301 sedum system, retaining moisture after rainfall and thus allowing the plants to take up the water for future use. The sedums are grown to maturity before being harvested, thus ensuring that they acclimatise quickly to their new rooftop location.

We currently cultivate 60,000m^2 of XF301 and are able to harvest the sedum and deliver to site within 24 hours.

Bauder XF301 Sedum System
pre-cultivated vegetation blanket on a patented nylon loop and geo-textile base carrier with special substrate and a pre-attached integral 8mm moisture retention fleece.

Bauder SDF Mat
multifunctional drainage, filtration and protection layer manufactured from ultraviolet resistant nylon woven loops which are thermally bonded to geo-textile filter fleece facings.

System Installation

Long length rolls being craned into position and installed.

Short 2m rolls of XF301 Sedum System installed by hand.

BAUDER PLANTING & VEGETATION

XF118 Native Species Wildflower Blanket
This vegetation blanket meets the growing demand for native species plants to satisfy the requirement of BREEAM. The 24 species of wildflowers and herbs incorporated into the blanket have been selected to provide a viable and vibrant plant that will be present on most of the biodiversity action plan lists that project specific ecology reports now demand.

XF300 Sedum Blanket and XF301 Sedum System
Both of these vegetation blankets provide dense sedum foliage cover featuring up to 11 species of sedum with some mosses and grasses for plant diversity.

The plants provide a lot of colour and are selected to suit our climate, and provide 90% ground coverage at installation.

Plug Planting
The use of small seedling plants have a number of advantages, each individual species can be chosen and the location and density of the planting can be controlled.

We supply a wide range of British provenance plug plant species for a Bauder green roof project.

Seeding
Seeding is a proven way to establish vegetation, however at roof level, the environment makes this a challenge without the correct provisions.

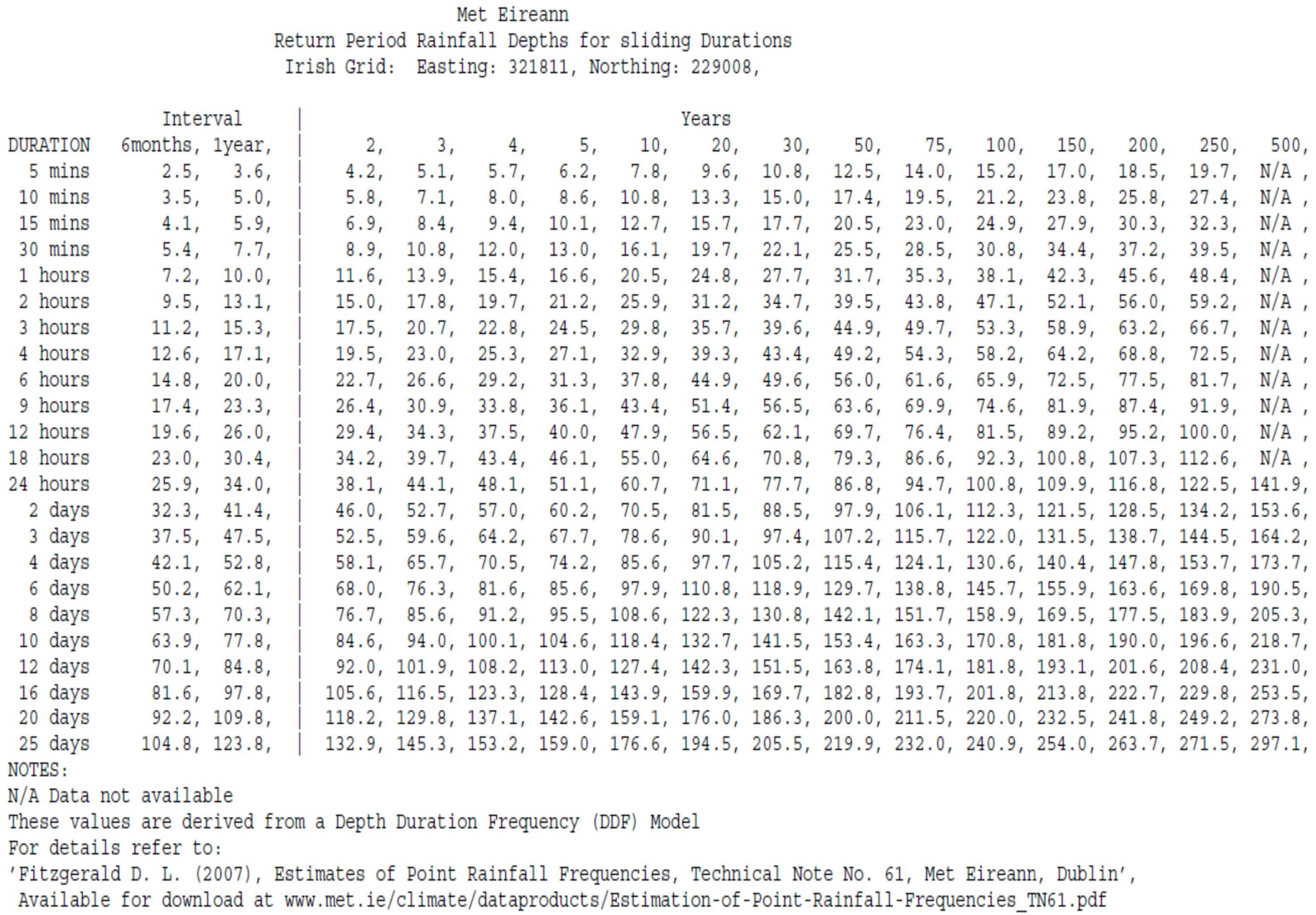
We supply a range of British and Scottish provenance seed mixes which have a unique blend of seed species, adhesive to bind the seed to the substrate, organic fertiliser for nutrients and mycorrhizal fungi to increase the root surface area and establish the plants as they grow.

flora LOCALE

RHS PERFECT FOR POLLINATORS

bauder.ie

Appendix C – Met Eireann Rainfall Data



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                         Met Eireann
           Return Period Rainfall Depths for sliding Durations
            Irish Grid:  Easting: 321811, Northing: 229008,

              Interval     |                                  Years
DURATION  6months, 1year,  |    2,     3,     4,     5,    10,    20,    30,    50,    75,   100,   150,   200,   250,   500,
  5 mins      2.5,    3.6, |   4.2,   5.1,   5.7,   6.2,   7.8,   9.6,  10.8,  12.5,  14.0,  15.2,  17.0,  18.5,  19.7,  N/A ,
 10 mins      3.5,    5.0, |   5.8,   7.1,   8.0,   8.6,  10.8,  13.3,  15.0,  17.4,  19.5,  21.2,  23.8,  25.8,  27.4,  N/A ,
 15 mins      4.1,    5.9, |   6.9,   8.4,   9.4,  10.1,  12.7,  15.7,  17.7,  20.5,  23.0,  24.9,  27.9,  30.3,  32.3,  N/A ,
 30 mins      5.4,    7.7, |   8.9,  10.8,  12.0,  13.0,  16.1,  19.7,  22.1,  25.5,  28.5,  30.8,  34.4,  37.2,  39.5,  N/A ,
 1 hours      7.2,   10.0, |  11.6,  13.9,  15.4,  16.6,  20.5,  24.8,  27.7,  31.7,  35.3,  38.1,  42.3,  45.6,  48.4,  N/A ,
 2 hours      9.5,   13.1, |  15.0,  17.8,  19.7,  21.2,  25.9,  31.2,  34.7,  39.5,  43.8,  47.1,  52.1,  56.0,  59.2,  N/A ,
 3 hours     11.2,   15.3, |  17.5,  20.7,  22.8,  24.5,  29.8,  35.7,  39.6,  44.9,  49.7,  53.3,  58.9,  63.2,  66.7,  N/A ,
 4 hours     12.6,   17.1, |  19.5,  23.0,  25.3,  27.1,  32.9,  39.3,  43.4,  49.2,  54.3,  58.2,  64.2,  68.8,  72.5,  N/A ,
 6 hours     14.8,   20.0, |  22.7,  26.6,  29.2,  31.3,  37.8,  44.9,  49.6,  56.0,  61.6,  65.9,  72.5,  77.5,  81.7,  N/A ,
 9 hours     17.4,   23.3, |  26.4,  30.9,  33.8,  36.1,  43.4,  51.4,  56.5,  63.6,  69.9,  74.6,  81.9,  87.4,  91.9,  N/A ,
12 hours     19.6,   26.0, |  29.4,  34.3,  37.5,  40.0,  47.9,  56.5,  62.1,  69.7,  76.4,  81.5,  89.2,  95.2, 100.0,  N/A ,
18 hours     23.0,   30.4, |  34.2,  39.7,  43.4,  46.1,  55.0,  64.6,  70.8,  79.3,  86.6,  92.3, 100.8, 107.3, 112.6,  N/A ,
24 hours     25.9,   34.0, |  38.1,  44.1,  48.1,  51.1,  60.7,  71.1,  77.7,  86.8,  94.7, 100.8, 109.9, 116.8, 122.5, 141.9,
  2 days     32.3,   41.4, |  46.0,  52.7,  57.0,  60.2,  70.5,  81.5,  88.5,  97.9, 106.1, 112.3, 121.5, 128.5, 134.2, 153.6,
  3 days     37.5,   47.5, |  52.5,  59.6,  64.2,  67.7,  78.6,  90.1,  97.4, 107.2, 115.7, 122.0, 131.5, 138.7, 144.5, 164.2,
  4 days     42.1,   52.8, |  58.1,  65.7,  70.5,  74.2,  85.6,  97.7, 105.2, 115.4, 124.1, 130.6, 140.4, 147.8, 153.7, 173.7,
  6 days     50.2,   62.1, |  68.0,  76.3,  81.6,  85.6,  97.9, 110.8, 118.9, 129.7, 138.8, 145.7, 155.9, 163.6, 169.8, 190.5,
  8 days     57.3,   70.3, |  76.7,  85.6,  91.2,  95.5, 108.6, 122.3, 130.8, 142.1, 151.7, 158.9, 169.5, 177.5, 183.9, 205.3,
 10 days     63.9,   77.8, |  84.6,  94.0, 100.1, 104.6, 118.4, 132.7, 141.5, 153.4, 163.3, 170.8, 181.8, 190.0, 196.6, 218.7,
 12 days     70.1,   84.8, |  92.0, 101.9, 108.2, 113.0, 127.4, 142.3, 151.5, 163.8, 174.1, 181.8, 193.1, 201.6, 208.4, 231.0,
 16 days     81.6,   97.8, | 105.6, 116.5, 123.3, 128.4, 143.9, 159.9, 169.7, 182.8, 193.7, 201.8, 213.8, 222.7, 229.8, 253.5,
 20 days     92.2,  109.8, | 118.2, 129.8, 137.1, 142.6, 159.1, 176.0, 186.3, 200.0, 211.5, 220.0, 232.5, 241.8, 249.2, 273.8,
 25 days    104.8,  123.8, | 132.9, 145.3, 153.2, 159.0, 176.6, 194.5, 205.5, 219.9, 232.0, 240.9, 254.0, 263.7, 271.5, 297.1,
NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
 Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf
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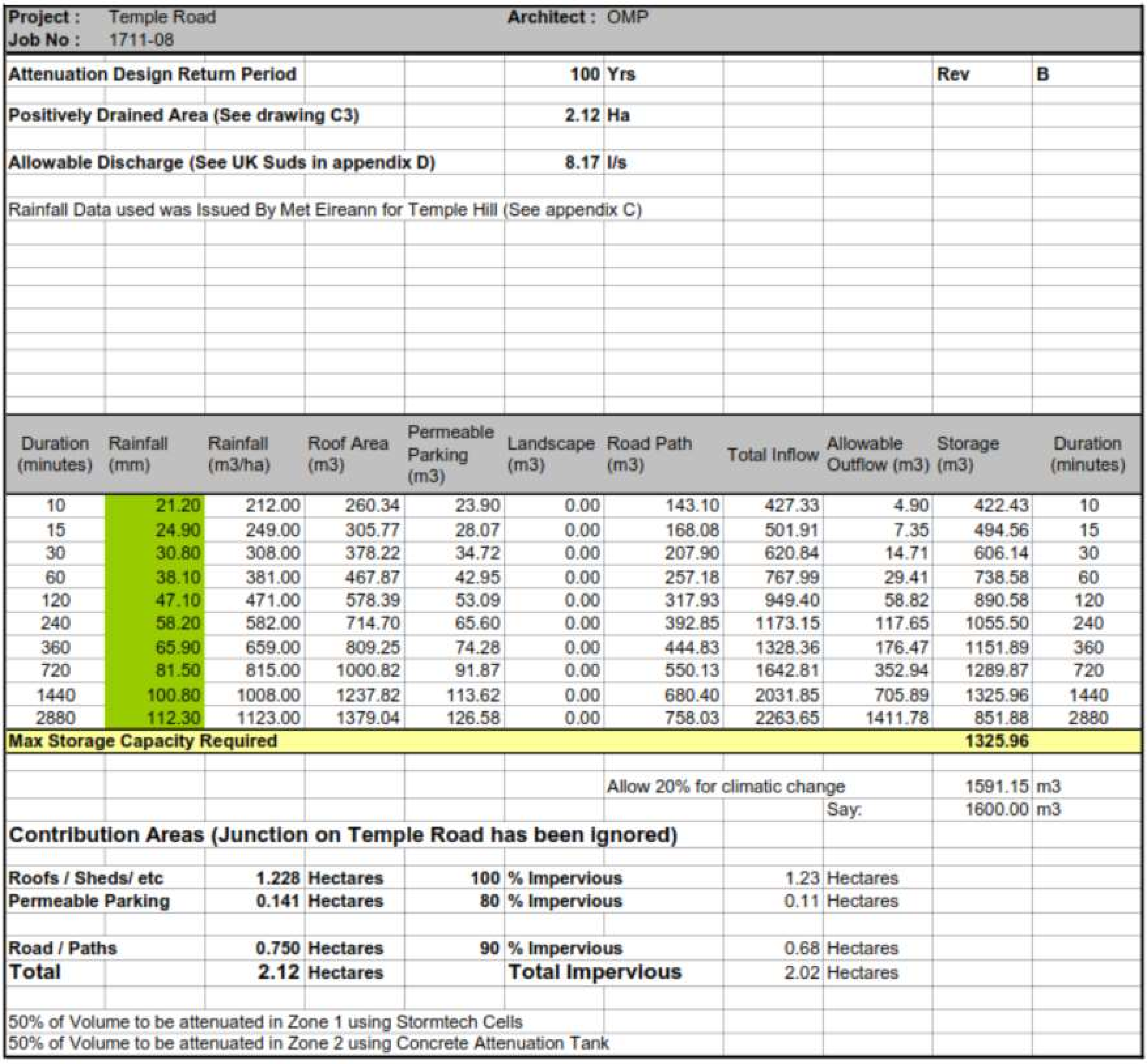
Appendix D – Attenuation Storage Proposals

Attenuation calculation for whole site.



Project : Temple Road **Architect :** OMP
Job No : 1711-08

Attenuation Design Return Period	**100**	**Yrs**	**Rev**	**B**
Positively Drained Area (See drawing C3)	**2.12**	**Ha**		
Allowable Discharge (See UK Suds in appendix D)	**8.17**	**l/s**		

Rainfall Data used was Issued By Met Eireann for Temple Hill (See appendix C)

Duration (minutes)	Rainfall (mm)	Rainfall (m3/ha)	Roof Area (m3)	Permeable Parking (m3)	Landscape (m3)	Road Path (m3)	Total Inflow	Allowable Outflow (m3)	Storage (m3)	Duration (minutes)
10	21.20	212.00	260.34	23.90	0.00	143.10	427.33	4.90	422.43	10
15	24.90	249.00	305.77	28.07	0.00	168.08	501.91	7.35	494.56	15
30	30.80	308.00	378.22	34.72	0.00	207.90	620.84	14.71	606.14	30
60	38.10	381.00	467.87	42.95	0.00	257.18	767.99	29.41	738.58	60
120	47.10	471.00	578.39	53.09	0.00	317.93	949.40	58.82	890.58	120
240	58.20	582.00	714.70	65.60	0.00	392.85	1173.15	117.65	1055.50	240
360	65.90	659.00	809.25	74.28	0.00	444.83	1328.36	176.47	1151.89	360
720	81.50	815.00	1000.82	91.87	0.00	550.13	1642.81	352.94	1289.87	720
1440	100.80	1008.00	1237.82	113.62	0.00	680.40	2031.85	705.89	1325.96	1440
2880	112.30	1123.00	1379.04	126.58	0.00	758.03	2263.65	1411.78	851.88	2880
Max Storage Capacity Required									**1325.96**	

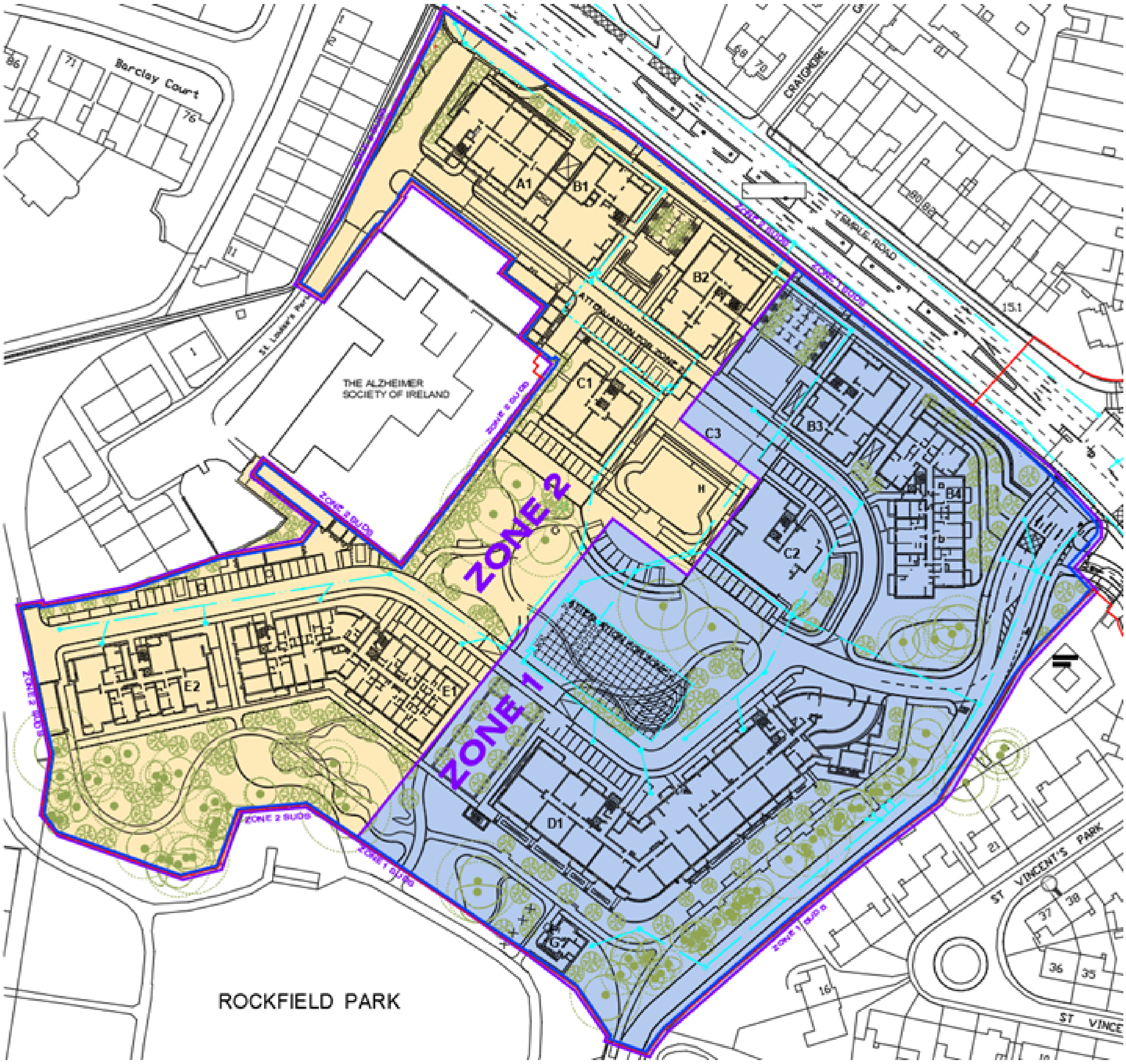
Allow 20% for climatic change	1591.15	m3
Say:	1600.00	m3

Contribution Areas (Junction on Temple Road has been ignored)

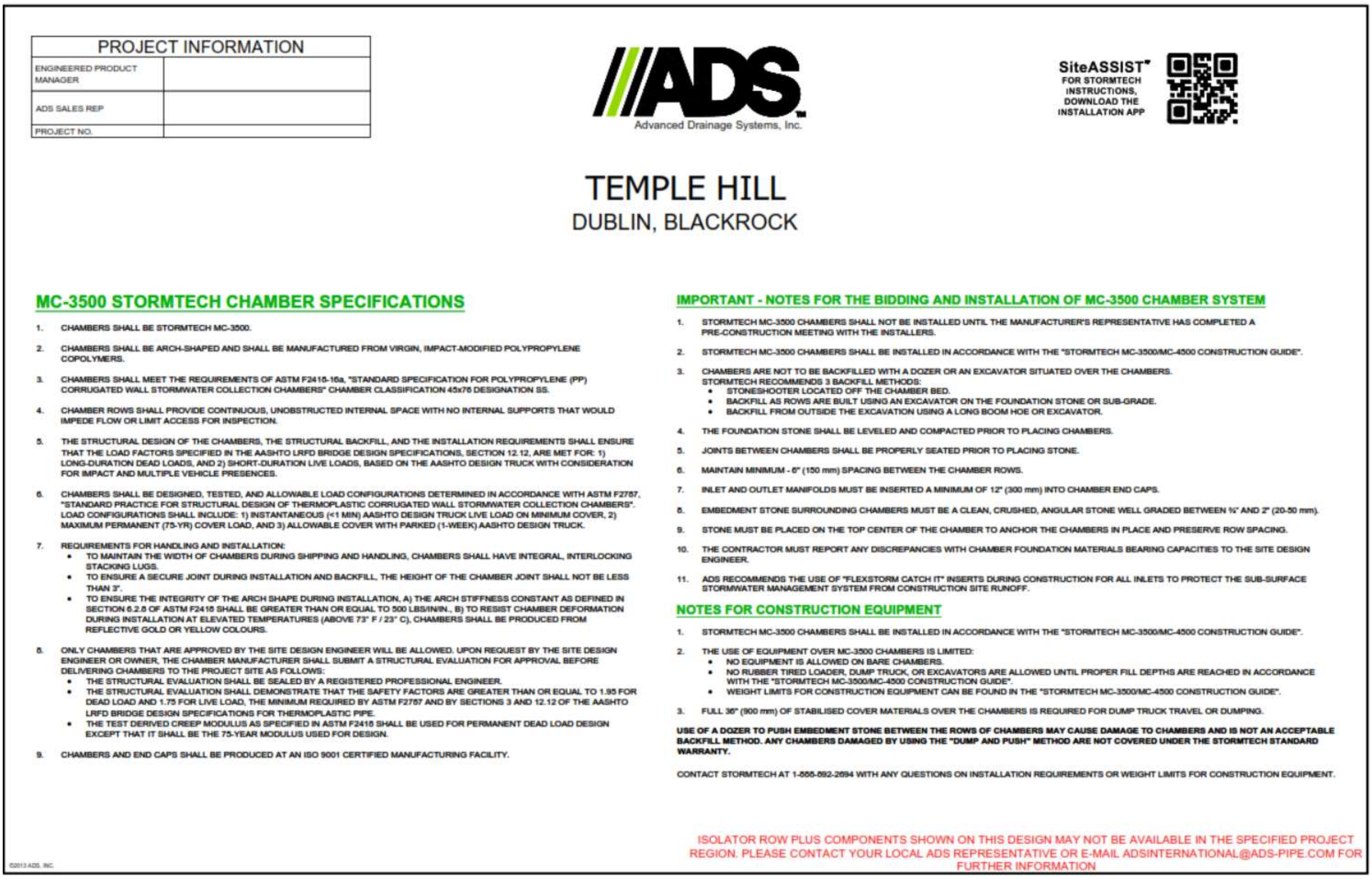
Roofs / Sheds/ etc	**1.228**	**Hectares**	**100**	**% Impervious**	1.23	Hectares
Permeable Parking	**0.141**	**Hectares**	**80**	**% Impervious**	0.11	Hectares
Road / Paths	**0.750**	**Hectares**	**90**	**% Impervious**	0.68	Hectares
Total	**2.12**	**Hectares**		**Total Impervious**	2.02	Hectares

50% of Volume to be attenuated in Zone 1 using Stormtech Cells
50% of Volume to be attenuated in Zone 2 using Concrete Attenuation Tank

Provide a Stormtech attenuation structure to accommodate 50% of volume (800m³) from zone 1 and a concrete attenuation tank under building B1 for 50% of volume (800m³) from zone 2.



Extract from Drawing C6-1 showing Zone1 amd Zone 2 Attenuation Zones



PROJECT INFORMATION

ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteASSIST™ FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

TEMPLE HILL
DUBLIN, BLACKROCK

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS, AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED, AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER, 2) MAXIMUM PERMANENT (75-YR) COVER LOAD, AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, A) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN., B) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLOURS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUB-GRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 6" (150 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE WELL GRADED BETWEEN ¾" AND 2" (20-50 mm).
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
10. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUB-SURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

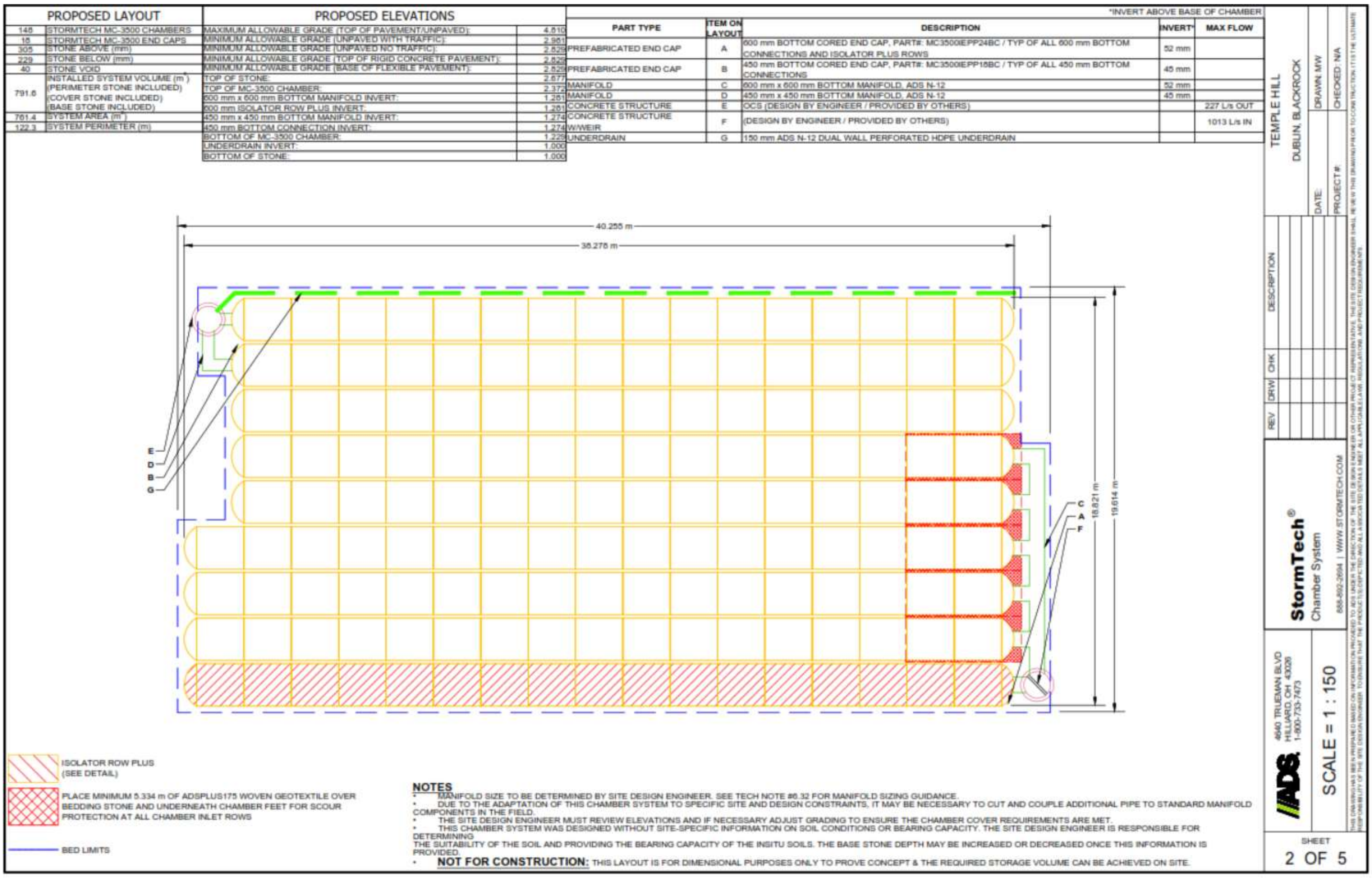
NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILISED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

ISOLATOR ROW PLUS COMPONENTS SHOWN ON THIS DESIGN MAY NOT BE AVAILABLE IN THE SPECIFIED PROJECT REGION. PLEASE CONTACT YOUR LOCAL ADS REPRESENTATIVE OR E-MAIL ADSINTERNATIONAL@ADS-PIPE.COM FOR FURTHER INFORMATION



PROPOSED LAYOUT	
148	STORMTECH MC-3500 CHAMBERS
16	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	STONE VOID
791.6	INSTALLED SYSTEM VOLUME (m³) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)
761.4	SYSTEM AREA (m²)
122.3	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS	
MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	4.810
MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	2.981
MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	2.829
MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	2.829
MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	2.829
TOP OF STONE:	2.677
TOP OF MC-3500 CHAMBER:	2.372
600 mm x 600 mm BOTTOM MANIFOLD INVERT:	1.281
600 mm ISOLATOR ROW PLUS INVERT:	1.281
450 mm x 450 mm BOTTOM MANIFOLD INVERT:	1.274
450 mm BOTTOM CONNECTION INVERT:	1.274
BOTTOM OF MC-3500 CHAMBER:	1.229
UNDERDRAIN INVERT:	1.000
BOTTOM OF STONE:	1.000

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	600 mm BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 600 mm BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	52 mm	
PREFABRICATED END CAP	B	450 mm BOTTOM CORED END CAP, PART#: MC3500IEPP18BC / TYP OF ALL 450 mm BOTTOM CONNECTIONS	45 mm	
MANIFOLD	C	600 mm x 600 mm BOTTOM MANIFOLD, ADS N-12	52 mm	
MANIFOLD	D	450 mm x 450 mm BOTTOM MANIFOLD, ADS N-12	45 mm	
CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		227 L/s OUT
CONCRETE STRUCTURE W/WEIR	F	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		1013 L/s IN
UNDERDRAIN	G	150 mm ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN		

▧	ISOLATOR ROW PLUS (SEE DETAIL)
▩	PLACE MINIMUM 5.334 m OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS
—	BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

TEMPLE HILL
DUBLIN, BLACKROCK

DATE	DRAWN: MW
PROJECT #:	CHECKED: N/A

REV	DRW	CHK	DESCRIPTION

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

SCALE = 1 : 150

SHEET
2 OF 5

Stormtech details for Zone 1 Attenuation

Appendix E – Storm Drain Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
2			12.250	1200	724722.909	729086.928	1.650
3			12.250	1200	724725.938	729081.443	1.575
4			12.200	1200	724728.641	729075.850	1.380
6			13.354	1200	724784.031	729035.492	2.104
ATT/HB Z2			16.181	1350	724763.624	729009.954	4.741
9	0.043	5.00	17.400	1350	724783.708	728980.338	4.000
10	0.138	5.00	18.500	1350	724764.552	728955.371	4.890
11	0.016	5.00	18.500	1200	724760.883	728936.195	4.740
12			19.550	1200	724739.042	728908.343	5.630
13	0.037	5.00	18.100	1200	724707.784	728928.851	4.020
14	0.108	5.00	16.000	2200	724616.402	728913.463	1.450
15			16.278	1200	724765.983	729007.995	2.615
16	0.111	5.00	16.525	1200	724730.955	729043.975	1.025
J6			16.651	1200	724772.619	729003.287	2.960
18	0.033	5.00	16.500	1200	724782.036	729015.504	1.500
J7			17.383	1200	724786.653	728993.299	3.633
20	0.049	5.00	17.750	1200	724797.327	729007.046	2.225
21			14.100	1200	724819.816	729020.622	1.330
22			14.400	1200	724814.438	729012.367	0.900
23			14.700	1200	724835.551	728996.291	1.000
24			19.200	1200	724791.402	728935.164	3.300
25			19.500	1200	724760.775	728926.488	3.530
ATT/HB Z1			19.516	1500	724757.564	728922.292	3.516
27			19.605	1500	724765.942	728916.211	3.555
28			19.500	1500	724775.721	728929.683	3.428
29			19.200	1350	724795.786	728935.367	3.081
30	0.035	5.00	18.600	1500	724819.139	728917.532	2.415
31	0.047	5.00	19.000	1500	724871.049	728892.805	2.686
32	0.039	5.00	19.740	1200	724860.844	728875.334	2.640
33			20.300	1200	724843.614	728860.738	2.300
34	0.077	5.00	21.300	1200	724795.107	728820.004	1.200
35			21.300	1200	724776.861	728830.566	1.100
36	0.109	5.00	17.500	2200	724886.980	728929.655	1.050
37	0.027	5.00	18.594	1350	724838.134	728948.472	1.994
38	0.126	5.00	19.170	1200	724808.396	728974.235	1.418
39			19.500	1200	724811.544	728901.679	2.650
40	0.035	5.00	20.000	1200	724789.555	728883.155	2.100
41			19.591	1200	724746.766	728907.417	3.541
42			19.600	1200	724744.645	728904.587	3.530
43	0.059	5.00	20.000	1200	724777.352	728880.072	1.920
44	0.011	5.00	21.300	1200	724763.809	728825.907	1.000

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.128	5.00	20.337	1200	724780.075	728868.140	1.687
45	0.055	5.00	19.688	1200	724728.932	728900.701	1.688
46		5.00	19.172	1200	724798.764	728939.291	0.975
47		5.00	19.165	1200	724803.423	728971.213	1.315
48	0.085	5.00	18.441	1200	724844.682	728947.551	1.441
J1			16.190		724625.914	728915.064	1.689
5	0.047	5.00	16.504		724626.479	728907.666	0.904
7	0.038	5.00	17.307		724656.857	728913.697	1.807
J2			16.963		724656.292	728920.180	2.618
J3			17.831		724689.196	728925.721	3.655
8	0.058	5.00	18.082		724688.070	728919.915	1.582
26	0.055	5.00	19.662		724815.421	728893.269	2.162
49	0.068	5.00	19.904		724757.912	728884.506	1.429
J4			19.796		724760.359	728892.809	1.846
Depth/Area 1	0.045	5.00	18.439		724828.177	728962.261	1.239
J5			18.836		724825.751	728959.419	1.742
J8			17.808		724776.184	728970.531	4.325
J9			17.445		724782.249	728978.375	4.028
17		5.00	17.956		724781.465	728966.554	1.476
19		5.00	17.161		724772.732	728985.689	1.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3	3	2	6.266	0.600	10.675	10.600	0.075	83.5	225	10.06	32.5
4	4	3	6.212	0.600	10.820	10.675	0.145	42.8	225	9.99	32.6
6	6	4	68.533	0.600	11.250	10.820	0.430	159.4	225	9.94	32.7
7	ATT/HB Z2	6	32.691	0.600	11.440	11.250	0.190	172.1	225	8.83	34.5
15	15	ATT/HB Z2	3.066	0.600	13.663	13.652	0.011	278.8	300	5.59	41.9
9	9	ATT/HB Z2	35.784	0.600	13.400	11.460	1.940	18.4	375	8.29	35.5
J9	J9	9	2.446	0.600	13.417	13.400	0.017	143.9	375	8.14	35.8
J8	J8	J9	9.915	0.600	13.483	13.417	0.066	150.2	375	8.12	35.9
19a	19	J9	12.003	0.600	15.686	15.446	0.240	50.0	150	5.14	43.3
17a	17	J8	6.611	0.600	16.480	16.348	0.132	50.1	150	5.08	43.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
3	1.431	56.9	86.0	1.350	1.425	0.733	0.0
4	2.004	79.7	86.3	1.155	1.350	0.733	0.0
6	1.033	41.1	86.5	1.879	1.155	0.733	0.0
7	0.994	39.5	91.4	4.516	1.879	0.733	0.0
15	0.937	66.2	29.2	2.315	2.229	0.193	0.0
9	4.235	467.8	69.4	3.625	4.346	0.541	0.0
J9	1.508	166.6	64.3	3.653	3.625	0.497	0.0
J8	1.476	163.0	64.4	3.950	3.653	0.497	0.0
19a	1.426	25.2	0.0	1.325	1.849	0.000	0.0
17a	1.425	25.2	0.0	1.326	1.310	0.000	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
10	10	J8	19.108	0.600	13.610	13.483	0.127	150.5	375	8.01	36.1
11	11	10	19.524	0.600	13.760	13.610	0.150	130.2	300	7.79	36.5
12	12	11	35.394	0.600	13.920	13.760	0.160	221.2	300	7.55	37.0
45	45	12	12.673	0.600	18.000	17.747	0.253	50.1	150	5.15	43.3
13	13	12	37.385	0.600	14.080	13.920	0.160	233.7	300	6.99	38.3
J3	J3	13	18.850	0.600	14.176	14.080	0.096	196.4	300	6.38	39.7
J2	J2	J3	33.367	0.600	14.345	14.176	0.169	197.4	300	6.10	40.5
8	8	J3	5.914	0.600	16.500	16.263	0.237	25.0	150	5.05	43.6
J1	J1	J2	30.806	0.600	14.501	14.345	0.156	197.5	300	5.60	41.9
7a	7	J2	6.508	0.600	15.500	15.240	0.260	25.0	150	5.05	43.6
5	5	J1	7.420	0.600	15.600	14.501	1.099	6.8	150	5.03	43.6
14	14	J1	9.646	0.600	14.550	14.501	0.049	196.9	300	5.14	43.3
16	16	15	56.605	0.600	15.500	13.750	1.750	32.3	225	5.41	42.5
17	J6	15	8.136	0.600	13.691	13.663	0.028	290.6	300	5.53	42.1
19	J7	J6	17.225	0.600	13.750	13.691	0.059	292.0	300	5.38	42.5
18	18	J6	15.425	0.600	15.000	13.750	1.250	12.3	100	5.12	43.4
20	20	J7	17.404	0.600	15.525	13.750	1.775	9.8	225	5.07	43.5
22	22	21	9.852	0.600	13.500	12.770	0.730	13.5	225	10.79	31.4
23	23	22	26.537	0.600	13.700	13.500	0.200	132.7	225	10.74	31.4
24	24	23	75.403	0.600	15.900	13.700	2.200	34.3	225	10.35	32.0
25	25	24	31.832	0.600	15.970	15.900	0.070	454.7	225	9.79	32.9
26	ATT/HB Z1	25	5.284	0.600	16.000	15.970	0.030	176.1	225	8.92	34.4
41	41	ATT/HB Z1	18.381	0.600	16.050	16.000	0.050	367.6	300	6.18	40.3
27	27	ATT/HB Z1	10.352	0.600	16.050	16.000	0.050	207.0	525	8.83	34.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
10	1.475	162.9	64.8	4.515	3.950	0.497	0.0
11	1.376	97.3	47.4	4.440	4.590	0.360	0.0
12	1.053	74.4	46.0	5.330	4.440	0.344	0.0
45	1.425	25.2	8.6	1.538	1.653	0.055	0.0
13	1.024	72.4	39.9	3.720	5.330	0.288	0.0
J3	1.118	79.0	36.1	3.355	3.720	0.251	0.0
J2	1.115	78.8	28.3	2.318	3.355	0.193	0.0
8	2.024	35.8	9.2	1.432	1.418	0.058	0.0
J1	1.115	78.8	23.5	1.389	2.318	0.155	0.0
7a	2.021	35.7	6.0	1.657	1.573	0.038	0.0
5	3.903	69.0	7.4	0.754	1.539	0.047	0.0
14	1.117	78.9	16.9	1.150	1.389	0.108	0.0
16	2.308	91.8	17.0	0.800	2.303	0.111	0.0
17	0.917	64.8	12.4	2.660	2.315	0.082	0.0
19	0.915	64.7	7.5	3.333	2.660	0.049	0.0
18	2.211	17.4	5.2	1.400	2.801	0.033	0.0
20	4.203	167.1	7.6	2.000	3.408	0.049	0.0
22	3.580	142.4	107.5	0.675	1.105	0.948	0.0
23	1.133	45.1	107.7	0.775	0.675	0.948	0.0
24	2.242	89.1	109.7	3.075	0.775	0.948	0.0
25	0.607	24.1	112.6	3.305	3.075	0.948	0.0
26	0.982	39.0	117.6	3.291	3.305	0.948	0.0
41	0.814	57.5	37.2	3.241	3.216	0.256	0.0
27	1.553	336.1	86.3	3.030	2.991	0.692	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
28	28	27	16.647	0.600	16.072	16.050	0.022	756.7	525	8.72	34.7
29	29	28	20.855	0.600	16.119	16.072	0.047	443.7	450	8.37	35.4
46	46	29	4.926	0.600	18.197	17.767	0.430	11.5	150	5.03	43.6
30	30	29	29.385	0.600	16.185	16.119	0.066	445.2	450	8.01	36.1
39	39	30	17.578	0.600	16.850	16.185	0.665	26.4	225	5.31	42.8
37	37	30	36.306	0.600	16.600	16.185	0.415	87.5	375	5.68	41.7
31	31	30	57.498	0.600	16.314	16.185	0.129	445.7	450	7.50	37.1
36	36	31	40.146	0.600	16.450	16.314	0.136	295.2	300	5.74	41.5
32	32	31	20.233	0.600	17.100	16.314	0.786	25.7	225	6.50	39.5
33	33	32	22.581	0.600	18.000	17.100	0.900	25.1	225	6.37	39.8
34	34	33	63.342	0.600	20.100	18.000	2.100	30.2	225	6.22	40.2
35	35	34	21.083	0.600	20.200	20.100	0.100	210.8	150	5.78	41.4
35a	44	35	13.859	0.600	20.300	20.200	0.100	138.6	150	5.27	42.9
J5	J5	37	16.528	0.600	17.094	16.600	0.494	33.5	225	5.36	42.6
48	48	37	6.612	0.600	17.000	16.600	0.400	16.5	150	5.04	43.6
Depth/Area 1	Depth/Area 1	J5	3.737	0.600	17.200	17.094	0.106	35.3	150	5.04	43.6
38	38	J5	22.819	0.600	17.775	17.094	0.681	33.5	225	5.24	43.0
47	47	38	5.819	0.600	17.850	17.752	0.098	59.4	150	5.07	43.5
26a	26	39	9.261	0.600	17.500	16.850	0.650	14.2	150	5.06	43.5
40	40	39	28.752	0.600	17.900	16.850	1.050	27.4	225	5.19	43.1
42	42	41	3.537	0.600	16.070	16.050	0.020	176.8	225	5.80	41.3
J4	J4	42	19.638	0.600	17.951	17.830	0.121	162.3	225	5.74	41.5
49	49	J4	8.656	0.600	18.475	17.950	0.525	16.5	150	5.06	43.5
43	43	J4	21.237	0.600	18.080	17.951	0.129	164.6	225	5.42	42.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
28	0.806	174.5	86.8	2.903	3.030	0.692	0.0
29	0.958	152.4	88.4	2.631	2.978	0.692	0.0
46	2.993	52.9	0.0	0.825	1.283	0.000	0.0
30	0.957	152.2	90.2	1.965	2.631	0.692	0.0
39	2.555	101.6	13.9	2.425	2.190	0.090	0.0
37	1.938	214.0	42.6	1.619	2.040	0.283	0.0
31	0.956	152.1	38.0	2.236	1.965	0.283	0.0
36	0.910	64.3	16.3	0.750	2.386	0.109	0.0
32	2.589	102.9	18.2	2.415	2.461	0.127	0.0
33	2.622	104.3	12.7	2.075	2.415	0.088	0.0
34	2.391	95.1	12.8	0.975	2.075	0.088	0.0
35	0.688	12.2	1.7	0.950	1.050	0.011	0.0
35a	0.852	15.0	1.8	0.850	0.950	0.011	0.0
J5	2.269	90.2	26.4	1.517	1.769	0.171	0.0
48	2.489	44.0	13.4	1.291	1.844	0.085	0.0
Depth/Area 1	1.701	30.1	7.1	1.089	1.592	0.045	0.0
38	2.267	90.2	19.6	1.170	1.517	0.126	0.0
47	1.307	23.1	0.0	1.165	1.268	0.000	0.0
26a	2.682	47.4	8.6	2.012	2.500	0.055	0.0
40	2.510	99.8	5.5	1.875	2.425	0.035	0.0
42	0.980	39.0	38.2	3.305	3.316	0.256	0.0
J4	1.023	40.7	38.3	1.620	1.545	0.256	0.0
49	2.493	44.0	10.7	1.279	1.696	0.068	0.0
43	1.016	40.4	28.8	1.695	1.620	0.188	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	1	43	12.239	0.600	18.650	18.080	0.570	21.5	225	5.07	43.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1	2.836	112.8	20.2	1.462	1.695	0.128	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
3	6.266	83.5	225	Circular	12.250	10.675	1.350	12.250	10.600	1.425
4	6.212	42.8	225	Circular	12.200	10.820	1.155	12.250	10.675	1.350
6	68.533	159.4	225	Circular	13.354	11.250	1.879	12.200	10.820	1.155
7	32.691	172.1	225	Circular	16.181	11.440	4.516	13.354	11.250	1.879
15	3.066	278.8	300	Circular	16.278	13.663	2.315	16.181	13.652	2.229
9	35.784	18.4	375	Circular	17.400	13.400	3.625	16.181	11.460	4.346
J9	2.446	143.9	375	Circular	17.445	13.417	3.653	17.400	13.400	3.625
J8	9.915	150.2	375	Circular	17.808	13.483	3.950	17.445	13.417	3.653
19a	12.003	50.0	150	Circular	17.161	15.686	1.325	17.445	15.446	1.849
17a	6.611	50.1	150	Circular	17.956	16.480	1.326	17.808	16.348	1.310
10	19.108	150.5	375	Circular	18.500	13.610	4.515	17.808	13.483	3.950
11	19.524	130.2	300	Circular	18.500	13.760	4.440	18.500	13.610	4.590
12	35.394	221.2	300	Circular	19.550	13.920	5.330	18.500	13.760	4.440
45	12.673	50.1	150	Circular	19.688	18.000	1.538	19.550	17.747	1.653
13	37.385	233.7	300	Circular	18.100	14.080	3.720	19.550	13.920	5.330
J3	18.850	196.4	300	Circular	17.831	14.176	3.355	18.100	14.080	3.720
J2	33.367	197.4	300	Circular	16.963	14.345	2.318	17.831	14.176	3.355
8	5.914	25.0	150	Circular	18.082	16.500	1.432	17.831	16.263	1.418
J1	30.806	197.5	300	Circular	16.190	14.501	1.389	16.963	14.345	2.318

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3	3	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
4	4	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
6	6	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
7	ATT/HB Z2	1350	Manhole	Adoptable	6	1200	Manhole	Adoptable
15	15	1200	Manhole	Adoptable	ATT/HB Z2	1350	Manhole	Adoptable
9	9	1350	Manhole	Adoptable	ATT/HB Z2	1350	Manhole	Adoptable
J9	J9		Junction		9	1350	Manhole	Adoptable
J8	J8		Junction		J9		Junction	
19a	19		Manhole	Adoptable	J9		Junction	
17a	17		Manhole	Adoptable	J8		Junction	
10	10	1350	Manhole	Adoptable	J8		Junction	
11	11	1200	Manhole	Adoptable	10	1350	Manhole	Adoptable
12	12	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
45	45	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
13	13	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
J3	J3		Junction		13	1200	Manhole	Adoptable
J2	J2		Junction		J3		Junction	
8	8		Manhole	Adoptable	J3		Junction	
J1	J1		Junction		J2		Junction	

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7a	6.508	25.0	150	Circular	17.307	15.500	1.657	16.963	15.240	1.573
5	7.420	6.8	150	Circular	16.504	15.600	0.754	16.190	14.501	1.539
14	9.646	196.9	300	Circular	16.000	14.550	1.150	16.190	14.501	1.389
16	56.605	32.3	225	Circular	16.525	15.500	0.800	16.278	13.750	2.303
17	8.136	290.6	300	Circular	16.651	13.691	2.660	16.278	13.663	2.315
19	17.225	292.0	300	Circular	17.383	13.750	3.333	16.651	13.691	2.660
18	15.425	12.3	100	Circular	16.500	15.000	1.400	16.651	13.750	2.801
20	17.404	9.8	225	Circular	17.750	15.525	2.000	17.383	13.750	3.408
22	9.852	13.5	225	Circular	14.400	13.500	0.675	14.100	12.770	1.105
23	26.537	132.7	225	Circular	14.700	13.700	0.775	14.400	13.500	0.675
24	75.403	34.3	225	Circular	19.200	15.900	3.075	14.700	13.700	0.775
25	31.832	454.7	225	Circular	19.500	15.970	3.305	19.200	15.900	3.075
26	5.284	176.1	225	Circular	19.516	16.000	3.291	19.500	15.970	3.305
41	18.381	367.6	300	Circular	19.591	16.050	3.241	19.516	16.000	3.216
27	10.352	207.0	525	Circular	19.605	16.050	3.030	19.516	16.000	2.991
28	16.647	756.7	525	Circular	19.500	16.072	2.903	19.605	16.050	3.030
29	20.855	443.7	450	Circular	19.200	16.119	2.631	19.500	16.072	2.978
46	4.926	11.5	150	Circular	19.172	18.197	0.825	19.200	17.767	1.283
30	29.385	445.2	450	Circular	18.600	16.185	1.965	19.200	16.119	2.631
39	17.578	26.4	225	Circular	19.500	16.850	2.425	18.600	16.185	2.190
37	36.306	87.5	375	Circular	18.594	16.600	1.619	18.600	16.185	2.040
31	57.498	445.7	450	Circular	19.000	16.314	2.236	18.600	16.185	1.965
36	40.146	295.2	300	Circular	17.500	16.450	0.750	19.000	16.314	2.386
32	20.233	25.7	225	Circular	19.740	17.100	2.415	19.000	16.314	2.461
33	22.581	25.1	225	Circular	20.300	18.000	2.075	19.740	17.100	2.415

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7a	7		Manhole	Adoptable	J2		Junction	
5	5		Manhole	Adoptable	J1		Junction	
14	14	2200	Manhole	Adoptable	J1		Junction	
16	16	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable
17	J6	1200	Junction		15	1200	Manhole	Adoptable
19	J7	1200	Junction		J6	1200	Junction	
18	18	1200	Manhole	Adoptable	J6	1200	Junction	
20	20	1200	Manhole	Adoptable	J7	1200	Junction	
22	22	1200	Manhole	Adoptable	21	1200	Manhole	Adoptable
23	23	1200	Manhole	Adoptable	22	1200	Manhole	Adoptable
24	24	1200	Manhole	Adoptable	23	1200	Manhole	Adoptable
25	25	1200	Manhole	Adoptable	24	1200	Manhole	Adoptable
26	ATT/HB Z1	1500	Manhole	Adoptable	25	1200	Manhole	Adoptable
41	41	1200	Manhole	Adoptable	ATT/HB Z1	1500	Manhole	Adoptable
27	27	1500	Manhole	Adoptable	ATT/HB Z1	1500	Manhole	Adoptable
28	28	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
29	29	1350	Manhole	Adoptable	28	1500	Manhole	Adoptable
46	46	1200	Manhole	Adoptable	29	1350	Manhole	Adoptable
30	30	1500	Manhole	Adoptable	29	1350	Manhole	Adoptable
39	39	1200	Manhole	Adoptable	30	1500	Manhole	Adoptable
37	37	1350	Manhole	Adoptable	30	1500	Manhole	Adoptable
31	31	1500	Manhole	Adoptable	30	1500	Manhole	Adoptable
36	36	2200	Manhole	Adoptable	31	1500	Manhole	Adoptable
32	32	1200	Manhole	Adoptable	31	1500	Manhole	Adoptable
33	33	1200	Manhole	Adoptable	32	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
34	63.342	30.2	225	Circular	21.300	20.100	0.975	20.300	18.000	2.075
35	21.083	210.8	150	Circular	21.300	20.200	0.950	21.300	20.100	1.050
35a	13.859	138.6	150	Circular	21.300	20.300	0.850	21.300	20.200	0.950
J5	16.528	33.5	225	Circular	18.836	17.094	1.517	18.594	16.600	1.769
48	6.612	16.5	150	Circular	18.441	17.000	1.291	18.594	16.600	1.844
Depth/Area 1	3.737	35.3	150	Circular	18.439	17.200	1.089	18.836	17.094	1.592
38	22.819	33.5	225	Circular	19.170	17.775	1.170	18.836	17.094	1.517
47	5.819	59.4	150	Circular	19.165	17.850	1.165	19.170	17.752	1.268
26a	9.261	14.2	150	Circular	19.662	17.500	2.012	19.500	16.850	2.500
40	28.752	27.4	225	Circular	20.000	17.900	1.875	19.500	16.850	2.425
42	3.537	176.8	225	Circular	19.600	16.070	3.305	19.591	16.050	3.316
J4	19.638	162.3	225	Circular	19.796	17.951	1.620	19.600	17.830	1.545
49	8.656	16.5	150	Circular	19.904	18.475	1.279	19.796	17.950	1.696
43	21.237	164.6	225	Circular	20.000	18.080	1.695	19.796	17.951	1.620
1	12.239	21.5	225	Circular	20.337	18.650	1.462	20.000	18.080	1.695

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
34	34	1200	Manhole	Adoptable	33	1200	Manhole	Adoptable
35	35	1200	Manhole	Adoptable	34	1200	Manhole	Adoptable
35a	44	1200	Manhole	Adoptable	35	1200	Manhole	Adoptable
J5	J5		Junction		37	1350	Manhole	Adoptable
48	48	1200	Manhole	Adoptable	37	1350	Manhole	Adoptable
Depth/Area 1	Depth/Area 1		Manhole	Adoptable	J5		Junction	
38	38	1200	Manhole	Adoptable	J5		Junction	
47	47	1200	Manhole	Adoptable	38	1200	Manhole	Adoptable
26a	26		Manhole	Adoptable	39	1200	Manhole	Adoptable
40	40	1200	Manhole	Adoptable	39	1200	Manhole	Adoptable
42	42	1200	Manhole	Adoptable	41	1200	Manhole	Adoptable
J4	J4		Junction		42	1200	Manhole	Adoptable
49	49		Manhole	Adoptable	J4		Junction	
43	43	1200	Manhole	Adoptable	J4		Junction	
1	1	1200	Manhole	Adoptable	43	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.000	Additional Storage (m^3/ha)	0.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440	2160

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	20	0	0
100	20	0	0

Node ATT/HB Z1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	16.000	Product Number	CTL-SHE-0090-4100-1400-4100
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.1	Min Node Diameter (mm)	1200

Node ATT/HB Z2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	11.440	Product Number	CTL-SHE-0082-4100-2110-4100
Design Depth (m)	2.110	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	4.1	Min Node Diameter (mm)	1200

Node ATT/HB Z1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	16.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**
0.000	525.0	0.0	1.400	525.0	0.0	1.401	0.0	0.0

Node ATT/HB Z2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	11.440
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**
0.000	366.1	0.0	2.110	366.1	0.0	2.111	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	2	630	10.636	0.036	3.1	0.0000	0.0000	OK
960 minute summer	3	630	10.713	0.038	3.1	0.0426	0.0000	OK
960 minute summer	4	630	10.851	0.031	3.1	0.0350	0.0000	OK
960 minute summer	6	630	11.294	0.044	3.1	0.0501	0.0000	OK
960 minute summer	ATT/HB Z2	660	11.793	0.353	15.2	129.7419	0.0000	SURCHARGED
15 minute summer	9	12	13.505	0.105	75.4	0.1501	0.0000	OK
15 minute summer	10	12	13.786	0.176	69.5	0.2522	0.0000	OK
15 minute summer	11	12	13.932	0.172	52.1	0.1944	0.0000	OK
15 minute summer	12	12	14.107	0.187	50.8	0.2120	0.0000	OK
15 minute summer	13	11	14.253	0.173	43.0	0.1952	0.0000	OK
15 minute summer	14	10	14.650	0.100	16.6	0.3786	0.0000	OK
15 minute summer	15	11	13.813	0.150	28.4	0.1697	0.0000	OK
15 minute summer	16	10	15.566	0.066	17.0	0.0741	0.0000	OK
15 minute summer	J6	11	13.816	0.125	12.3	0.0000	0.0000	OK
15 minute summer	18	10	15.037	0.037	5.1	0.0420	0.0000	OK
15 minute summer	J7	11	13.819	0.069	7.4	0.0000	0.0000	OK
15 minute summer	20	10	15.557	0.032	7.4	0.0363	0.0000	OK
1440 minute summer	21	960	12.796	0.026	3.9	0.0000	0.0000	OK
1440 minute summer	22	960	13.526	0.026	3.9	0.0297	0.0000	OK
1440 minute summer	23	960	13.748	0.048	3.9	0.0548	0.0000	OK
1440 minute summer	24	960	15.932	0.032	3.9	0.0362	0.0000	OK
1440 minute summer	25	960	16.032	0.062	3.9	0.0707	0.0000	OK
1440 minute summer	ATT/HB Z1	960	16.324	0.324	14.1	170.8674	0.0000	SURCHARGED
15 minute summer	27	10	16.367	0.317	101.3	0.5602	0.0000	OK
15 minute summer	28	11	16.378	0.306	97.7	0.5411	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	3	3	2	3.1	0.749	0.055	0.0263	164.8
960 minute summer	4	4	3	3.1	0.828	0.040	0.0237	
960 minute summer	6	6	4	3.1	0.723	0.077	0.3009	
960 minute summer	ATT/HB Z2	Hydro-Brake®	6	3.1				
15 minute summer	9	9	ATT/HB Z2	75.6	3.089	0.162	0.8762	
15 minute summer	10	10	J8	69.8	1.411	0.429	0.9458	
15 minute summer	11	11	10	52.7	1.266	0.541	0.8274	
15 minute summer	12	12	11	50.2	1.141	0.675	1.5580	
15 minute summer	13	13	12	42.7	0.969	0.590	1.6471	
15 minute summer	14	14	J1	16.4	0.742	0.207	0.2127	
15 minute summer	15	15	ATT/HB Z2	28.5	0.889	0.431	0.0985	
15 minute summer	16	16	15	16.6	1.750	0.181	0.5367	
15 minute summer	J6	17	15	12.0	0.391	0.184	0.2565	
15 minute summer	18	18	J6	5.1	1.737	0.292	0.0621	
15 minute summer	J7	19	J6	7.2	0.384	0.111	0.3456	
15 minute summer	20	20	J7	7.4	1.157	0.044	0.1197	
1440 minute summer	22	22	21	3.9	1.541	0.027	0.0250	263.6
1440 minute summer	23	23	22	3.9	0.905	0.087	0.1174	
1440 minute summer	24	24	23	3.9	0.814	0.044	0.3661	
1440 minute summer	25	25	24	3.9	0.646	0.162	0.1976	
1440 minute summer	ATT/HB Z1	Hydro-Brake®	25	3.9				
15 minute summer	27	27	ATT/HB Z1	105.4	2.281	0.314	0.7103	
15 minute summer	28	28	27	101.3	1.050	0.580	2.2104	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	29	11	16.419	0.300	93.4	0.4293	0.0000	OK
15 minute summer	30	11	16.473	0.288	96.7	0.5092	0.0000	OK
15 minute summer	31	12	16.496	0.182	42.0	0.3221	0.0000	OK
15 minute summer	32	11	17.165	0.065	18.9	0.0737	0.0000	OK
15 minute summer	33	11	18.054	0.054	13.2	0.0610	0.0000	OK
15 minute summer	34	10	20.158	0.058	13.4	0.0654	0.0000	OK
15 minute summer	35	11	20.238	0.038	1.8	0.0431	0.0000	OK
15 minute summer	36	11	16.551	0.101	16.7	0.3847	0.0000	OK
15 minute summer	37	10	16.712	0.112	42.9	0.1599	0.0000	OK
15 minute summer	38	10	17.845	0.093	19.3	0.1054	0.0000	OK
15 minute summer	39	10	16.905	0.055	13.7	0.0626	0.0000	OK
15 minute summer	40	10	17.935	0.035	5.4	0.0399	0.0000	OK
15 minute summer	41	10	16.725	0.675	46.0	0.7629	0.0000	SURCHARGED
15 minute summer	42	10	16.778	0.708	38.4	0.8006	0.0000	SURCHARGED
15 minute summer	43	10	18.224	0.144	28.6	0.1627	0.0000	OK
15 minute summer	44	10	20.335	0.035	1.8	0.0400	0.0000	OK
15 minute summer	1	10	18.713	0.063	19.6	0.0714	0.0000	OK
15 minute summer	45	10	18.062	0.062	8.4	0.0707	0.0000	OK
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	1	17.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	48	10	17.056	0.056	13.0	0.0632	0.0000	OK
15 minute summer	J1	10	14.612	0.111	23.5	0.0000	0.0000	OK
15 minute summer	5	10	15.633	0.033	7.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	29	29	28	97.7	0.949	0.641	2.3684	
15 minute summer	30	30	29	93.4	0.881	0.614	3.2243	
15 minute summer	31	31	30	38.4	0.519	0.253	4.7899	
15 minute summer	32	32	31	19.0	1.008	0.184	0.4387	
15 minute summer	33	33	32	13.2	1.576	0.127	0.1897	
15 minute summer	34	34	33	13.2	1.739	0.138	0.4827	
15 minute summer	35	35	34	1.7	0.367	0.143	0.1023	
15 minute summer	36	36	31	16.2	0.598	0.251	1.2849	
15 minute summer	37	37	30	42.4	0.872	0.198	2.1460	
15 minute summer	38	38	J5	19.2	1.626	0.213	0.2696	
15 minute summer	39	39	30	13.6	0.792	0.133	0.4160	
15 minute summer	40	40	39	5.3	0.939	0.054	0.1657	
15 minute summer	41	41	ATT/HB Z1	62.0	1.701	1.078	0.6743	
15 minute summer	42	42	41	46.0	1.156	1.180	0.1407	
15 minute summer	43	43	J4	28.3	0.935	0.700	0.6398	
15 minute summer	44	35a	35	1.8	0.549	0.118	0.0457	
15 minute summer	1	1	43	19.5	1.099	0.173	0.2197	
15 minute summer	45	45	12	8.3	1.242	0.331	0.0851	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	0.0	0.000	0.000	0.0334	
15 minute summer	48	48	37	13.0	1.285	0.295	0.0662	
15 minute summer	J1	J1	J2	23.3	0.919	0.295	0.7867	
15 minute summer	5	5	J1	7.2	1.318	0.104	0.0623	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	15.542	0.042	5.8	0.0000	0.0000	OK
15 minute summer	J2	11	14.469	0.124	29.0	0.0000	0.0000	OK
15 minute summer	J3	11	14.329	0.153	37.5	0.0000	0.0000	OK
15 minute summer	8	10	16.553	0.053	8.9	0.0000	0.0000	OK
15 minute summer	26	10	17.543	0.043	8.4	0.0000	0.0000	OK
15 minute summer	49	10	18.525	0.050	10.4	0.0000	0.0000	OK
15 minute summer	J4	11	18.129	0.179	38.7	0.0000	0.0000	OK
15 minute summer	Depth/Area 1	10	17.253	0.053	6.9	0.0000	0.0000	OK
15 minute summer	J5	10	17.176	0.082	26.1	0.0000	0.0000	OK
15 minute summer	J8	12	13.652	0.169	69.8	0.0000	0.0000	OK
15 minute summer	J9	12	13.584	0.167	70.1	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	7	7a	J2	5.8	1.456	0.161	0.0258	
15 minute summer	J2	J2	J3	29.0	0.912	0.368	1.0623	
15 minute summer	J3	J3	13	37.6	0.964	0.476	0.7354	
15 minute summer	8	8	J3	8.9	1.633	0.248	0.0321	
15 minute summer	26	26a	39	8.4	1.675	0.177	0.0464	
15 minute summer	49	49	J4	10.4	1.008	0.235	0.0982	
15 minute summer	J4	J4	42	38.4	1.184	0.944	0.6366	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	6.9	0.896	0.229	0.0287	
15 minute summer	J5	J5	37	25.9	1.583	0.287	0.2705	
15 minute summer	J8	J8	J9	70.1	1.467	0.430	0.4738	
15 minute summer	J9	J9	9	70.2	1.948	0.421	0.0888	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	2	240	10.636	0.036	3.1	0.0000	0.0000	OK
30 minute summer	3	239	10.713	0.038	3.1	0.0426	0.0000	OK
30 minute summer	4	239	10.851	0.031	3.1	0.0350	0.0000	OK
30 minute summer	6	237	11.294	0.044	3.1	0.0501	0.0000	OK
1440 minute summer	ATT/HB Z2	1200	12.489	1.049	25.6	385.4251	0.0000	SURCHARGED
15 minute summer	9	11	13.569	0.169	176.2	0.2412	0.0000	OK
15 minute summer	10	11	13.926	0.316	161.1	0.4528	0.0000	OK
15 minute summer	11	12	14.202	0.442	113.9	0.5004	0.0000	SURCHARGED
15 minute summer	12	12	14.618	0.698	108.5	0.7900	0.0000	SURCHARGED
15 minute summer	13	12	14.918	0.838	89.9	0.9474	0.0000	SURCHARGED
15 minute summer	14	12	15.209	0.659	44.2	2.5061	0.0000	SURCHARGED
15 minute summer	15	11	13.934	0.271	75.7	0.3062	0.0000	OK
15 minute summer	16	10	15.610	0.110	45.3	0.1249	0.0000	OK
15 minute summer	J6	11	13.941	0.250	32.1	0.0000	0.0000	OK
15 minute summer	18	10	15.067	0.067	13.6	0.0754	0.0000	OK
15 minute summer	J7	11	13.944	0.194	19.8	0.0000	0.0000	OK
15 minute summer	20	10	15.577	0.052	19.9	0.0590	0.0000	OK
60 minute summer	21	212	12.796	0.026	4.0	0.0000	0.0000	OK
60 minute summer	22	212	13.526	0.026	4.0	0.0300	0.0000	OK
60 minute summer	23	215	13.749	0.049	4.0	0.0553	0.0000	OK
60 minute summer	24	211	15.932	0.032	4.0	0.0365	0.0000	OK
60 minute summer	25	45	16.033	0.063	4.0	0.0712	0.0000	OK
1440 minute summer	ATT/HB Z1	1290	16.918	0.918	29.6	483.4901	0.0000	SURCHARGED
1440 minute summer	27	1290	16.918	0.868	20.9	1.5335	0.0000	SURCHARGED
1440 minute summer	28	1290	16.918	0.846	21.2	1.4946	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	3	3	2	3.1	0.749	0.055	0.0263	47.8
30 minute summer	4	4	3	3.1	0.828	0.040	0.0237	
30 minute summer	6	6	4	3.1	0.724	0.077	0.3009	
1440 minute summer	ATT/HB Z2	Hydro-Brake®	6	3.1				
15 minute summer	9	9	ATT/HB Z2	176.4	3.841	0.377	2.0821	
15 minute summer	10	10	J8	159.8	1.681	0.981	1.8262	
15 minute summer	11	11	10	114.2	1.623	1.174	1.3749	
15 minute summer	12	12	11	108.8	1.545	1.462	2.4924	
15 minute summer	13	13	12	89.9	1.277	1.243	2.6326	
15 minute summer	14	14	J1	40.3	0.899	0.510	0.6793	
15 minute summer	15	15	ATT/HB Z2	76.4	1.249	1.154	0.1858	
15 minute summer	16	16	15	44.9	1.986	0.490	1.5184	
15 minute summer	J6	17	15	32.2	0.496	0.496	0.5276	
15 minute summer	18	18	J6	13.5	1.849	0.779	0.1031	
15 minute summer	J7	19	J6	19.1	0.407	0.296	0.9562	
15 minute summer	20	20	J7	19.8	1.301	0.119	0.3760	
60 minute summer	22	22	21	4.0	1.548	0.028	0.0252	64.5
60 minute summer	23	23	22	4.0	0.909	0.088	0.1187	
60 minute summer	24	24	23	4.0	0.818	0.044	0.3702	
60 minute summer	25	25	24	4.0	0.650	0.164	0.1998	
1440 minute summer	ATT/HB Z1	Hydro-Brake®	25	4.0				
1440 minute summer	27	27	ATT/HB Z1	20.7	0.771	0.062	2.2364	
1440 minute summer	28	28	27	20.9	0.377	0.120	3.5963	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	29	1290	16.918	0.799	21.7	1.1432	0.0000	SURCHARGED
15 minute summer	30	11	16.953	0.768	249.5	1.3568	0.0000	SURCHARGED
15 minute summer	31	11	17.027	0.713	107.4	1.2606	0.0000	SURCHARGED
15 minute summer	32	11	17.251	0.151	50.8	0.1709	0.0000	OK
15 minute summer	33	11	18.090	0.090	35.4	0.1015	0.0000	OK
15 minute summer	34	10	20.198	0.098	35.9	0.1107	0.0000	OK
15 minute summer	35	11	20.264	0.064	4.6	0.0719	0.0000	OK
15 minute summer	36	11	17.070	0.620	44.5	2.3584	0.0000	SURCHARGED
15 minute summer	37	11	17.075	0.475	111.3	0.6792	0.0000	SURCHARGED
15 minute summer	38	10	17.896	0.144	51.5	0.1631	0.0000	OK
15 minute summer	39	12	17.006	0.156	36.7	0.1764	0.0000	OK
15 minute summer	40	10	17.957	0.057	14.4	0.0649	0.0000	OK
1440 minute summer	41	1290	16.918	0.868	8.9	0.9816	0.0000	SURCHARGED
15 minute summer	42	8	17.013	0.943	96.4	1.0663	0.0000	SURCHARGED
15 minute summer	43	11	19.260	1.180	72.3	1.3351	0.0000	SURCHARGED
15 minute summer	44	10	20.359	0.059	4.7	0.0671	0.0000	OK
15 minute summer	1	11	19.414	0.764	52.4	0.8635	0.0000	SURCHARGED
15 minute summer	45	10	18.123	0.123	22.5	0.1387	0.0000	OK
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	10	17.897	0.047	0.8	0.0528	0.0000	OK
15 minute summer	48	11	17.373	0.373	34.8	0.4224	0.0000	SURCHARGED
15 minute summer	J1	12	15.198	0.697	58.5	0.0000	0.0000	SURCHARGED
15 minute summer	5	10	15.654	0.054	19.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	29	29	28	21.2	0.390	0.139	3.3043	
15 minute summer	30	30	29	251.3	1.586	1.651	4.6559	
15 minute summer	31	31	30	104.4	0.659	0.687	9.1102	
15 minute summer	32	32	31	49.2	1.364	0.478	0.6891	
15 minute summer	33	33	32	35.3	1.954	0.338	0.4865	
15 minute summer	34	34	33	35.4	2.270	0.373	0.9882	
15 minute summer	35	35	34	4.6	0.484	0.378	0.2017	
15 minute summer	36	36	31	39.8	0.710	0.619	2.8271	
15 minute summer	37	37	30	103.5	1.105	0.484	4.0044	
15 minute summer	38	38	J5	51.0	2.031	0.566	0.6725	
15 minute summer	39	39	30	34.0	1.052	0.335	0.6077	
15 minute summer	40	40	39	14.3	1.223	0.143	0.5211	
1440 minute summer	41	41	ATT/HB Z1	8.9	0.515	0.155	1.2944	
15 minute summer	42	42	41	96.4	2.425	2.475	0.1407	
15 minute summer	43	43	J4	71.3	1.794	1.766	0.8446	
15 minute summer	44	35a	35	4.6	0.697	0.309	0.0931	
15 minute summer	1	1	43	49.1	1.234	0.435	0.4868	
15 minute summer	45	45	12	22.3	1.524	0.884	0.1849	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	-0.8	-0.092	-0.036	0.0642	
15 minute summer	48	48	37	32.6	1.903	0.740	0.1164	
15 minute summer	J1	J1	J2	55.8	1.127	0.707	2.1693	
15 minute summer	5	5	J1	19.3	1.397	0.279	0.0866	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	15.573	0.073	15.5	0.0000	0.0000	OK
15 minute summer	J2	12	15.135	0.790	70.3	0.0000	0.0000	SURCHARGED
15 minute summer	J3	12	15.034	0.858	87.9	0.0000	0.0000	SURCHARGED
15 minute summer	8	10	16.597	0.097	23.9	0.0000	0.0000	OK
15 minute summer	26	10	17.575	0.075	22.4	0.0000	0.0000	OK
15 minute summer	49	11	19.023	0.548	27.7	0.0000	0.0000	SURCHARGED
15 minute summer	J4	11	18.799	0.849	97.1	0.0000	0.0000	SURCHARGED
15 minute summer	Depth/Area 1	12	17.356	0.156	18.5	0.0000	0.0000	SURCHARGED
15 minute summer	J5	12	17.314	0.220	69.5	0.0000	0.0000	OK
15 minute summer	J8	12	13.776	0.293	159.8	0.0000	0.0000	OK
15 minute summer	J9	12	13.705	0.288	160.5	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	7	7a	J2	15.4	1.882	0.432	0.0534	
15 minute summer	J2	J2	J3	65.4	1.041	0.830	2.3497	
15 minute summer	J3	J3	13	78.2	1.111	0.989	1.3274	
15 minute summer	8	8	J3	23.8	2.067	0.666	0.0681	
15 minute summer	26	26a	39	22.4	2.178	0.473	0.1184	
15 minute summer	49	49	J4	25.8	1.463	0.585	0.1524	
15 minute summer	J4	J4	42	96.4	2.425	2.370	0.7731	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	18.4	1.145	0.613	0.0658	
15 minute summer	J5	J5	37	68.5	2.076	0.760	0.6550	
15 minute summer	J8	J8	J9	160.5	1.752	0.985	0.9087	
15 minute summer	J9	J9	9	160.8	2.346	0.966	0.1694	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	2	1290	10.637	0.037	3.4	0.0000	0.0000	OK
1440 minute summer	3	1290	10.714	0.039	3.4	0.0440	0.0000	OK
1440 minute summer	4	1290	10.852	0.032	3.4	0.0361	0.0000	OK
1440 minute summer	6	1290	11.296	0.046	3.4	0.0517	0.0000	OK
1440 minute summer	ATT/HB Z2	1290	12.803	1.363	31.7	500.9394	0.0000	SURCHARGED
15 minute summer	9	11	13.593	0.193	230.6	0.2769	0.0000	OK
15 minute summer	10	11	14.075	0.465	201.4	0.6661	0.0000	SURCHARGED
15 minute summer	11	12	14.478	0.718	138.7	0.8121	0.0000	SURCHARGED
15 minute summer	12	12	15.092	1.172	132.2	1.3252	0.0000	SURCHARGED
15 minute summer	13	12	15.517	1.437	107.6	1.6249	0.0000	SURCHARGED
15 minute summer	14	12	15.916	1.366	57.4	5.1929	0.0000	FLOOD RISK
15 minute summer	15	11	13.991	0.328	97.5	0.3704	0.0000	SURCHARGED
15 minute summer	16	10	15.629	0.129	58.8	0.1464	0.0000	OK
15 minute summer	J6	11	14.006	0.315	41.0	0.0000	0.0000	SURCHARGED
15 minute summer	18	11	15.195	0.195	17.6	0.2200	0.0000	SURCHARGED
15 minute summer	J7	11	14.013	0.263	25.7	0.0000	0.0000	OK
15 minute summer	20	10	15.584	0.059	25.8	0.0673	0.0000	OK
30 minute summer	21	222	12.796	0.026	4.0	0.0000	0.0000	OK
30 minute summer	22	222	13.526	0.026	4.0	0.0300	0.0000	OK
30 minute summer	23	225	13.749	0.049	4.0	0.0553	0.0000	OK
30 minute summer	24	221	15.932	0.032	4.0	0.0365	0.0000	OK
30 minute summer	25	25	16.033	0.063	4.0	0.0712	0.0000	OK
2160 minute summer	ATT/HB Z1	1740	17.203	1.203	28.0	633.7805	0.0000	SURCHARGED
2160 minute summer	27	1740	17.203	1.153	20.2	2.0376	0.0000	SURCHARGED
2160 minute summer	28	1740	17.203	1.131	20.2	1.9988	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	3	3	2	3.4	0.762	0.059	0.0276	274.8
1440 minute summer	4	4	3	3.4	0.842	0.042	0.0248	
1440 minute summer	6	6	4	3.4	0.737	0.082	0.3149	
1440 minute summer	ATT/HB Z2	Hydro-Brake®	6	3.4				
15 minute summer	9	9	ATT/HB Z2	219.7	4.035	0.470	2.5110	
15 minute summer	10	10	J8	200.7	1.819	1.232	2.0894	
15 minute summer	11	11	10	138.9	1.973	1.428	1.3749	
15 minute summer	12	12	11	132.1	1.877	1.776	2.4924	
15 minute summer	13	13	12	109.9	1.561	1.519	2.6326	
15 minute summer	14	14	J1	48.8	0.901	0.619	0.6793	
15 minute summer	15	15	ATT/HB Z2	97.9	1.416	1.480	0.2016	
15 minute summer	16	16	15	58.4	1.960	0.636	1.7943	
15 minute summer	J6	17	15	41.0	0.583	0.633	0.5729	
15 minute summer	18	18	J6	16.3	2.122	0.936	0.1207	
15 minute summer	J7	19	J6	25.2	0.404	0.390	1.1698	
15 minute summer	20	20	J7	25.7	1.338	0.154	0.4189	
30 minute summer	22	22	21	4.0	1.548	0.028	0.0252	59.8
30 minute summer	23	23	22	4.0	0.909	0.088	0.1187	
30 minute summer	24	24	23	4.0	0.862	0.044	0.3702	
30 minute summer	25	25	24	4.0	0.650	0.164	0.1998	
2160 minute summer	ATT/HB Z1	Hydro-Brake®	25	4.0				
2160 minute summer	27	27	ATT/HB Z1	20.1	0.619	0.060	2.2364	
2160 minute summer	28	28	27	20.2	0.345	0.116	3.5963	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
2160 minute summer	29	1740	17.203	1.084	20.3	1.5515	0.0000	SURCHARGED
15 minute summer	30	12	17.283	1.098	313.9	1.9408	0.0000	SURCHARGED
15 minute summer	31	12	17.395	1.081	130.4	1.9095	0.0000	SURCHARGED
15 minute summer	32	12	17.744	0.644	66.1	0.7279	0.0000	SURCHARGED
15 minute summer	33	11	18.113	0.113	46.1	0.1281	0.0000	OK
15 minute summer	34	10	20.214	0.114	46.6	0.1292	0.0000	OK
15 minute summer	35	11	20.274	0.074	6.0	0.0832	0.0000	OK
15 minute summer	36	12	17.487	1.037	66.0	3.9400	0.0000	FLOOD RISK
15 minute summer	37	12	17.466	0.866	129.6	1.2391	0.0000	SURCHARGED
15 minute summer	38	12	18.188	0.436	66.9	0.4929	0.0000	SURCHARGED
15 minute summer	39	12	17.424	0.574	46.4	0.6496	0.0000	SURCHARGED
15 minute summer	40	10	17.966	0.066	18.7	0.0741	0.0000	OK
2160 minute summer	41	1740	17.203	1.153	7.9	1.3042	0.0000	SURCHARGED
2160 minute summer	42	1740	17.203	1.133	8.0	1.2817	0.0000	SURCHARGED
15 minute summer	43	11	19.976	1.896	92.6	2.1438	0.0000	FLOOD RISK
15 minute summer	44	10	20.369	0.069	6.1	0.0781	0.0000	OK
15 minute summer	1	11	20.224	1.574	68.1	1.7799	0.0000	FLOOD RISK
15 minute summer	45	11	18.288	0.288	29.3	0.3252	0.0000	SURCHARGED
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	12	18.191	0.341	3.9	0.3858	0.0000	SURCHARGED
15 minute summer	48	11	17.958	0.958	45.2	1.0832	0.0000	SURCHARGED
15 minute summer	J1	12	15.899	1.398	72.6	0.0000	0.0000	SURCHARGED
15 minute summer	5	12	15.996	0.395	25.0	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
2160 minute summer	29	29	28	20.2	0.363	0.133	3.3043	
15 minute summer	30	30	29	315.0	1.988	2.070	4.6559	
15 minute summer	31	31	30	131.0	0.827	0.862	9.1102	
15 minute summer	32	32	31	60.8	1.529	0.591	0.8047	
15 minute summer	33	33	32	45.4	1.885	0.435	0.6749	
15 minute summer	34	34	33	46.1	2.426	0.485	1.2508	
15 minute summer	35	35	34	6.0	0.529	0.489	0.2407	
15 minute summer	36	36	31	50.6	0.719	0.787	2.8271	
15 minute summer	37	37	30	127.4	1.155	0.595	4.0044	
15 minute summer	38	38	J5	62.2	2.047	0.690	0.9075	
15 minute summer	39	39	30	40.9	1.070	0.402	0.6991	
15 minute summer	40	40	39	18.6	1.253	0.186	0.7096	
2160 minute summer	41	41	ATT/HB Z1	7.9	0.389	0.137	1.2944	
2160 minute summer	42	42	41	7.9	0.367	0.204	0.1407	
15 minute summer	43	43	J4	90.2	2.267	2.232	0.8446	
15 minute summer	44	35a	35	6.0	0.740	0.400	0.1134	
15 minute summer	1	1	43	62.5	1.571	0.554	0.4868	
15 minute summer	45	45	12	28.4	1.614	1.129	0.2208	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	6.4	0.398	0.277	0.1024	
15 minute summer	48	48	37	41.0	2.327	0.931	0.1164	
15 minute summer	J1	J1	J2	60.1	1.122	0.762	2.1693	
15 minute summer	5	5	J1	24.3	1.672	0.352	0.1306	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	12	15.869	0.369	20.1	0.0000	0.0000	SURCHARGED
15 minute summer	J2	12	15.815	1.470	72.1	0.0000	0.0000	SURCHARGED
15 minute summer	J3	12	15.677	1.501	93.1	0.0000	0.0000	SURCHARGED
15 minute summer	8	10	16.620	0.120	31.0	0.0000	0.0000	OK
15 minute summer	26	12	17.653	0.153	29.1	0.0000	0.0000	SURCHARGED
15 minute summer	49	11	19.596	1.121	36.0	0.0000	0.0000	SURCHARGED
15 minute summer	J4	11	19.238	1.288	122.8	0.0000	0.0000	SURCHARGED
15 minute summer	Depth/Area 1	12	17.956	0.756	24.0	0.0000	0.0000	SURCHARGED
15 minute summer	J5	12	17.890	0.796	83.2	0.0000	0.0000	SURCHARGED
15 minute summer	J8	11	13.840	0.357	200.7	0.0000	0.0000	OK
15 minute summer	J9	11	13.753	0.336	199.4	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	7	7a	J2	20.0	1.998	0.561	0.1146	
15 minute summer	J2	J2	J3	78.8	1.120	1.000	2.3497	
15 minute summer	J3	J3	13	95.6	1.358	1.210	1.3274	
15 minute summer	8	8	J3	30.8	2.154	0.863	0.0846	
15 minute summer	26	26a	39	27.8	2.228	0.586	0.1630	
15 minute summer	49	49	J4	32.6	1.851	0.740	0.1524	
15 minute summer	J4	J4	42	121.2	3.048	2.979	0.7731	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	21.0	1.193	0.699	0.0658	
15 minute summer	J5	J5	37	79.0	2.070	0.876	0.6573	
15 minute summer	J8	J8	J9	199.4	1.877	1.223	1.0532	
15 minute summer	J9	J9	9	208.7	2.563	1.253	0.1973	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Appendix F – Storm Drain Calculations – 50% Blockage

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
2			12.250	1200	724722.909	729086.928	1.650
3			12.250	1200	724725.938	729081.443	1.575
4			12.200	1200	724728.641	729075.850	1.380
6			13.354	1200	724784.031	729035.492	2.104
ATT/HB Z2			16.181	1350	724763.624	729009.954	4.741
9	0.043	5.00	17.400	1350	724783.708	728980.338	4.000
10	0.138	5.00	18.500	1350	724764.552	728955.371	4.890
11	0.016	5.00	18.500	1200	724760.883	728936.195	4.740
12			19.550	1200	724739.042	728908.343	5.630
13	0.037	5.00	18.100	1200	724707.784	728928.851	4.020
14	0.108	5.00	16.000	2200	724616.402	728913.463	1.450
15			16.278	1200	724765.983	729007.995	2.615
16	0.111	5.00	16.525	1200	724730.955	729043.975	1.025
J6			16.651	1200	724772.619	729003.287	2.960
18	0.033	5.00	16.500	1200	724782.036	729015.504	1.500
J7			17.383	1200	724786.653	728993.299	3.633
20	0.049	5.00	17.750	1200	724797.327	729007.046	2.225
21			14.100	1200	724819.816	729020.622	1.330
22			14.400	1200	724814.438	729012.367	0.900
23			14.700	1200	724835.551	728996.291	1.000
24			19.200	1200	724791.402	728935.164	3.300
25			19.500	1200	724760.775	728926.488	3.530
ATT/HB Z1			19.516	1500	724757.564	728922.292	3.516
27			19.605	1500	724765.942	728916.211	3.555
28			19.500	1500	724775.721	728929.683	3.428
29			19.200	1350	724795.786	728935.367	3.081
30	0.035	5.00	18.600	1500	724819.139	728917.532	2.415
31	0.047	5.00	19.000	1500	724871.049	728892.805	2.686
32	0.039	5.00	19.740	1200	724860.844	728875.334	2.640
33			20.300	1200	724843.614	728860.738	2.300
34	0.077	5.00	21.300	1200	724795.107	728820.004	1.200
35			21.300	1200	724776.861	728830.566	1.100
36	0.109	5.00	17.500	2200	724886.980	728929.655	1.050
37	0.027	5.00	18.594	1350	724838.134	728948.472	1.994
38	0.126	5.00	19.170	1200	724808.396	728974.235	1.418
39			19.500	1200	724811.544	728901.679	2.650
40	0.035	5.00	20.000	1200	724789.555	728883.155	2.100
41			19.591	1200	724746.766	728907.417	3.541
42			19.600	1200	724744.645	728904.587	3.530
43	0.059	5.00	20.000	1200	724777.352	728880.072	1.920
44	0.011	5.00	21.300	1200	724763.809	728825.907	1.000

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.128	5.00	20.337	1200	724780.075	728868.140	1.687
45	0.055	5.00	19.688	1200	724728.932	728900.701	1.688
46		5.00	19.172	1200	724798.764	728939.291	0.975
47		5.00	19.165	1200	724803.423	728971.213	1.315
48	0.085	5.00	18.441	1200	724844.682	728947.551	1.441
J1			16.190		724625.914	728915.064	1.689
5	0.047	5.00	16.504		724626.479	728907.666	0.904
7	0.038	5.00	17.307		724656.857	728913.697	1.807
J2			16.963		724656.292	728920.180	2.618
J3			17.831		724689.196	728925.721	3.655
8	0.058	5.00	18.082		724688.070	728919.915	1.582
26	0.055	5.00	19.662		724815.421	728893.269	2.162
49	0.068	5.00	19.904		724757.912	728884.506	1.429
J4			19.796		724760.359	728892.809	1.846
Depth/Area 1	0.045	5.00	18.439		724828.177	728962.261	1.239
J5			18.836		724825.751	728959.419	1.742
J8			17.808		724776.184	728970.531	4.325
J9			17.445		724782.249	728978.375	4.028
17		5.00	17.956		724781.465	728966.554	1.476
19		5.00	17.161		724772.732	728985.689	1.475

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3	3	2	6.266	0.600	10.675	10.600	0.075	83.5	225	10.06	32.5
4	4	3	6.212	0.600	10.820	10.675	0.145	42.8	225	9.99	32.6
6	6	4	68.533	0.600	11.250	10.820	0.430	159.4	225	9.94	32.7
7	ATT/HB Z2	6	32.691	0.600	11.440	11.250	0.190	172.1	225	8.83	34.5
15	15	ATT/HB Z2	3.066	0.600	13.663	13.652	0.011	278.8	300	5.59	41.9
9	9	ATT/HB Z2	35.784	0.600	13.400	11.460	1.940	18.4	375	8.29	35.5
J9	J9	9	2.446	0.600	13.417	13.400	0.017	143.9	375	8.14	35.8
J8	J8	J9	9.915	0.600	13.483	13.417	0.066	150.2	375	8.12	35.9
19a	19	J9	12.003	0.600	15.686	15.446	0.240	50.0	150	5.14	43.3
17a	17	J8	6.611	0.600	16.480	16.348	0.132	50.1	150	5.08	43.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
3	1.431	56.9	86.0	1.350	1.425	0.733	0.0
4	2.004	79.7	86.3	1.155	1.350	0.733	0.0
6	1.033	41.1	86.5	1.879	1.155	0.733	0.0
7	0.994	39.5	91.4	4.516	1.879	0.733	0.0
15	0.937	66.2	29.2	2.315	2.229	0.193	0.0
9	4.235	467.8	69.4	3.625	4.346	0.541	0.0
J9	1.508	166.6	64.3	3.653	3.625	0.497	0.0
J8	1.476	163.0	64.4	3.950	3.653	0.497	0.0
19a	1.426	25.2	0.0	1.325	1.849	0.000	0.0
17a	1.425	25.2	0.0	1.326	1.310	0.000	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
10	10	J8	19.108	0.600	13.610	13.483	0.127	150.5	375	8.01	36.1
11	11	10	19.524	0.600	13.760	13.610	0.150	130.2	300	7.79	36.5
12	12	11	35.394	0.600	13.920	13.760	0.160	221.2	300	7.55	37.0
45	45	12	12.673	0.600	18.000	17.747	0.253	50.1	150	5.15	43.3
13	13	12	37.385	0.600	14.080	13.920	0.160	233.7	300	6.99	38.3
J3	J3	13	18.850	0.600	14.176	14.080	0.096	196.4	300	6.38	39.7
J2	J2	J3	33.367	0.600	14.345	14.176	0.169	197.4	300	6.10	40.5
8	8	J3	5.914	0.600	16.500	16.263	0.237	25.0	150	5.05	43.6
J1	J1	J2	30.806	0.600	14.501	14.345	0.156	197.5	300	5.60	41.9
7a	7	J2	6.508	0.600	15.500	15.240	0.260	25.0	150	5.05	43.6
5	5	J1	7.420	0.600	15.600	14.501	1.099	6.8	150	5.03	43.6
14	14	J1	9.646	0.600	14.550	14.501	0.049	196.9	300	5.14	43.3
16	16	15	56.605	0.600	15.500	13.750	1.750	32.3	225	5.41	42.5
17	J6	15	8.136	0.600	13.691	13.663	0.028	290.6	300	5.53	42.1
19	J7	J6	17.225	0.600	13.750	13.691	0.059	292.0	300	5.38	42.5
18	18	J6	15.425	0.600	15.000	13.750	1.250	12.3	100	5.12	43.4
20	20	J7	17.404	0.600	15.525	13.750	1.775	9.8	225	5.07	43.5
22	22	21	9.852	0.600	13.500	12.770	0.730	13.5	225	10.79	31.4
23	23	22	26.537	0.600	13.700	13.500	0.200	132.7	225	10.74	31.4
24	24	23	75.403	0.600	15.900	13.700	2.200	34.3	225	10.35	32.0
25	25	24	31.832	0.600	15.970	15.900	0.070	454.7	225	9.79	32.9
26	ATT/HB Z1	25	5.284	0.600	16.000	15.970	0.030	176.1	225	8.92	34.4
41	41	ATT/HB Z1	18.381	0.600	16.050	16.000	0.050	367.6	300	6.18	40.3
27	27	ATT/HB Z1	10.352	0.600	16.050	16.000	0.050	207.0	525	8.83	34.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
10	1.475	162.9	64.8	4.515	3.950	0.497	0.0
11	1.376	97.3	47.4	4.440	4.590	0.360	0.0
12	1.053	74.4	46.0	5.330	4.440	0.344	0.0
45	1.425	25.2	8.6	1.538	1.653	0.055	0.0
13	1.024	72.4	39.9	3.720	5.330	0.288	0.0
J3	1.118	79.0	36.1	3.355	3.720	0.251	0.0
J2	1.115	78.8	28.3	2.318	3.355	0.193	0.0
8	2.024	35.8	9.2	1.432	1.418	0.058	0.0
J1	1.115	78.8	23.5	1.389	2.318	0.155	0.0
7a	2.021	35.7	6.0	1.657	1.573	0.038	0.0
5	3.903	69.0	7.4	0.754	1.539	0.047	0.0
14	1.117	78.9	16.9	1.150	1.389	0.108	0.0
16	2.308	91.8	17.0	0.800	2.303	0.111	0.0
17	0.917	64.8	12.4	2.660	2.315	0.082	0.0
19	0.915	64.7	7.5	3.333	2.660	0.049	0.0
18	2.211	17.4	5.2	1.400	2.801	0.033	0.0
20	4.203	167.1	7.6	2.000	3.408	0.049	0.0
22	3.580	142.4	107.5	0.675	1.105	0.948	0.0
23	1.133	45.1	107.7	0.775	0.675	0.948	0.0
24	2.242	89.1	109.7	3.075	0.775	0.948	0.0
25	0.607	24.1	112.6	3.305	3.075	0.948	0.0
26	0.982	39.0	117.6	3.291	3.305	0.948	0.0
41	0.814	57.5	37.2	3.241	3.216	0.256	0.0
27	1.553	336.1	86.3	3.030	2.991	0.692	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
28	28	27	16.647	0.600	16.072	16.050	0.022	756.7	525	8.72	34.7
29	29	28	20.855	0.600	16.119	16.072	0.047	443.7	450	8.37	35.4
46	46	29	4.926	0.600	18.197	17.767	0.430	11.5	150	5.03	43.6
30	30	29	29.385	0.600	16.185	16.119	0.066	445.2	450	8.01	36.1
39	39	30	17.578	0.600	16.850	16.185	0.665	26.4	225	5.31	42.8
37	37	30	36.306	0.600	16.600	16.185	0.415	87.5	375	5.68	41.7
31	31	30	57.498	0.600	16.314	16.185	0.129	445.7	450	7.50	37.1
36	36	31	40.146	0.600	16.450	16.314	0.136	295.2	300	5.74	41.5
32	32	31	20.233	0.600	17.100	16.314	0.786	25.7	225	6.50	39.5
33	33	32	22.581	0.600	18.000	17.100	0.900	25.1	225	6.37	39.8
34	34	33	63.342	0.600	20.100	18.000	2.100	30.2	225	6.22	40.2
35	35	34	21.083	0.600	20.200	20.100	0.100	210.8	150	5.78	41.4
35a	44	35	13.859	0.600	20.300	20.200	0.100	138.6	150	5.27	42.9
J5	J5	37	16.528	0.600	17.094	16.600	0.494	33.5	225	5.36	42.6
48	48	37	6.612	0.600	17.000	16.600	0.400	16.5	150	5.04	43.6
Depth/Area 1	Depth/Area 1	J5	3.737	0.600	17.200	17.094	0.106	35.3	150	5.04	43.6
38	38	J5	22.819	0.600	17.775	17.094	0.681	33.5	225	5.24	43.0
47	47	38	5.819	0.600	17.850	17.752	0.098	59.4	150	5.07	43.5
26a	26	39	9.261	0.600	17.500	16.850	0.650	14.2	150	5.06	43.5
40	40	39	28.752	0.600	17.900	16.850	1.050	27.4	225	5.19	43.1
42	42	41	3.537	0.600	16.070	16.050	0.020	176.8	225	5.80	41.3
J4	J4	42	19.638	0.600	17.951	17.830	0.121	162.3	225	5.74	41.5
49	49	J4	8.656	0.600	18.475	17.950	0.525	16.5	150	5.06	43.5
43	43	J4	21.237	0.600	18.080	17.951	0.129	164.6	225	5.42	42.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
28	0.806	174.5	86.8	2.903	3.030	0.692	0.0
29	0.958	152.4	88.4	2.631	2.978	0.692	0.0
46	2.993	52.9	0.0	0.825	1.283	0.000	0.0
30	0.957	152.2	90.2	1.965	2.631	0.692	0.0
39	2.555	101.6	13.9	2.425	2.190	0.090	0.0
37	1.938	214.0	42.6	1.619	2.040	0.283	0.0
31	0.956	152.1	38.0	2.236	1.965	0.283	0.0
36	0.910	64.3	16.3	0.750	2.386	0.109	0.0
32	2.589	102.9	18.2	2.415	2.461	0.127	0.0
33	2.622	104.3	12.7	2.075	2.415	0.088	0.0
34	2.391	95.1	12.8	0.975	2.075	0.088	0.0
35	0.688	12.2	1.7	0.950	1.050	0.011	0.0
35a	0.852	15.0	1.8	0.850	0.950	0.011	0.0
J5	2.269	90.2	26.4	1.517	1.769	0.171	0.0
48	2.489	44.0	13.4	1.291	1.844	0.085	0.0
Depth/Area 1	1.701	30.1	7.1	1.089	1.592	0.045	0.0
38	2.267	90.2	19.6	1.170	1.517	0.126	0.0
47	1.307	23.1	0.0	1.165	1.268	0.000	0.0
26a	2.682	47.4	8.6	2.012	2.500	0.055	0.0
40	2.510	99.8	5.5	1.875	2.425	0.035	0.0
42	0.980	39.0	38.2	3.305	3.316	0.256	0.0
J4	1.023	40.7	38.3	1.620	1.545	0.256	0.0
49	2.493	44.0	10.7	1.279	1.696	0.068	0.0
43	1.016	40.4	28.8	1.695	1.620	0.188	0.0

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	1	43	12.239	0.600	18.650	18.080	0.570	21.5	225	5.07	43.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1	2.836	112.8	20.2	1.462	1.695	0.128	0.0

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
3	6.266	83.5	225	Circular	12.250	10.675	1.350	12.250	10.600	1.425
4	6.212	42.8	225	Circular	12.200	10.820	1.155	12.250	10.675	1.350
6	68.533	159.4	225	Circular	13.354	11.250	1.879	12.200	10.820	1.155
7	32.691	172.1	225	Circular	16.181	11.440	4.516	13.354	11.250	1.879
15	3.066	278.8	300	Circular	16.278	13.663	2.315	16.181	13.652	2.229
9	35.784	18.4	375	Circular	17.400	13.400	3.625	16.181	11.460	4.346
J9	2.446	143.9	375	Circular	17.445	13.417	3.653	17.400	13.400	3.625
J8	9.915	150.2	375	Circular	17.808	13.483	3.950	17.445	13.417	3.653
19a	12.003	50.0	150	Circular	17.161	15.686	1.325	17.445	15.446	1.849
17a	6.611	50.1	150	Circular	17.956	16.480	1.326	17.808	16.348	1.310
10	19.108	150.5	375	Circular	18.500	13.610	4.515	17.808	13.483	3.950
11	19.524	130.2	300	Circular	18.500	13.760	4.440	18.500	13.610	4.590
12	35.394	221.2	300	Circular	19.550	13.920	5.330	18.500	13.760	4.440
45	12.673	50.1	150	Circular	19.688	18.000	1.538	19.550	17.747	1.653
13	37.385	233.7	300	Circular	18.100	14.080	3.720	19.550	13.920	5.330
J3	18.850	196.4	300	Circular	17.831	14.176	3.355	18.100	14.080	3.720
J2	33.367	197.4	300	Circular	16.963	14.345	2.318	17.831	14.176	3.355
8	5.914	25.0	150	Circular	18.082	16.500	1.432	17.831	16.263	1.418
J1	30.806	197.5	300	Circular	16.190	14.501	1.389	16.963	14.345	2.318

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3	3	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
4	4	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
6	6	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
7	ATT/HB Z2	1350	Manhole	Adoptable	6	1200	Manhole	Adoptable
15	15	1200	Manhole	Adoptable	ATT/HB Z2	1350	Manhole	Adoptable
9	9	1350	Manhole	Adoptable	ATT/HB Z2	1350	Manhole	Adoptable
J9	J9		Junction		9	1350	Manhole	Adoptable
J8	J8		Junction		J9		Junction	
19a	19		Manhole	Adoptable	J9		Junction	
17a	17		Manhole	Adoptable	J8		Junction	
10	10	1350	Manhole	Adoptable	J8		Junction	
11	11	1200	Manhole	Adoptable	10	1350	Manhole	Adoptable
12	12	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
45	45	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
13	13	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
J3	J3		Junction		13	1200	Manhole	Adoptable
J2	J2		Junction		J3		Junction	
8	8		Manhole	Adoptable	J3		Junction	
J1	J1		Junction		J2		Junction	

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
7a	6.508	25.0	150	Circular	17.307	15.500	1.657	16.963	15.240	1.573
5	7.420	6.8	150	Circular	16.504	15.600	0.754	16.190	14.501	1.539
14	9.646	196.9	300	Circular	16.000	14.550	1.150	16.190	14.501	1.389
16	56.605	32.3	225	Circular	16.525	15.500	0.800	16.278	13.750	2.303
17	8.136	290.6	300	Circular	16.651	13.691	2.660	16.278	13.663	2.315
19	17.225	292.0	300	Circular	17.383	13.750	3.333	16.651	13.691	2.660
18	15.425	12.3	100	Circular	16.500	15.000	1.400	16.651	13.750	2.801
20	17.404	9.8	225	Circular	17.750	15.525	2.000	17.383	13.750	3.408
22	9.852	13.5	225	Circular	14.400	13.500	0.675	14.100	12.770	1.105
23	26.537	132.7	225	Circular	14.700	13.700	0.775	14.400	13.500	0.675
24	75.403	34.3	225	Circular	19.200	15.900	3.075	14.700	13.700	0.775
25	31.832	454.7	225	Circular	19.500	15.970	3.305	19.200	15.900	3.075
26	5.284	176.1	225	Circular	19.516	16.000	3.291	19.500	15.970	3.305
41	18.381	367.6	300	Circular	19.591	16.050	3.241	19.516	16.000	3.216
27	10.352	207.0	525	Circular	19.605	16.050	3.030	19.516	16.000	2.991
28	16.647	756.7	525	Circular	19.500	16.072	2.903	19.605	16.050	3.030
29	20.855	443.7	450	Circular	19.200	16.119	2.631	19.500	16.072	2.978
46	4.926	11.5	150	Circular	19.172	18.197	0.825	19.200	17.767	1.283
30	29.385	445.2	450	Circular	18.600	16.185	1.965	19.200	16.119	2.631
39	17.578	26.4	225	Circular	19.500	16.850	2.425	18.600	16.185	2.190
37	36.306	87.5	375	Circular	18.594	16.600	1.619	18.600	16.185	2.040
31	57.498	445.7	450	Circular	19.000	16.314	2.236	18.600	16.185	1.965
36	40.146	295.2	300	Circular	17.500	16.450	0.750	19.000	16.314	2.386
32	20.233	25.7	225	Circular	19.740	17.100	2.415	19.000	16.314	2.461
33	22.581	25.1	225	Circular	20.300	18.000	2.075	19.740	17.100	2.415

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
7a	7		Manhole	Adoptable	J2		Junction	
5	5		Manhole	Adoptable	J1		Junction	
14	14	2200	Manhole	Adoptable	J1		Junction	
16	16	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable
17	J6	1200	Junction		15	1200	Manhole	Adoptable
19	J7	1200	Junction		J6	1200	Junction	
18	18	1200	Manhole	Adoptable	J6	1200	Junction	
20	20	1200	Manhole	Adoptable	J7	1200	Junction	
22	22	1200	Manhole	Adoptable	21	1200	Manhole	Adoptable
23	23	1200	Manhole	Adoptable	22	1200	Manhole	Adoptable
24	24	1200	Manhole	Adoptable	23	1200	Manhole	Adoptable
25	25	1200	Manhole	Adoptable	24	1200	Manhole	Adoptable
26	ATT/HB Z1	1500	Manhole	Adoptable	25	1200	Manhole	Adoptable
41	41	1200	Manhole	Adoptable	ATT/HB Z1	1500	Manhole	Adoptable
27	27	1500	Manhole	Adoptable	ATT/HB Z1	1500	Manhole	Adoptable
28	28	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
29	29	1350	Manhole	Adoptable	28	1500	Manhole	Adoptable
46	46	1200	Manhole	Adoptable	29	1350	Manhole	Adoptable
30	30	1500	Manhole	Adoptable	29	1350	Manhole	Adoptable
39	39	1200	Manhole	Adoptable	30	1500	Manhole	Adoptable
37	37	1350	Manhole	Adoptable	30	1500	Manhole	Adoptable
31	31	1500	Manhole	Adoptable	30	1500	Manhole	Adoptable
36	36	2200	Manhole	Adoptable	31	1500	Manhole	Adoptable
32	32	1200	Manhole	Adoptable	31	1500	Manhole	Adoptable
33	33	1200	Manhole	Adoptable	32	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
34	63.342	30.2	225	Circular	21.300	20.100	0.975	20.300	18.000	2.075
35	21.083	210.8	150	Circular	21.300	20.200	0.950	21.300	20.100	1.050
35a	13.859	138.6	150	Circular	21.300	20.300	0.850	21.300	20.200	0.950
J5	16.528	33.5	225	Circular	18.836	17.094	1.517	18.594	16.600	1.769
48	6.612	16.5	150	Circular	18.441	17.000	1.291	18.594	16.600	1.844
Depth/Area 1	3.737	35.3	150	Circular	18.439	17.200	1.089	18.836	17.094	1.592
38	22.819	33.5	225	Circular	19.170	17.775	1.170	18.836	17.094	1.517
47	5.819	59.4	150	Circular	19.165	17.850	1.165	19.170	17.752	1.268
26a	9.261	14.2	150	Circular	19.662	17.500	2.012	19.500	16.850	2.500
40	28.752	27.4	225	Circular	20.000	17.900	1.875	19.500	16.850	2.425
42	3.537	176.8	225	Circular	19.600	16.070	3.305	19.591	16.050	3.316
J4	19.638	162.3	225	Circular	19.796	17.951	1.620	19.600	17.830	1.545
49	8.656	16.5	150	Circular	19.904	18.475	1.279	19.796	17.950	1.696
43	21.237	164.6	225	Circular	20.000	18.080	1.695	19.796	17.951	1.620
1	12.239	21.5	225	Circular	20.337	18.650	1.462	20.000	18.080	1.695

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
34	34	1200	Manhole	Adoptable	33	1200	Manhole	Adoptable
35	35	1200	Manhole	Adoptable	34	1200	Manhole	Adoptable
35a	44	1200	Manhole	Adoptable	35	1200	Manhole	Adoptable
J5	J5		Junction		37	1350	Manhole	Adoptable
48	48	1200	Manhole	Adoptable	37	1350	Manhole	Adoptable
Depth/Area 1	Depth/Area 1		Manhole	Adoptable	J5		Junction	
38	38	1200	Manhole	Adoptable	J5		Junction	
47	47	1200	Manhole	Adoptable	38	1200	Manhole	Adoptable
26a	26		Manhole	Adoptable	39	1200	Manhole	Adoptable
40	40	1200	Manhole	Adoptable	39	1200	Manhole	Adoptable
42	42	1200	Manhole	Adoptable	41	1200	Manhole	Adoptable
J4	J4		Junction		42	1200	Manhole	Adoptable
49	49		Manhole	Adoptable	J4		Junction	
43	43	1200	Manhole	Adoptable	J4		Junction	
1	1	1200	Manhole	Adoptable	43	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.000	Additional Storage (m³/ha)	0.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440	2160

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	20	0	0
100	20	0	0

Node ATT/HB Z1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	16.000	Product Number	CTL-SHE-0062-2000-1400-2000
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node ATT/HB Z2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	11.440	Product Number	CTL-SHE-0056-2000-2110-2000
Design Depth (m)	2.110	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node ATT/HB Z1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	16.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**
0.000	525.0	0.0	1.400	525.0	0.0	1.401	0.0	0.0

Node ATT/HB Z2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	11.440
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf Area (m²)**
0.000	366.1	0.0	2.110	366.1	0.0	2.111	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	2	92	10.623	0.023	1.3	0.0000	0.0000	OK
120 minute summer	3	92	10.699	0.024	1.3	0.0273	0.0000	OK
120 minute summer	4	92	10.840	0.020	1.3	0.0226	0.0000	OK
180 minute summer	6	116	11.279	0.029	1.3	0.0327	0.0000	OK
2160 minute summer	ATT/HB Z2	1860	11.953	0.513	8.4	188.4839	0.0000	SURCHARGED
15 minute summer	9	12	13.505	0.105	75.4	0.1501	0.0000	OK
15 minute summer	10	12	13.786	0.176	69.5	0.2522	0.0000	OK
15 minute summer	11	12	13.932	0.172	52.1	0.1944	0.0000	OK
15 minute summer	12	12	14.107	0.187	50.8	0.2120	0.0000	OK
15 minute summer	13	11	14.253	0.173	43.0	0.1952	0.0000	OK
15 minute summer	14	10	14.650	0.100	16.6	0.3786	0.0000	OK
15 minute summer	15	11	13.813	0.150	28.4	0.1697	0.0000	OK
15 minute summer	16	10	15.566	0.066	17.0	0.0741	0.0000	OK
15 minute summer	J6	11	13.816	0.125	12.3	0.0000	0.0000	OK
15 minute summer	18	10	15.037	0.037	5.1	0.0420	0.0000	OK
15 minute summer	J7	11	13.819	0.069	7.4	0.0000	0.0000	OK
15 minute summer	20	10	15.557	0.032	7.4	0.0363	0.0000	OK
180 minute summer	21	184	12.787	0.017	1.6	0.0000	0.0000	OK
180 minute summer	22	188	13.517	0.017	1.6	0.0195	0.0000	OK
180 minute summer	23	184	13.732	0.032	1.6	0.0358	0.0000	OK
180 minute summer	24	180	15.921	0.021	1.6	0.0239	0.0000	OK
480 minute summer	25	280	16.011	0.041	1.6	0.0466	0.0000	OK
2160 minute summer	ATT/HB Z1	1740	16.438	0.438	10.3	230.4616	0.0000	SURCHARGED
2160 minute summer	27	1740	16.438	0.388	7.6	0.6848	0.0000	OK
2160 minute summer	28	1740	16.438	0.366	7.7	0.6459	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute summer	3	3	2	1.3	0.581	0.023	0.0139	24.0
120 minute summer	4	4	3	1.3	0.647	0.016	0.0124	
180 minute summer	6	6	4	1.3	0.558	0.031	0.1603	
2160 minute summer	ATT/HB Z2	Hydro-Brake®	6	1.3				
15 minute summer	9	9	ATT/HB Z2	75.6	3.089	0.162	0.8762	
15 minute summer	10	10	J8	69.8	1.411	0.429	0.9458	
15 minute summer	11	11	10	52.7	1.266	0.541	0.8274	
15 minute summer	12	12	11	50.2	1.141	0.675	1.5580	
15 minute summer	13	13	12	42.7	0.969	0.590	1.6471	
15 minute summer	14	14	J1	16.4	0.742	0.207	0.2127	
15 minute summer	15	15	ATT/HB Z2	28.5	0.889	0.431	0.0985	
15 minute summer	16	16	15	16.6	1.750	0.181	0.5367	
15 minute summer	J6	17	15	12.0	0.391	0.184	0.2565	
15 minute summer	18	18	J6	5.1	1.737	0.292	0.0621	
15 minute summer	J7	19	J6	7.2	0.384	0.111	0.3456	
15 minute summer	20	20	J7	7.4	1.157	0.044	0.1197	
180 minute summer	22	22	21	1.6	1.187	0.011	0.0135	33.4
180 minute summer	23	23	22	1.6	0.701	0.036	0.0634	
180 minute summer	24	24	23	1.6	0.625	0.018	0.1983	
480 minute summer	25	25	24	1.6	0.490	0.067	0.1087	
2160 minute summer	ATT/HB Z1	Hydro-Brake®	25	1.6				
2160 minute summer	27	27	ATT/HB Z1	7.4	0.531	0.022	1.8799	
2160 minute summer	28	28	27	7.6	0.323	0.043	2.7583	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	29	1740	16.437	0.318	7.9	0.4558	0.0000	OK
15 minute summer	30	11	16.473	0.288	96.7	0.5092	0.0000	OK
15 minute summer	31	12	16.496	0.182	42.0	0.3220	0.0000	OK
15 minute summer	32	11	17.165	0.065	18.9	0.0737	0.0000	OK
15 minute summer	33	11	18.054	0.054	13.2	0.0610	0.0000	OK
15 minute summer	34	10	20.158	0.058	13.4	0.0654	0.0000	OK
15 minute summer	35	11	20.238	0.038	1.8	0.0431	0.0000	OK
15 minute summer	36	11	16.551	0.101	16.7	0.3847	0.0000	OK
15 minute summer	37	10	16.712	0.112	42.9	0.1599	0.0000	OK
15 minute summer	38	10	17.845	0.093	19.3	0.1054	0.0000	OK
15 minute summer	39	10	16.905	0.055	13.7	0.0626	0.0000	OK
15 minute summer	40	10	17.935	0.035	5.4	0.0399	0.0000	OK
15 minute summer	41	10	16.724	0.674	46.0	0.7627	0.0000	SURCHARGED
15 minute summer	42	10	16.778	0.708	38.4	0.8004	0.0000	SURCHARGED
15 minute summer	43	10	18.224	0.144	28.6	0.1627	0.0000	OK
15 minute summer	44	10	20.335	0.035	1.8	0.0400	0.0000	OK
15 minute summer	1	10	18.713	0.063	19.6	0.0714	0.0000	OK
15 minute summer	45	10	18.062	0.062	8.4	0.0707	0.0000	OK
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	1	17.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	48	10	17.056	0.056	13.0	0.0632	0.0000	OK
15 minute summer	J1	10	14.612	0.111	23.5	0.0000	0.0000	OK
15 minute summer	5	10	15.633	0.033	7.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute summer	29	29	28	7.7	0.378	0.051	2.6890	
15 minute summer	30	30	29	93.4	0.881	0.614	3.2241	
15 minute summer	31	31	30	38.4	0.519	0.253	4.7897	
15 minute summer	32	32	31	19.0	1.008	0.184	0.4387	
15 minute summer	33	33	32	13.2	1.576	0.127	0.1897	
15 minute summer	34	34	33	13.2	1.739	0.138	0.4827	
15 minute summer	35	35	34	1.7	0.367	0.143	0.1023	
15 minute summer	36	36	31	16.2	0.598	0.251	1.2849	
15 minute summer	37	37	30	42.4	0.872	0.198	2.1460	
15 minute summer	38	38	J5	19.2	1.626	0.213	0.2696	
15 minute summer	39	39	30	13.6	0.792	0.133	0.4160	
15 minute summer	40	40	39	5.3	0.939	0.054	0.1657	
15 minute summer	41	41	ATT/HB Z1	62.0	1.701	1.078	0.6743	
15 minute summer	42	42	41	46.0	1.156	1.180	0.1407	
15 minute summer	43	43	J4	28.3	0.935	0.700	0.6398	
15 minute summer	44	35a	35	1.8	0.549	0.118	0.0457	
15 minute summer	1	1	43	19.5	1.099	0.173	0.2197	
15 minute summer	45	45	12	8.3	1.242	0.331	0.0851	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	0.0	0.000	0.000	0.0334	
15 minute summer	48	48	37	13.0	1.285	0.295	0.0662	
15 minute summer	J1	J1	J2	23.3	0.919	0.295	0.7867	
15 minute summer	5	5	J1	7.2	1.318	0.104	0.0623	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	10	15.542	0.042	5.8	0.0000	0.0000	OK
15 minute summer	J2	11	14.469	0.124	29.0	0.0000	0.0000	OK
15 minute summer	J3	11	14.329	0.153	37.5	0.0000	0.0000	OK
15 minute summer	8	10	16.553	0.053	8.9	0.0000	0.0000	OK
15 minute summer	26	10	17.543	0.043	8.4	0.0000	0.0000	OK
15 minute summer	49	10	18.525	0.050	10.4	0.0000	0.0000	OK
15 minute summer	J4	11	18.129	0.179	38.7	0.0000	0.0000	OK
15 minute summer	Depth/Area 1	10	17.253	0.053	6.9	0.0000	0.0000	OK
15 minute summer	J5	10	17.176	0.082	26.1	0.0000	0.0000	OK
15 minute summer	J8	12	13.652	0.169	69.8	0.0000	0.0000	OK
15 minute summer	J9	12	13.584	0.167	70.1	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	7	7a	J2	5.8	1.456	0.161	0.0258	
15 minute summer	J2	J2	J3	29.0	0.912	0.368	1.0623	
15 minute summer	J3	J3	13	37.6	0.964	0.476	0.7354	
15 minute summer	8	8	J3	8.9	1.633	0.248	0.0321	
15 minute summer	26	26a	39	8.4	1.675	0.177	0.0464	
15 minute summer	49	49	J4	10.4	1.008	0.235	0.0982	
15 minute summer	J4	J4	42	38.4	1.184	0.944	0.6366	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	6.9	0.896	0.229	0.0287	
15 minute summer	J5	J5	37	25.9	1.583	0.287	0.2705	
15 minute summer	J8	J8	J9	70.1	1.467	0.430	0.4738	
15 minute summer	J9	J9	9	70.2	1.948	0.421	0.0888	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	2	2160	10.626	0.026	1.6	0.0000	0.0000	OK
2160 minute summer	3	2160	10.702	0.027	1.6	0.0306	0.0000	OK
2160 minute summer	4	2160	10.842	0.022	1.6	0.0252	0.0000	OK
2160 minute summer	6	2160	11.282	0.032	1.6	0.0365	0.0000	OK
2160 minute summer	ATT/HB Z2	2160	12.778	1.338	18.5	491.7858	0.0000	SURCHARGED
15 minute summer	9	11	13.569	0.169	176.2	0.2412	0.0000	OK
15 minute summer	10	11	13.926	0.316	161.1	0.4528	0.0000	OK
15 minute summer	11	12	14.202	0.442	113.9	0.5004	0.0000	SURCHARGED
15 minute summer	12	12	14.618	0.698	108.5	0.7900	0.0000	SURCHARGED
15 minute summer	13	12	14.918	0.838	89.9	0.9474	0.0000	SURCHARGED
15 minute summer	14	12	15.209	0.659	44.2	2.5061	0.0000	SURCHARGED
15 minute summer	15	11	13.934	0.271	75.7	0.3062	0.0000	OK
15 minute summer	16	10	15.610	0.110	45.3	0.1249	0.0000	OK
15 minute summer	J6	11	13.941	0.250	32.1	0.0000	0.0000	OK
15 minute summer	18	10	15.067	0.067	13.6	0.0754	0.0000	OK
15 minute summer	J7	11	13.944	0.194	19.8	0.0000	0.0000	OK
15 minute summer	20	10	15.577	0.052	19.9	0.0590	0.0000	OK
2160 minute summer	21	2160	12.788	0.018	1.8	0.0000	0.0000	OK
2160 minute summer	22	2160	13.518	0.018	1.8	0.0207	0.0000	OK
2160 minute summer	23	2160	13.734	0.034	1.8	0.0380	0.0000	OK
2160 minute summer	24	2160	15.922	0.022	1.8	0.0253	0.0000	OK
2160 minute summer	25	2160	16.014	0.044	1.8	0.0494	0.0000	OK
2160 minute summer	ATT/HB Z1	2160	17.169	1.169	22.4	615.8566	0.0000	SURCHARGED
2160 minute summer	27	2160	17.169	1.119	16.1	1.9770	0.0000	SURCHARGED
2160 minute summer	28	2160	17.169	1.097	16.2	1.9389	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute summer	3	3	2	1.6	0.621	0.029	0.0164	181.9
2160 minute summer	4	4	3	1.6	0.695	0.020	0.0146	
2160 minute summer	6	6	4	1.6	0.598	0.040	0.1886	
2160 minute summer	ATT/HB Z2	Hydro-Brake®	6	1.6				
15 minute summer	9	9	ATT/HB Z2	176.4	3.841	0.377	2.0944	
15 minute summer	10	10	J8	159.8	1.681	0.981	1.8262	
15 minute summer	11	11	10	114.2	1.623	1.174	1.3749	
15 minute summer	12	12	11	108.8	1.545	1.462	2.4924	
15 minute summer	13	13	12	89.9	1.277	1.243	2.6326	
15 minute summer	14	14	J1	40.3	0.899	0.510	0.6793	
15 minute summer	15	15	ATT/HB Z2	76.4	1.249	1.154	0.1858	
15 minute summer	16	16	15	44.9	1.986	0.490	1.5184	
15 minute summer	J6	17	15	32.2	0.496	0.496	0.5276	
15 minute summer	18	18	J6	13.5	1.849	0.779	0.1031	
15 minute summer	J7	19	J6	19.1	0.407	0.296	0.9562	
15 minute summer	20	20	J7	19.8	1.301	0.119	0.3760	
2160 minute summer	22	22	21	1.8	1.234	0.013	0.0147	208.6
2160 minute summer	23	23	22	1.8	0.726	0.041	0.0691	
2160 minute summer	24	24	23	1.8	0.649	0.021	0.2163	
2160 minute summer	25	25	24	1.8	0.510	0.076	0.1183	
2160 minute summer	ATT/HB Z1	Hydro-Brake®	25	1.8				
2160 minute summer	27	27	ATT/HB Z1	16.0	0.621	0.048	2.2364	
2160 minute summer	28	28	27	16.1	0.326	0.092	3.5963	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
2160 minute summer	29	2160	17.169	1.050	16.2	1.5023	0.0000	SURCHARGED
2160 minute summer	30	2160	17.169	0.984	16.6	1.7379	0.0000	SURCHARGED
2160 minute summer	31	2100	17.170	0.856	6.9	1.5118	0.0000	SURCHARGED
15 minute summer	32	11	17.251	0.151	50.8	0.1709	0.0000	OK
15 minute summer	33	11	18.090	0.090	35.4	0.1015	0.0000	OK
15 minute summer	34	10	20.198	0.098	35.9	0.1107	0.0000	OK
15 minute summer	35	11	20.264	0.064	4.6	0.0719	0.0000	OK
2160 minute summer	36	2100	17.170	0.720	2.8	2.7349	0.0000	SURCHARGED
2160 minute summer	37	2160	17.169	0.569	7.3	0.8142	0.0000	SURCHARGED
15 minute summer	38	10	17.896	0.144	51.5	0.1631	0.0000	OK
2160 minute summer	39	2100	17.169	0.319	2.3	0.3610	0.0000	SURCHARGED
15 minute summer	40	10	17.957	0.057	14.4	0.0649	0.0000	OK
2160 minute summer	41	2160	17.167	1.117	6.5	1.2635	0.0000	SURCHARGED
2160 minute summer	42	2160	17.169	1.099	6.5	1.2430	0.0000	SURCHARGED
15 minute summer	43	11	19.260	1.180	72.3	1.3351	0.0000	SURCHARGED
15 minute summer	44	10	20.359	0.059	4.7	0.0671	0.0000	OK
15 minute summer	1	11	19.414	0.764	52.4	0.8635	0.0000	SURCHARGED
15 minute summer	45	10	18.123	0.123	22.5	0.1387	0.0000	OK
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	10	17.897	0.047	0.8	0.0528	0.0000	OK
15 minute summer	48	11	17.373	0.373	34.8	0.4223	0.0000	SURCHARGED
15 minute summer	J1	12	15.198	0.697	58.5	0.0000	0.0000	SURCHARGED
15 minute summer	5	10	15.654	0.054	19.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
2160 minute summer	29	29	28	16.2	0.337	0.106	3.3043	
2160 minute summer	30	30	29	16.2	0.404	0.107	4.6559	
2160 minute summer	31	31	30	6.5	0.256	0.043	9.1102	
15 minute summer	32	32	31	49.2	1.364	0.478	0.6890	
15 minute summer	33	33	32	35.3	1.954	0.338	0.4865	
15 minute summer	34	34	33	35.4	2.270	0.373	0.9882	
15 minute summer	35	35	34	4.6	0.484	0.378	0.2017	
2160 minute summer	36	36	31	2.4	0.279	0.038	2.8271	
2160 minute summer	37	37	30	7.3	0.337	0.034	4.0044	
15 minute summer	38	38	J5	51.0	2.031	0.566	0.6726	
2160 minute summer	39	39	30	2.3	0.189	0.023	0.6991	
15 minute summer	40	40	39	14.3	1.223	0.143	0.5209	
2160 minute summer	41	41	ATT/HB Z1	6.4	0.367	0.111	1.2944	
2160 minute summer	42	42	41	6.5	0.355	0.166	0.1407	
15 minute summer	43	43	J4	71.3	1.794	1.766	0.8446	
15 minute summer	44	35a	35	4.6	0.697	0.309	0.0931	
15 minute summer	1	1	43	49.1	1.234	0.435	0.4868	
15 minute summer	45	45	12	22.3	1.524	0.884	0.1849	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	-0.8	-0.092	-0.036	0.0642	
15 minute summer	48	48	37	32.6	1.903	0.740	0.1164	
15 minute summer	J1	J1	J2	55.8	1.127	0.707	2.1693	
15 minute summer	5	5	J1	19.3	1.397	0.279	0.0866	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	7	10	15.573	0.073	15.5	0.0000	0.0000	OK
15 minute summer	J2	12	15.135	0.790	70.3	0.0000	0.0000	SURCHARGED
15 minute summer	J3	12	15.034	0.858	87.9	0.0000	0.0000	SURCHARGED
15 minute summer	8	10	16.597	0.097	23.9	0.0000	0.0000	OK
15 minute summer	26	10	17.575	0.075	22.4	0.0000	0.0000	OK
15 minute summer	49	11	19.023	0.548	27.7	0.0000	0.0000	SURCHARGED
15 minute summer	J4	11	18.799	0.849	97.1	0.0000	0.0000	SURCHARGED
15 minute summer	Depth/Area 1	12	17.356	0.156	18.5	0.0000	0.0000	SURCHARGED
15 minute summer	J5	12	17.314	0.220	69.5	0.0000	0.0000	OK
15 minute summer	J8	12	13.776	0.293	159.8	0.0000	0.0000	OK
15 minute summer	J9	12	13.705	0.288	160.5	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	7	7a	J2	15.4	1.882	0.432	0.0534	
15 minute summer	J2	J2	J3	65.4	1.041	0.830	2.3497	
15 minute summer	J3	J3	13	78.2	1.111	0.989	1.3274	
15 minute summer	8	8	J3	23.8	2.067	0.666	0.0681	
15 minute summer	26	26a	39	22.4	2.178	0.473	0.1184	
15 minute summer	49	49	J4	25.8	1.463	0.585	0.1524	
15 minute summer	J4	J4	42	96.4	2.425	2.370	0.7731	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	18.4	1.145	0.613	0.0658	
15 minute summer	J5	J5	37	68.5	2.076	0.760	0.6550	
15 minute summer	J8	J8	J9	160.5	1.752	0.985	0.9087	
15 minute summer	J9	J9	9	160.8	2.347	0.966	0.1693	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	2	2160	10.628	0.028	1.8	0.0000	0.0000	OK
2160 minute summer	3	2160	10.704	0.029	1.8	0.0323	0.0000	OK
2160 minute summer	4	2160	10.844	0.024	1.8	0.0266	0.0000	OK
2160 minute summer	6	2160	11.284	0.034	1.8	0.0385	0.0000	OK
2160 minute summer	ATT/HB Z2	2160	13.155	1.715	22.9	630.2394	0.0000	SURCHARGED
15 minute summer	9	11	13.593	0.193	230.6	0.2769	0.0000	OK
15 minute summer	10	11	14.075	0.465	201.4	0.6661	0.0000	SURCHARGED
15 minute summer	11	12	14.478	0.718	138.7	0.8121	0.0000	SURCHARGED
15 minute summer	12	12	15.092	1.172	132.2	1.3252	0.0000	SURCHARGED
15 minute summer	13	12	15.517	1.437	107.6	1.6249	0.0000	SURCHARGED
15 minute summer	14	12	15.916	1.366	57.4	5.1929	0.0000	FLOOD RISK
15 minute summer	15	11	13.991	0.328	97.5	0.3704	0.0000	SURCHARGED
15 minute summer	16	10	15.629	0.129	58.8	0.1464	0.0000	OK
15 minute summer	J6	11	14.006	0.315	41.0	0.0000	0.0000	SURCHARGED
15 minute summer	18	11	15.195	0.195	17.6	0.2200	0.0000	SURCHARGED
15 minute summer	J7	11	14.013	0.263	25.7	0.0000	0.0000	OK
15 minute summer	20	10	15.584	0.059	25.8	0.0673	0.0000	OK
1440 minute summer	21	1320	12.789	0.019	2.1	0.0000	0.0000	OK
1440 minute summer	22	1320	13.519	0.019	2.1	0.0218	0.0000	OK
1440 minute summer	23	1320	13.736	0.036	2.1	0.0402	0.0000	OK
2160 minute summer	24	1860	15.924	0.024	2.1	0.0267	0.0000	OK
2160 minute summer	25	1740	16.016	0.046	2.1	0.0521	0.0000	OK
2160 minute summer	ATT/HB Z1	1740	17.503	1.503	28.3	737.9177	0.0000	SURCHARGED
2160 minute summer	27	1920	17.505	1.455	20.5	2.5706	0.0000	SURCHARGED
2160 minute summer	28	1740	17.503	1.431	20.6	2.5290	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute summer	3	3	2	1.8	0.642	0.032	0.0178	199.8
2160 minute summer	4	4	3	1.8	0.716	0.023	0.0159	
2160 minute summer	6	6	4	1.8	0.619	0.044	0.2039	
2160 minute summer	ATT/HB Z2	Hydro-Brake®	6	1.8				
15 minute summer	9	9	ATT/HB Z2	219.7	4.035	0.470	2.5178	
15 minute summer	10	10	J8	200.7	1.819	1.232	2.0894	
15 minute summer	11	11	10	138.9	1.973	1.428	1.3749	
15 minute summer	12	12	11	132.1	1.877	1.776	2.4924	
15 minute summer	13	13	12	109.9	1.561	1.519	2.6326	
15 minute summer	14	14	J1	48.8	0.901	0.619	0.6793	
15 minute summer	15	15	ATT/HB Z2	97.9	1.416	1.480	0.2016	
15 minute summer	16	16	15	58.4	1.960	0.636	1.7943	
15 minute summer	J6	17	15	41.0	0.583	0.633	0.5729	
15 minute summer	18	18	J6	16.3	2.122	0.936	0.1207	
15 minute summer	J7	19	J6	25.2	0.404	0.390	1.1698	
15 minute summer	20	20	J7	25.7	1.338	0.154	0.4189	
1440 minute summer	22	22	21	2.1	1.278	0.014	0.0159	159.8
1440 minute summer	23	23	22	2.1	0.750	0.046	0.0747	
2160 minute summer	24	24	23	2.1	0.672	0.023	0.2340	
2160 minute summer	25	25	24	2.1	0.529	0.085	0.1279	
2160 minute summer	ATT/HB Z1	Hydro-Brake®	25	2.1				
2160 minute summer	27	27	ATT/HB Z1	20.4	0.619	0.061	2.2364	
2160 minute summer	28	28	27	20.5	0.345	0.117	3.5963	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute summer	29	1740	17.503	1.384	20.6	1.9800	0.0000	SURCHARGED
2160 minute summer	30	1740	17.502	1.317	20.9	2.3268	0.0000	SURCHARGED
2160 minute summer	31	1740	17.502	1.188	8.7	2.0990	0.0000	SURCHARGED
15 minute summer	32	12	17.744	0.644	66.1	0.7279	0.0000	SURCHARGED
15 minute summer	33	11	18.113	0.113	46.1	0.1281	0.0000	OK
15 minute summer	34	10	20.214	0.114	46.6	0.1292	0.0000	OK
15 minute summer	35	11	20.274	0.074	6.0	0.0832	0.0000	OK
2160 minute summer	36	1560	17.500	1.050	3.4	3.9911	61.8985	FLOOD
2160 minute summer	37	1560	17.501	0.901	8.8	1.2900	0.0000	SURCHARGED
15 minute summer	38	12	18.188	0.436	66.9	0.4929	0.0000	SURCHARGED
2160 minute summer	39	1560	17.502	0.652	2.8	0.7374	0.0000	SURCHARGED
15 minute summer	40	10	17.966	0.066	18.7	0.0741	0.0000	OK
2160 minute summer	41	1680	17.504	1.454	7.9	1.6449	0.0000	SURCHARGED
2160 minute summer	42	1680	17.507	1.437	8.0	1.6247	0.0000	SURCHARGED
15 minute summer	43	11	19.976	1.896	92.6	2.1438	0.0000	FLOOD RISK
15 minute summer	44	10	20.369	0.069	6.1	0.0781	0.0000	OK
15 minute summer	1	11	20.224	1.574	68.1	1.7799	0.0000	FLOOD RISK
15 minute summer	45	11	18.288	0.288	29.3	0.3252	0.0000	SURCHARGED
15 minute summer	46	1	18.197	0.000	0.0	0.0000	0.0000	OK
15 minute summer	47	12	18.191	0.341	3.9	0.3858	0.0000	SURCHARGED
15 minute summer	48	11	17.958	0.958	45.2	1.0832	0.0000	SURCHARGED
15 minute summer	J1	12	15.899	1.398	72.6	0.0000	0.0000	FLOOD RISK
15 minute summer	5	12	15.996	0.395	25.0	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute summer	29	29	28	20.6	0.339	0.135	3.3043	
2160 minute summer	30	30	29	20.6	0.397	0.136	4.6559	
2160 minute summer	31	31	30	8.6	0.254	0.056	9.1102	
15 minute summer	32	32	31	60.8	1.529	0.591	0.8047	
15 minute summer	33	33	32	45.4	1.885	0.435	0.6749	
15 minute summer	34	34	33	46.1	2.426	0.485	1.2508	
15 minute summer	35	35	34	6.0	0.529	0.489	0.2407	
2160 minute summer	36	36	31	3.2	0.272	0.050	2.8271	
2160 minute summer	37	37	30	8.4	0.335	0.039	4.0044	
15 minute summer	38	38	J5	62.2	2.047	0.690	0.9075	
2160 minute summer	39	39	30	2.8	0.174	0.028	0.6991	
15 minute summer	40	40	39	18.6	1.253	0.186	0.7096	
2160 minute summer	41	41	ATT/HB Z1	7.9	0.388	0.137	1.2944	
2160 minute summer	42	42	41	7.9	0.356	0.204	0.1407	
15 minute summer	43	43	J4	90.2	2.267	2.232	0.8446	
15 minute summer	44	35a	35	6.0	0.740	0.400	0.1134	
15 minute summer	1	1	43	62.5	1.571	0.554	0.4868	
15 minute summer	45	45	12	28.4	1.614	1.129	0.2208	
15 minute summer	46	46	29	0.0	0.000	0.000	0.0000	
15 minute summer	47	47	38	6.4	0.398	0.277	0.1024	
15 minute summer	48	48	37	41.0	2.327	0.931	0.1164	
15 minute summer	J1	J1	J2	60.1	1.122	0.762	2.1693	
15 minute summer	5	5	J1	24.3	1.672	0.352	0.1306	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.53%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	7	12	15.869	0.369	20.1	0.0000	0.0000	SURCHARGED
15 minute summer	J2	12	15.815	1.470	72.1	0.0000	0.0000	SURCHARGED
15 minute summer	J3	12	15.677	1.501	93.1	0.0000	0.0000	SURCHARGED
15 minute summer	8	10	16.620	0.120	31.0	0.0000	0.0000	OK
15 minute summer	26	12	17.653	0.153	29.1	0.0000	0.0000	SURCHARGED
15 minute summer	49	11	19.596	1.121	36.0	0.0000	0.0000	SURCHARGED
15 minute summer	J4	11	19.238	1.288	122.8	0.0000	0.0000	SURCHARGED
15 minute summer	Depth/Area 1	12	17.956	0.756	24.0	0.0000	0.0000	SURCHARGED
15 minute summer	J5	12	17.890	0.796	83.2	0.0000	0.0000	SURCHARGED
15 minute summer	J8	11	13.840	0.357	200.7	0.0000	0.0000	OK
15 minute summer	J9	11	13.753	0.336	199.4	0.0000	0.0000	OK
15 minute summer	17	1	16.480	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	1	15.686	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	7	7a	J2	20.0	1.998	0.561	0.1146	
15 minute summer	J2	J2	J3	78.8	1.120	1.000	2.3497	
15 minute summer	J3	J3	13	95.6	1.358	1.210	1.3274	
15 minute summer	8	8	J3	30.8	2.154	0.863	0.0846	
15 minute summer	26	26a	39	27.8	2.228	0.586	0.1630	
15 minute summer	49	49	J4	32.6	1.851	0.740	0.1524	
15 minute summer	J4	J4	42	121.2	3.048	2.979	0.7731	
15 minute summer	Depth/Area 1	Depth/Area 1	J5	21.0	1.193	0.699	0.0658	
15 minute summer	J5	J5	37	79.0	2.070	0.876	0.6573	
15 minute summer	J8	J8	J9	199.4	1.877	1.223	1.0532	
15 minute summer	J9	J9	9	208.7	2.564	1.253	0.1973	
15 minute summer	17	17a	J8	0.0	0.000	0.000	0.0000	
15 minute summer	19	19a	J9	0.0	0.000	0.000	0.0000	

Appendix G – Hydro-Brake Flow Control Details for Z1 and Z2

N.B. A penstock valve will be provided in the Hydro-Brake manhole, upstream of the Hydro-Brake. The Hydro-Brake shall be installed **without** a bypass door. Details presented are standard details and will be customised to the project at final design stage.

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.400	4.100
Flush-Flo™	0.394	3.957
Kick-Flo®	0.803	3.173
Mean Flow		3.520

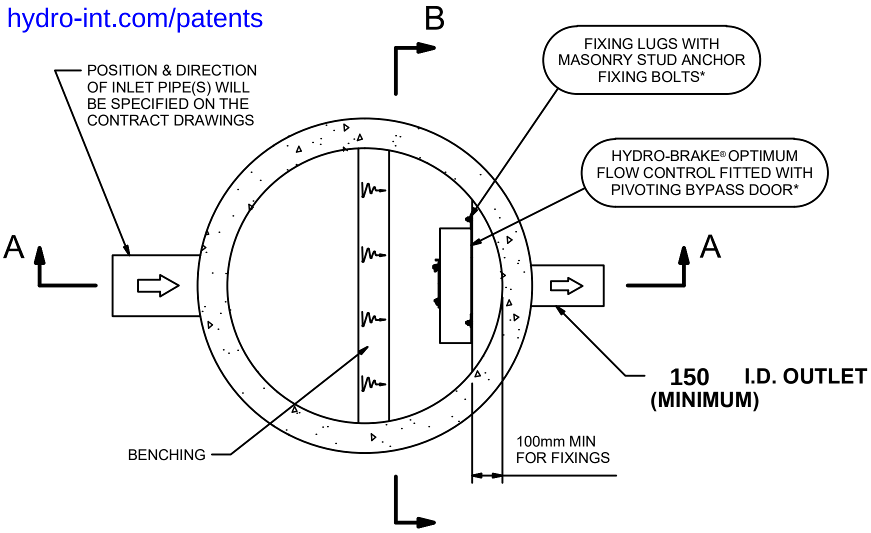
Hydro-Brake® Optimum Flow Control including:

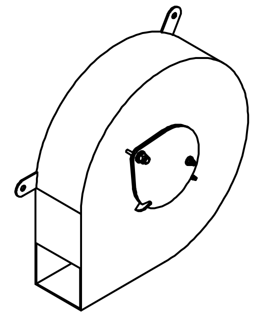
- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

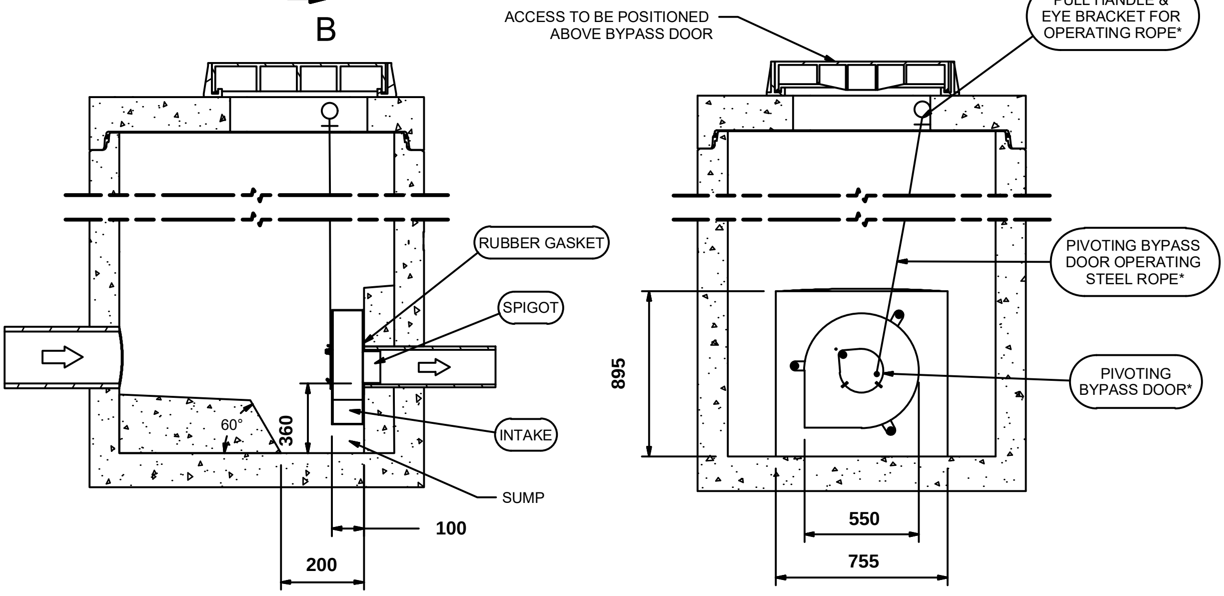
CERTIFICATE 08/4596

PT/329/0412

hydro-int.com/patents







SECTION A-A

SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE !

The head/flow characteristics of this SHE-0090-4100-1400-4100 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve. **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

DATE	9/27/2021 5:11 PM
SITE	Temple Hill
DESIGNER	Marcus Wallace
REF	Zone 1

SHE-0090-4100-1400-4100

Hydro-Brake® Optimum

marcus.wallace@jjc.ie

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.400	4.100
Flush-Flo	0.394	3.957
Kick-Flo®	0.803	3.173
Mean Flow		3.520

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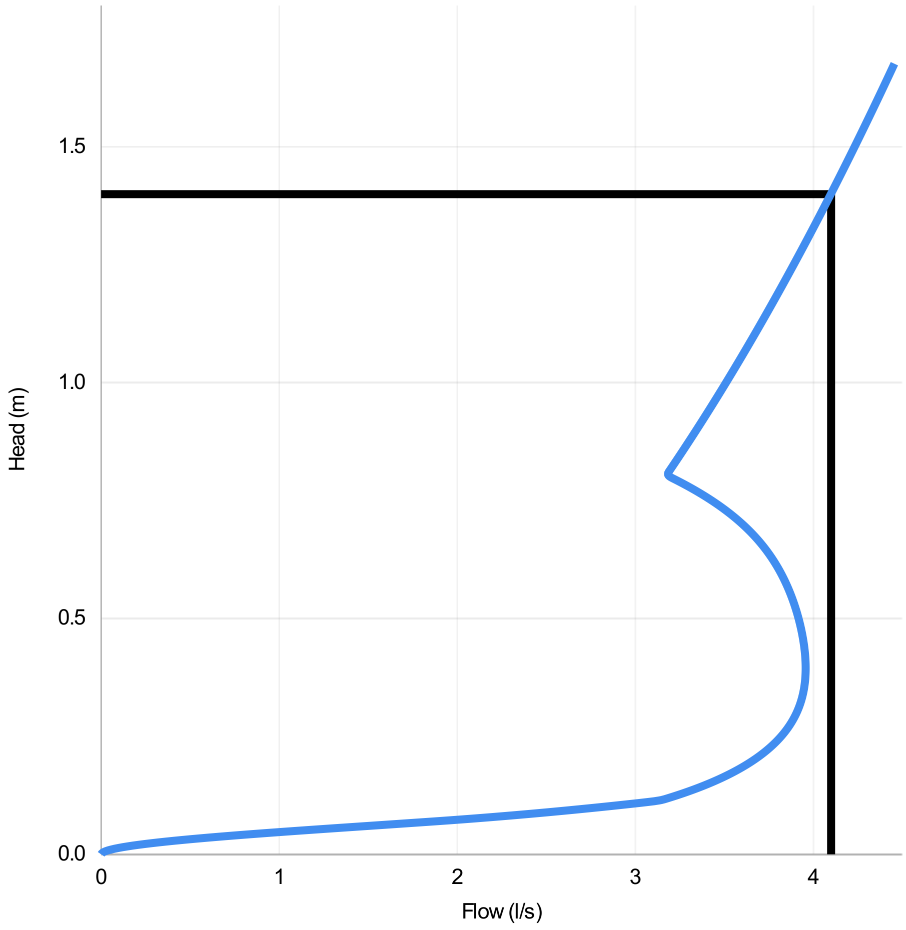
CERTIFICATE No 08/4596

WRc APPROVED
PT/329/0412



Head (m)	Flow (l/s)
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0.097	2.713
0.145	3.380
0.193	3.638
0.241	3.798
0.290	3.892
0.338	3.941
0.386	3.957
0.434	3.951
0.483	3.929
0.531	3.892
0.579	3.841
0.628	3.768
0.676	3.667
0.724	3.526
0.772	3.334
0.821	3.205
0.869	3.290
0.917	3.373
0.966	3.453
1.014	3.531
1.062	3.608
1.110	3.682
1.159	3.755
1.207	3.827
1.255	3.897
1.303	3.965
1.352	4.032
1.400	4.098

DESIGN ADVICE

!

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The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	27/09/2021 17:11
Site	Temple Hill
DESIGNER	Marcus Wallace
Ref	Zone 1

SHE-0090-4100-1400-4100

Hydro-Brake Optimum®

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.110	4.100
Flush-Flo™	0.359	3.112
Kick-Flo®	0.727	2.509
Mean Flow		3.139

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE 08/4596

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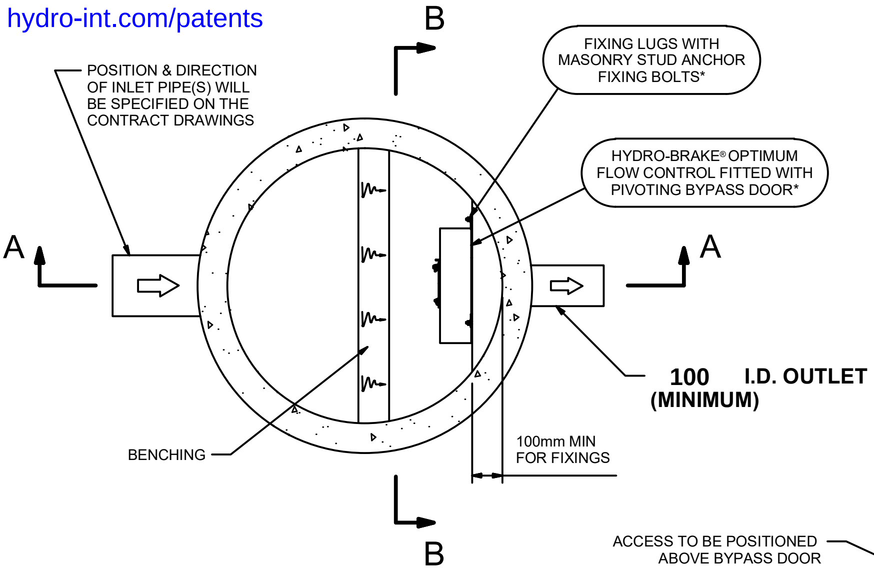
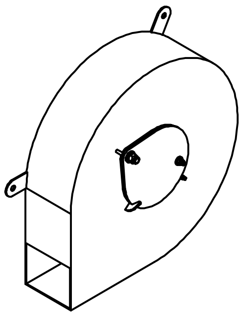
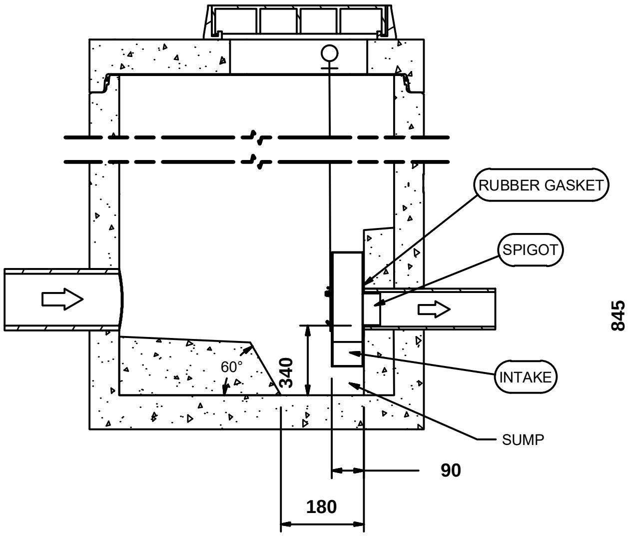
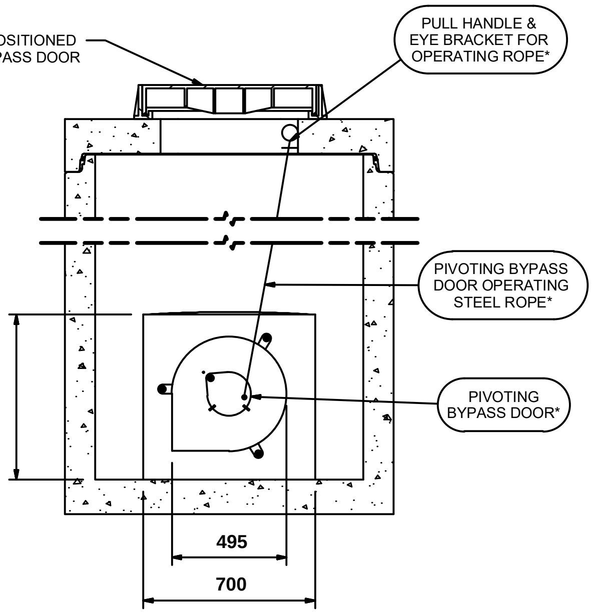






SECTION A-A



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Hydro International®

DATE	10/11/2021 4:18 PM
SITE	Temple Hill
DESIGNER	Marcus Wallace
REF	Zone 2

SHE-0082-4100-2110-4100
Hydro-Brake® Optimum

Hydro International Ltd, Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD. Tel; 01275 878371 Fax; 01275 874979 Web; www.hydro-int.com Email; enquiries@hydro-int.com

marcus.wallace@jjc.ie

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.110	4.100
Flush-Flo	0.359	3.112
Kick-Flo®	0.727	2.509
Mean Flow		3.139

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BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

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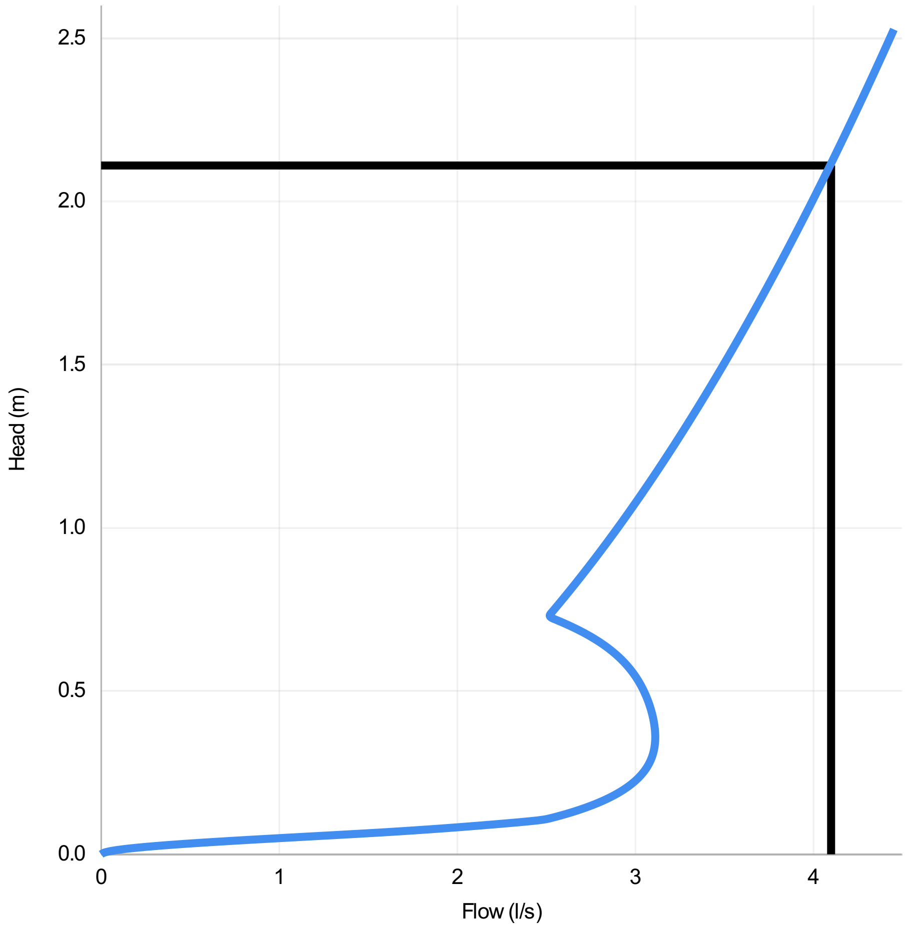
Head (m)	Flow (l/s)
0.000	0.000
0.073	1.746
0.146	2.734
0.218	2.986
0.291	3.089
0.364	3.112
0.437	3.092
0.509	3.040
0.582	2.948
0.655	2.786
0.728	2.520
0.800	2.621
0.873	2.727
0.946	2.829
1.019	2.926
1.091	3.020
1.164	3.111
1.237	3.199
1.310	3.284
1.382	3.367
1.455	3.447
1.528	3.526
1.601	3.602
1.673	3.677
1.746	3.750
1.819	3.822
1.892	3.892
1.964	3.961
2.037	4.028
2.110	4.094



DESIGN ADVICE

!

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Hydro International®

DATE	11/10/2021 16:18
Site	Temple Hill
DESIGNER	Marcus Wallace
Ref	Zone 2

SHE-0082-4100-2110-4100

Hydro-Brake Optimum®

Appendix H – JBA – Flood Risk Assessment

St Teresa’s Land’s, Temple Hill, Monkstown, Blackrock, Co Dublin

Flood Risk Assessment

September 2021

www.jbaconsulting.ie

Oval Target Ltd
55 Percy Place
BALLSBRIDGE
Co Dublin

JBA Project Manager

David Casey
Unit 3, Block 660,
Greenogue Business Plaza,
Rathcoole,
Dublin.

Revision History

Revision Ref/Date	Amendments	Issued to
13/02/2018 / v1.0	Draft Report	Oval Target Ltd
01/08/2018 / v2.0	Revised Site Layout	Oval Target Ltd
28/08/2018 / v3.0	Update Drainage Calculations	Oval Target Ltd
15/02/2019 / v4.0	Response to RFI	Oval Target Ltd
15/12/2021 / v5.0	Updated Site Layout	Oval Target Ltd

Contract

This report describes work commissioned by Lisa Rocca, on behalf of Oval Target Ltd, by a letter dated 17/01/2018. Oval Target's representative for the contract was Marcus Wallace of JJ Campbell. David Casey of JBA Consulting carried out this work.

Prepared by .... David Casey BSc MSc MCIWEM

Senior Engineer

Reviewed by .... Elizabeth Russell BSc MSc CEnv MCIWEM C.WEM

Principal Analyst

Purpose

This document has been prepared as a Flood Risk Assessment for Oval Target Ltd. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Oval Target Ltd.

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JBA is aiming to reduce its per capita carbon emissions.

Contents

List of Figures

1 Overview

Under The Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHlG & OPW, 2009) proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk. This requires a review of all available flood information and assessment of Flood Zones for the development site.

1.1 Terms of Reference

JBA Consulting was appointed to prepare a Flood Risk Assessment (FRA) for a proposed residential development located at Temple Hill, Blackrock, Co Dublin.

1.2 Aims & Objectives

This study is being completed to inform the planning application for the proposed site. It aims to identify, quantify and communicate to applicant, Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives are to:

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Assess the impact the proposed development has on flood risk in respect to the issue of attenuation and displacement of flooding,
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW / DoEHLG planning guidance, "The Planning System and Flood Risk Management ". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

1.3 Development Proposal

Oval Target Limited intend to apply to An Bord Pleanála for planning permission for a Strategic Housing Development on a site of c. 3.9 ha at 'St. Teresa's House' (A Protected Structure) and 'St. Teresa's Lodge' (A Protected Structure) Temple Hill, Monkstown, Blackrock, Co. Dublin.

The development will consist of a new residential and mixed use scheme of 493 residential units and associated residential amenities, a childcare facility and café in the form of (a) a combination of new apartment buildings (A1-C2 and D1 – E2); (b) the subdivision, conversion and re-use of 'St. Teresa's House' (Block H); and (c) the dismantling, relocation and change of use from residential to café of 'St. Teresa's Lodge' (Block G) within the site development area. A detailed development description is now set out as follows:

The proposal provides for the demolition (total c. 207 sq m GFA) of (a) a single storey return (approx. 20 sq m) along the boundary with The Alzheimer's Society of Ireland; (b) the ground floor switch room (approx. 24.9sq.m.), (c) ground floor structures northwest of St. Teresa's House (26.8sq.m), (d) basement boiler room northwest of St. Teresa's House (17.0 sq.m), (e) ground floor structures northeast of St. Teresa's house (22.0sq.m.) (f) basement stores northeast of St. Teresa's house (67.8 sq.m.) and (g) a non - original ground floor rear extension (approx. 28.5 sq m) associated with the Gate Lodge.

The new development will provide for the construction of a new mixed use scheme of 487 no. apartment units in the form of 11 no. new residential development blocks (Blocks A1-C2 and D1 – E2) as follows:

- Block A1 (5 storeys) comprising 37 no. apartments (33 no. 1 bed units and 4 no. 2 bed units)
- Block B1 (10 storeys) comprising 55 no. apartments (37 no. 1 bed units, 10 no. 2 bed units, 8 no. 3 bed units)
- Block B2 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B3 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B4 (5 storeys) comprising 41 no. apartments (4 no. studio units, 4 no. 1 bed units, 27 no. 2 bed units and 6 no. 3 bed units)
- Block C1 (3 storeys) comprising 10 no. apartments (1 no. studio units, 3 no. 1 bed units and 6 no. 2 beds)
- Block C2 (3 storeys) comprising 6 no. apartments (2 no. 1 bed units and 4 no. 2 bed units) together with a creche facility of 392 sq m at ground floor level and outdoor play area space of 302 sq m.
- Block C3 (1 storey over basement level) comprising residential amenity space of 451 sq m.
- Block D1 (6 storeys) comprising 134 no. apartments (12 no. studio units, 22 no. 1 bed units, 90 no. 2 bed units and 10 no. 3 bed units).
- Block E1 (6 storeys) comprising 70 no. apartment units (34 no. 1 bed units, 26 no. 2 bed units and 10 no. 3 bed units).
- Block E2 (6 storeys) comprising 50 units (1 no. studio units, 29 no. 1 bed units, 18 no. 2 bed units and 2 no. 3 bed units).

Each new residential unit has associated private open space in the form of a terrace / balcony.

The development also provides for Block H, which relates to the subdivision and conversion of 'St. Teresa's House' (3 storeys) into 6 no. apartments (5 no. 2 bed units and 1 no. 3 bed unit) including the demolition of non-original additions and partitions, removal and relocation of existing doors, re-instatement of blocked up windows, replacement of windows, repair and refurbishment of joinery throughout and the upgrade of roof finishes and rainwater goods where appropriate.

It is also proposed to dismantle and relocate 'St. Teresa's Lodge' (1 storey) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa's Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate.

It is also proposed to dismantle and relocate 'St. Teresa's Lodge' (1 storey - gross floor area 69.63sq m) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa's Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate. A non - original extension (approx. 28.5 sq m) is proposed for demolition. The current proposal seeks a new extension of this building (approx. 26.8 sq m) and a change of use from residential to café use to deliver a Part M compliant single storey building of approx. 67.4 sq m

Total Open space (approx. 15,099.7 sq m) is proposed as follows: (a) public open space (approx. 11,572.3 sq m) in the form of a central parkland, garden link, woodland parkland (incorporating an existing folly), a tree belt; and (b) residential communal open space (approx. 3,527.4 sq m) in the form of entrance gardens, plazas, terraces, gardens and roof terraces for Blocks B2 and B3. Provision is also made for new pedestrian connections to Rockfield Park on the southern site boundary and Temple Hill along the northern site boundary.

Basement areas are proposed below Blocks A1, B1 to B4 and D1 (c. 7,295 sq. m GFA). A total of 252 residential car parking spaces (161 at basement level and 91 at surface level); 1056 bicycle spaces (656 at basement level and 400 at surface level); and 20 motorcycle spaces at basement level are proposed. 8 no. car spaces for creche use are proposed at surface level.

The proposal also provides for further Bin Storage areas, Bike Storage areas, ESB substations and switch rooms with a combined floor area of 356.2 sq m at surface level.

The development also comprises works to the existing entrance to St. Teresa's; the adjoining property at 'Carmond'; and residential development at St. Vincent's Park from Temple Hill (N31/R113). Works include the realignment and upgrade of the existing signalised junction and associated footpaths to provide for improved and safer vehicular access/egress to the site and improved and safer access/egress for vehicular traffic to/from the property at 'Carmond' and the adjoining residential development at St Vincent's Park.

Emergency vehicular access and pedestrian/cyclist access is also proposed via a secondary long established existing access point along Temple Hill. There are no works proposed to the existing gates (Protected Structure) at this location.

The associated site and infrastructural works include provision for water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works including tree protection; green roofs; boundary treatment; internal roads and footpaths; and electrical services including solar panels at roof level above Blocks A1, B1 - B4, C1-C3, D1, E1, E2, as depicted in Figure 1-2 over page.

Figure 1-1 Site Layout

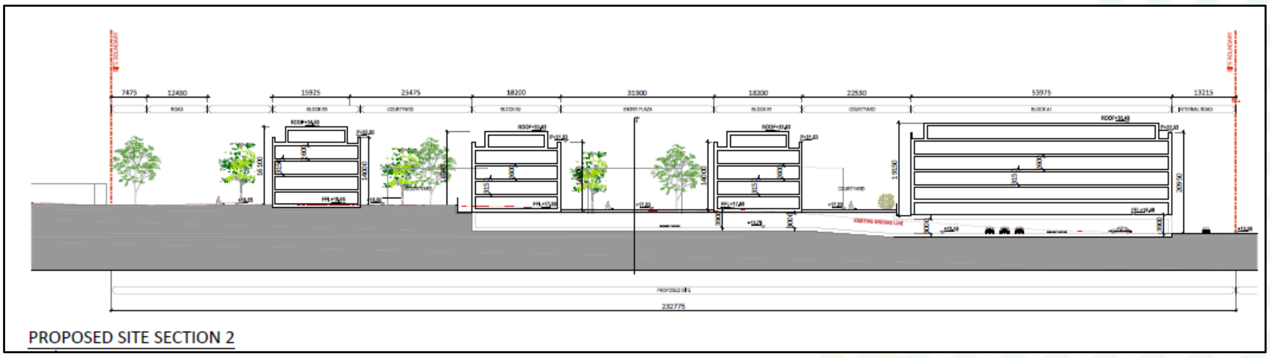


Figure 1-2 Site Cross Section

ss

2 Site Background

2.1 Location

The proposed development is located in St Teresa's lands in Temple Hill, Blackrock, Dublin. The site is located in an urban environment. The N31 runs along the sites northern boundary, while existing residential developments border the site to west and south-east. The Rockfield Park playing pitches are located to the south of the development.

The site is zoned for residential use under the Dun Laoghaire Rathdown Development Plan 2016-2022. Figure 2-1 outlines the site location and local mapping.

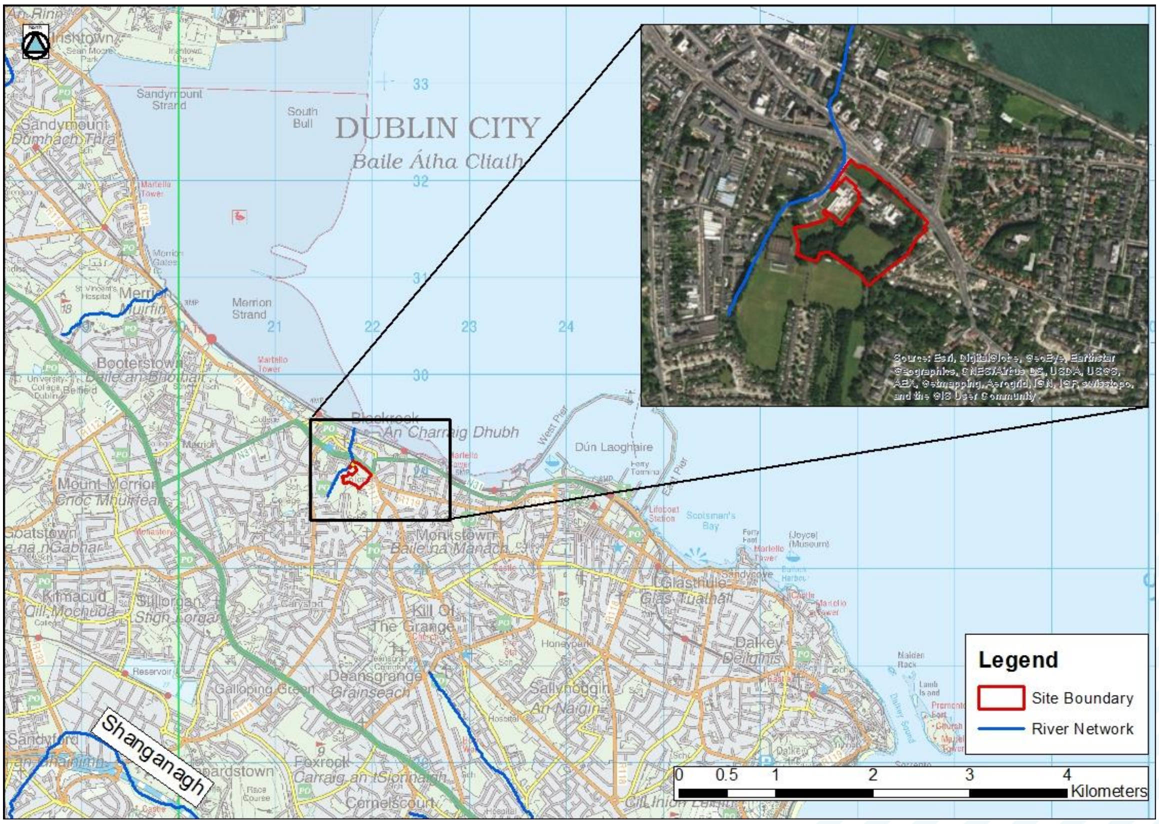


Figure 2-1 Site Location & Hydrological Environment

2.2 Watercourses

The site is located in close proximity to the coastline, with Dublin Bay located c. 350m northeast of the site boundary. The main watercourse is identified as the Carysfort-Maretimo Stream which is located c. 20m from the site's western boundary. The Carysfort-Maretimo Stream runs predominantly in a north-easterly direction in the area and discharges to Dublin Bay c. 400m north of the site.

Flood defences are in place along the Carysfort-Maretimo in the vicinity of the development. The stream is culverted under the Temple Road at the sites north-western boundary.

Other watercourses in the area have been identified as the Priory Stream which is located c. 650m northwest and the Sradbrook Stream which is located c. 850m to the southeast.

2.3 Local and site topography

The site covers an area of approximately 4 ha. There is a fall noted across the site that runs in an SW-NE direction towards the coastline. The topography varies from a high of c. 21mOD along the sites southern boundary to a low of c. 12.5mOD with the boundary with the Temple Road.

3 Flood Risk Identification

An assessment of the potential and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's website, www.floodmaps.ie and general internet searches.

The OPW host a National Flood hazard mapping website, www.floodmaps.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. See Figure 3-1 for historic flood events in the area.

- Flooding at Barclay Road and Temple Road, Blackrock, Co. Dublin, on the 24th Oct 2011- Overtopping of the Carysfort-Maretimo Stream following heavy rainfall. Located at the sites northern boundary.
- Flooding at Carysfort Avenue, Blackrock, Co. Dublin, on the 24th Oct 2011- Overtopping of the Carysfort-Maretimo Stream following heavy rainfall. Located c. 450m to the south of the site.
- Flooding at Newtownpark Avenue, Blackrock, Co. Dublin, on the 24th Oct 2011. Pluvial/Surface water flooding following heavy rainfall. Located c. 1km south-east of the site.

The October 24th flood event occurred along Temple Rd at the site's north-eastern boundary. Based on the proximity of the site to this flood point, inundation of a section of the site was likely but restricted to the most northern boundary. Based on the site topography it is unlikely that any areas containing the proposed residential uses were affected.

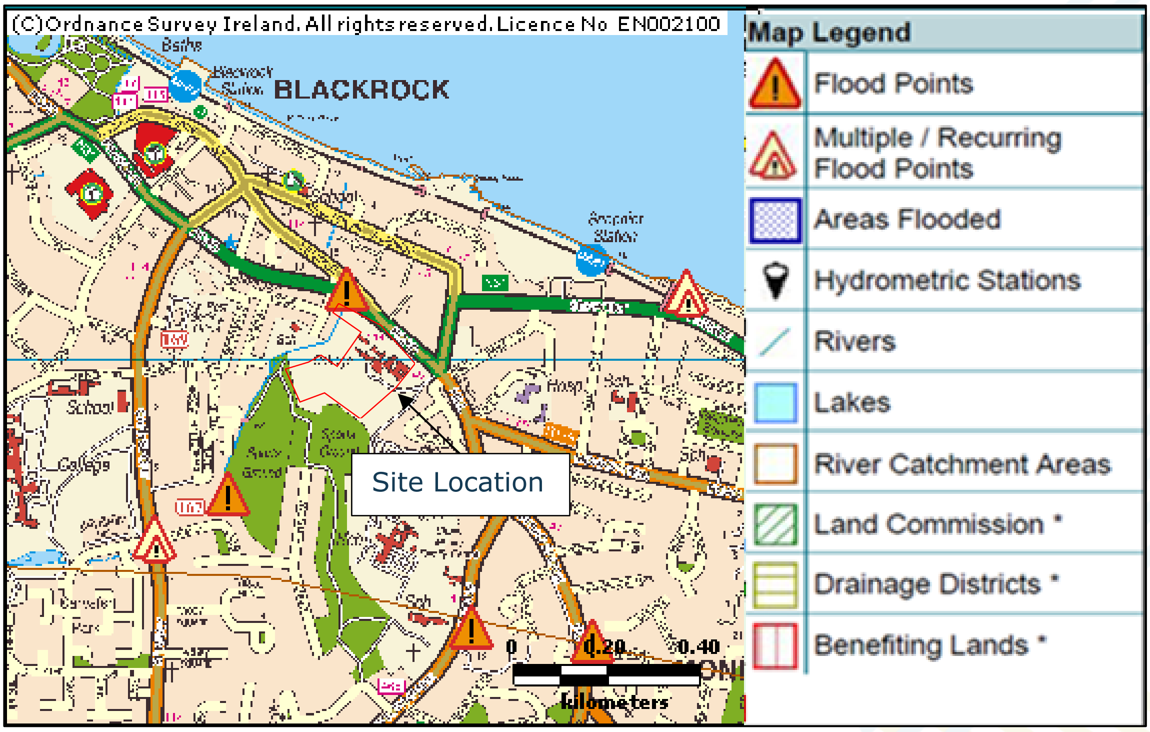


Figure 3-1 Floodmaps.ie

3.1.1 Internet Search

An internet search was conducted to gather information about whether or not the site was affected by flooding previously. While there were no results for flooding affecting the site itself, there were reports confirming the flooding in the areas as highlighted on Floodmaps.ie (Section 3.1).

3.2 Predictive Flooding

The area has been a subject to two predicative flood mapping or modelling studies and another related study:

- Eastern Catchment Flood Risk Assessment and Management Study (2016);
- OPW Preliminary Flood Risk Assessment (2011);
- Dun Laoghaire-Rathdown Development Plan 2016-2022 (2016).

The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the OPW PRFA study.

3.2.1 Catchment Flood Risk Assessment and Management Study (Eastern CFRAM)

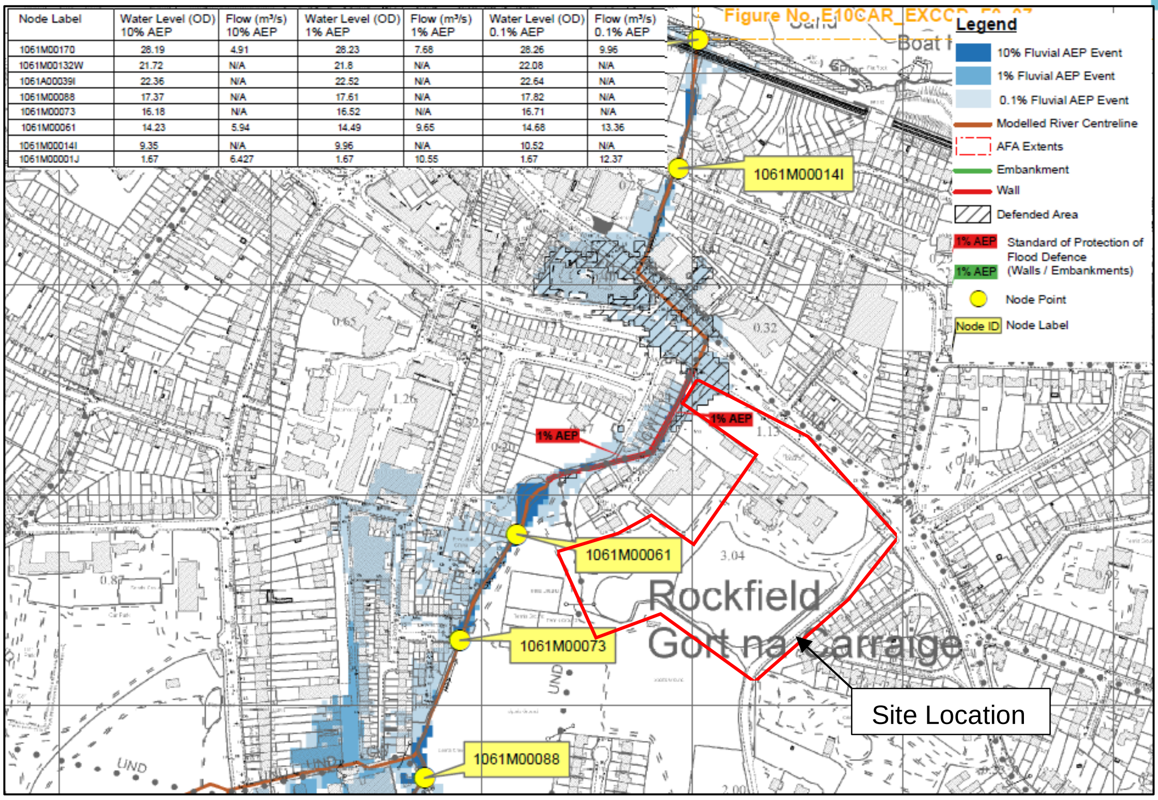
The Eastern CFRAM Study is the most detailed mapping undertaken in the Dublin region. It commenced in June 2011 with final flood maps issued during 2016. The Eastern CFRAM Study involves detailed hydraulic modelling of rivers and their tributaries, including the Carysfort-Maretimo, which is the nearest watercourse to the site. Following the detailed hydraulic modelling, flood maps were produced for the 10%, 1% and 0.1% AEP flood events.

The available flood maps have been reviewed and confirm that the most northern extent of the site, and directly adjacent to the Carysfort-Maretimo is located within Flood Zone A (defended) & B. The flood defences along the Carysfort-Maretimo provides flood protection up to the 1% AEP flood event. See Figure 3-2 for the flood maps

Flooding appears to originate from Carysfort-Maretimo system following surcharging of the culvert system underneath the Temple Rd, directly downstream of the site. The stream overtops its right bank which results in inundation of c. 40m into the site.

Review of the available data confirms that the 0.1% AEP flood level flood depth within the site is ranges from 0-250mm in the affected area, refer to Figure 3-3.

Coastal flooding does not impact on or in the vicinity of the proposed development. Review of the Eastern CFRAM data indicates a 0.5% AEP and 0.1% AEP flood level of 3.04mOD and 3.25mOD respectively. Refer to Figure 3-4 for the tidal flood extents in the area.



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
1061M00170	28.19	4.91	28.23	7.68	28.26	9.96
1061M00132W	21.72	N/A	21.8	N/A	22.08	N/A
1061A00039I	22.36	N/A	22.52	N/A	22.64	N/A
1061M00088	17.37	N/A	17.61	N/A	17.82	N/A
1061M00073	16.18	N/A	16.52	N/A	16.71	N/A
1061M00061	14.23	5.94	14.49	9.65	14.68	13.36
1061M00014I	9.35	N/A	9.96	N/A	10.52	N/A
1061M00001J	1.67	6.427	1.67	10.55	1.67	12.37

Figure 3-2 Eastern CFRAM Flood Extent Map

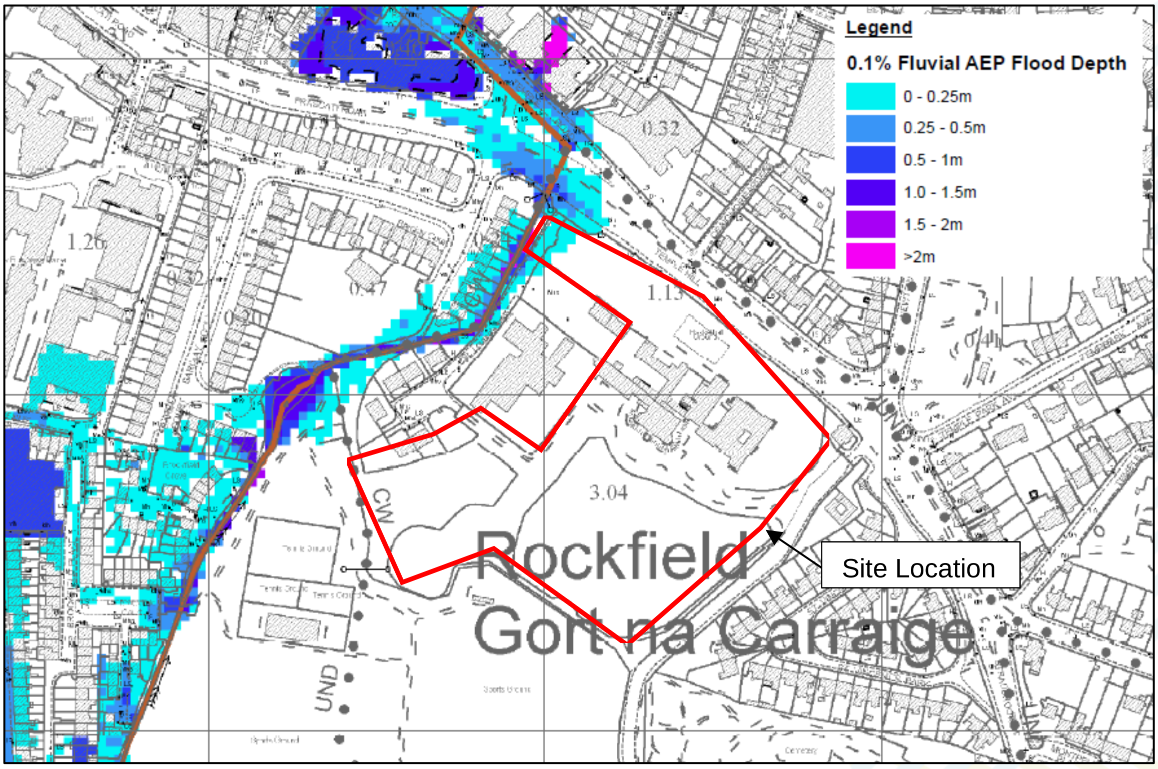
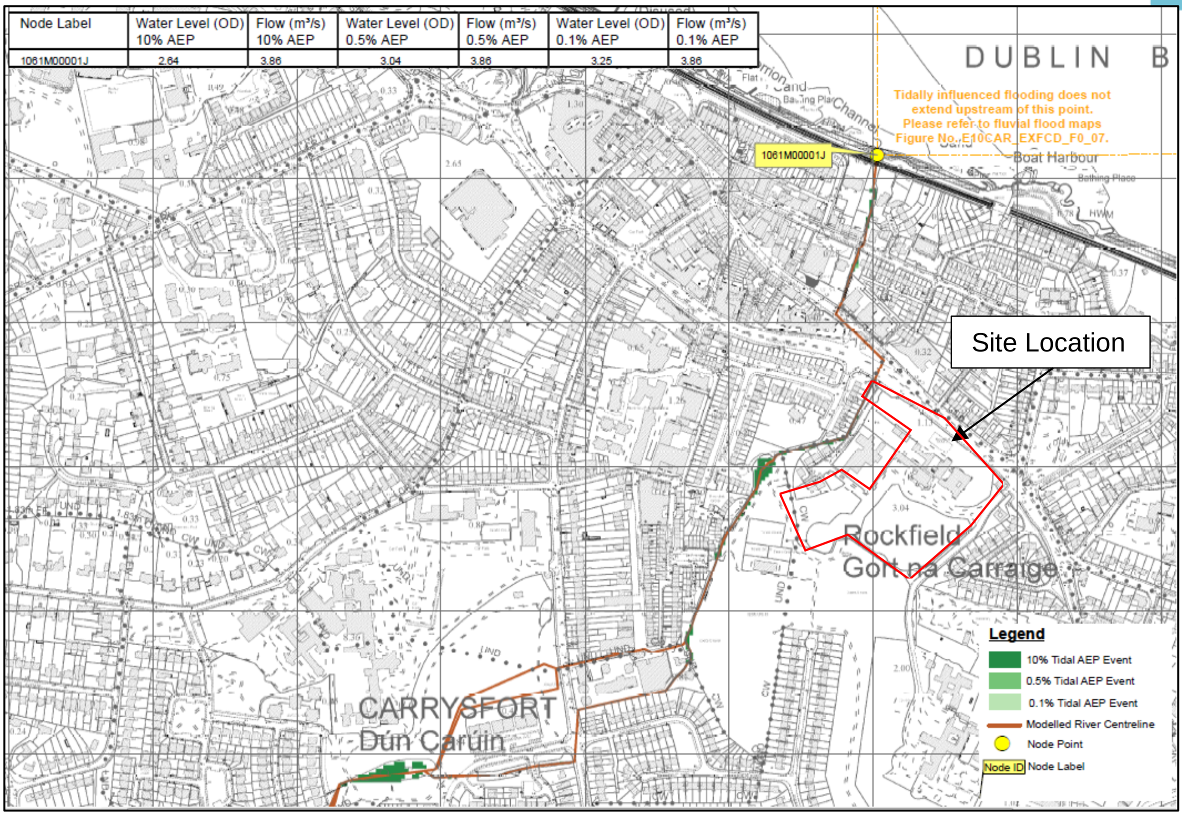


Figure 3-3 Eastern CFRAM Flood Depth Map



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m³/s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
1061M00001J	2.64	3.86	3.04	3.86	3.25	3.86

Figure 3-4 Eastern CFRAM Tidal Flood Risk Map

3.2.1 Dun Laoghaire-Rathdown County Council Strategic Flood Risk Assessment

The Strategic Flood Risk Assessment (SFRA) has been prepared as part of the Dun Laoghaire-Rathdown Development Plan (DLR) 2016-2022. The SFRA informs the strategic land use planning decisions by providing an assessment of flood risk within the region and enables the application of the sequential approach, including Justification Test. A range of flood map sources (OPW PFRA, Eastern CFRAM etc.) were reviewed as part of the SFRA to inform the use of the Justification Test for developments at risk of flooding. In addition to the Justification Test, various flood management policies and objectives are outlined for inclusion within the Dun Laoghaire-Rathdown Development Plan. See Appendix B for the stated policies.

An extract of the flood map produced as part of the SFRA is presented in Figure 3-5. It should be noted that the SFRA flood maps are based on the Eastern CFRAM flood outlines, which places the western boundary of the site within Flood Zone B and therefore, at a moderate risk of flooding.

The flood defences along the Carysfort-Maretimo is referred to within the SFRA, as site 16, as follows *"These defences are of robust construction, although consideration of the impacts of overtopping, either through higher return period events or with the impact of climate change on river flows, should be taken into account in any site specific flood risk assessment. Breach assessment is unlikely to be required"*

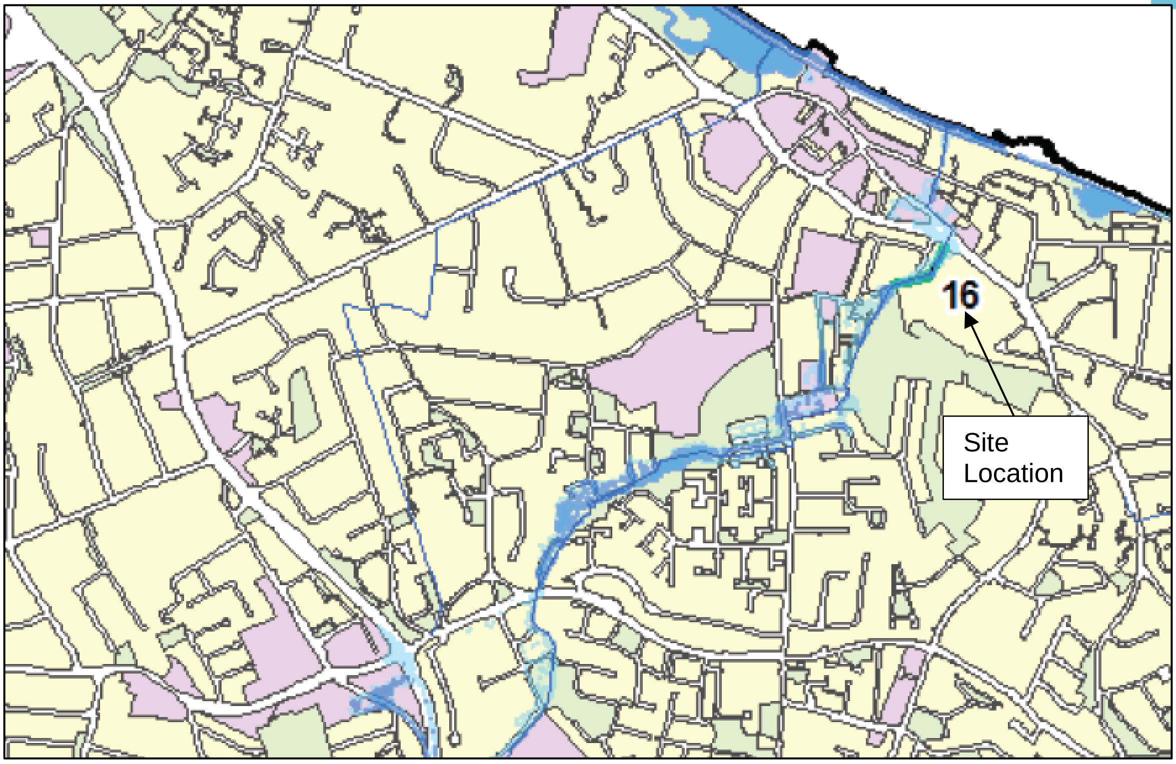


Figure 3-5 DLR SFRA Flood Map

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. These sources are described below:

3.3.1 Fluvial

Sources of historic flood information have been researched as part of the FRA. The main watercourse in the area is the Carysfort-Maretimo which runs adjacent to the site's northern boundary (<20m). The Carysfort-Maretimo provides the main source of flood risk to the development.

Review of floodmaps.ie indicates the occurrence of historic flooding along Temple Road in the vicinity of the site's northern boundary. The source of flooding originated from overtopping of the Carysfort-Maretimo following heavy rainfall. It is unclear if the site itself was inundated, but based on the site topography, any inundation onsite would have been restricted to the north-western corner.

Review of the Eastern CFRAM and SFRA flood maps places the eastern boundary of the site within Flood Zone A, albeit defended, and Flood Zone B. The site is protected by a flood wall located along the Carysfort-Maretimo that provides protection up to the 1% AEP standard. Although the site is protected from the 1% AEP flood event, as per the guidelines the flood zone extents should not be inclusive of any flood defences. It is considered therefore that the eastern boundary of site is within Flood Zone A/B.

Specific mitigation measures will be outlined in Section 4 to manage the identified fluvial flood risks to the site.

3.3.2 Coastal

The site is located within 300m of the coastline, therefore the risk of tidal flooding has been assessed. There has been no recorded instance of coastal flooding in the study area. Review of the Eastern CFRAM flood map for the area indicates a 0.5% AEP and

0.1% AEP flood level of 3.04mOD and 3.25mOD respectively, while the lowest site level onsite is c. 12.5mOD.

Considering the above, coastal flooding is not considered to present a flood risk to the site.

3.3.3 Pluvial

Pluvial or surface water flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. A number of sources have been researched such as the OPW PFRA flood mapping and review of floodmaps.ie. Based on review of the available information there is no recorded or predicted pluvial flooding at the site or immediate surrounding area.

Specific measures in relation to the proposed stormwater system to manage onsite surface water flows is referred to Section 4.

3.3.4 Groundwater

The OPW PFRA was reviewed and did not indicate groundwater flooding at the site or surrounding area. The GSI groundwater vulnerability for the site is classified as 'moderate' and 'high' which indicates a groundwater depth of ranging from 3-10+m.

Furthermore, there are no karst features in the area which would indicate areas at risk of groundwater flooding.

In summary, there is no known risk of groundwater flooding in this area and has been screened out at this stage.

4 Flood Risk Assessment

4.1 Flood Risk

Review of the available sources of flooding outlined in Section 3 confirms that there has likely been some inundation at the site along its most northern boundary. The is based on recoded flooding that has occurred along Temple Road in October 2011. Furthermore, both the Eastern CFRAM and Dublin City SFRA flood maps identifies that the eastern boundary of the site lies within Flood Zone A (defended) and B.

The main flood risk is identified as overtopping of the Carysfort-Maretimo Steam adjacent to the site's boundary. Flood defences have been constructed along the Carysfort-Maretimo that provide protection to the 1% AEP standard. Therefore, flood risk is only considered at the site from overtopping of the Carysfort-Maretimo flood defences or exceedance events. The only possible receptor at risk of inundation is identified as the ground floor carpark at Block A1.

With reference to Figure 4-1, it is shown that the proposed ground/basement car park entrance is located in Flood Zone A/B. The apartments contained in Block A1 are situated on the first floor at a level of 16.48mOD and therefore, are not at risk of flooding. The associated ground floor FFL for Block A1 is 13.15mOD.

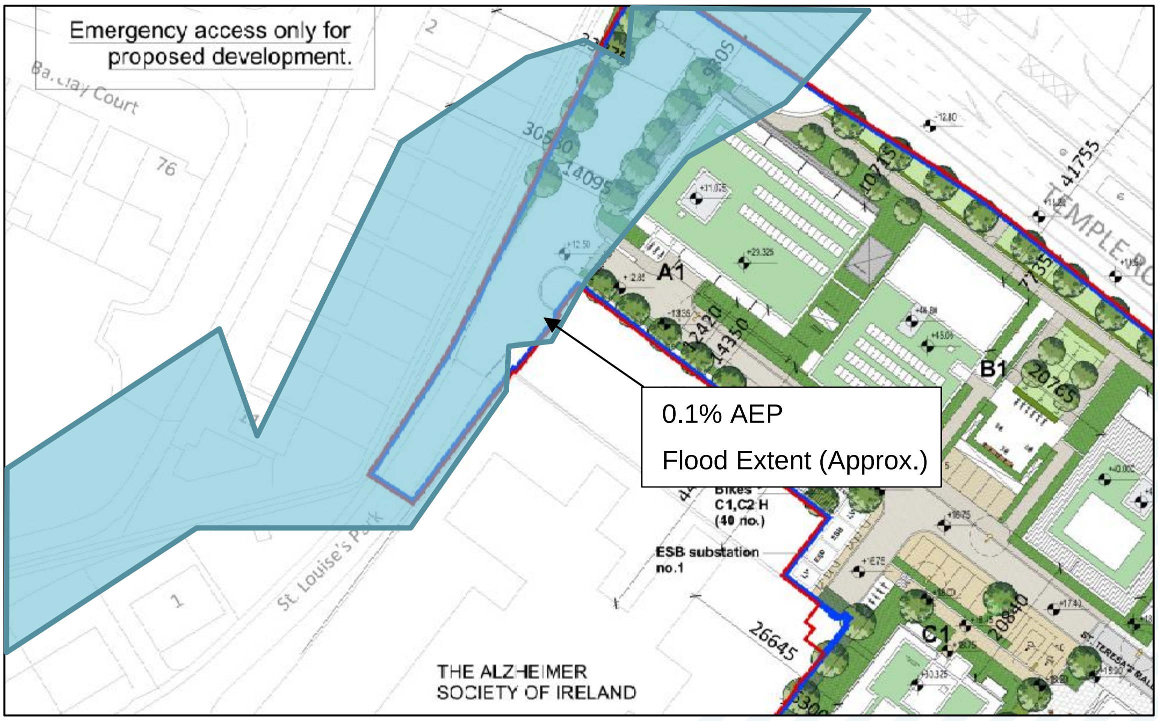


Figure 4-1 Overlay of 0.1% AEP Flood Extent onto Site Layout

Following the site visit it was noted that a stone-faced block boundary wall currently runs along the site's boundary with the access roadway along the site north-western boundary, see Figure 4-2. The existing wall, gateway and access road will be retained for access to the proposed development. It is reasonable to assume that the boundary wall was not incorporated into the CFRAM model, as it is an informal, ineffective structure as per standard CFRAM modelling practices. Therefore, its potential impact on the flood extents has not been accounted for.

Figure 4-2 Access Road Photograph

Given the construction type and height, the wall is reasoned to be of sufficient stature/size to impede overland flow at least up to 300mm. It will therefore have an impact upon the flood extents depicted in the CFRAM flood map presented in Figure 3-2 and Figure 4-1. It is noted that there is a gateway, and the impact of this is discussed in the following paragraphs.

Although the extents will be changed by the wall, the overland flow rates overtopping the Carysfort-Maretimo Steam will remain the same so the overall impact will be an increase in flood depths along the road, when compared to the CFRAM outputs.

Further analysis has been carried out to appraise the potential impact of the boundary wall on the CFRAM flood extents. The methodology employed was to use the Manning's equation to calculate the flow rate along the access road based on the maximum flood depth (250mm) and CFRAM flow path width (17.5m). Refer to Table 4-1 for a summary of the parameters used in the Manning's calculation.

Table 4-1 Manning's Calc Parameters

Parameter	CFRAM extents	Existing condition
Width	17.5	8.3
Slope	0.004	0.004
Manning's	0.035	0.35
Qm^3/s	1.44	1.44
Depth (m)	0.25	0.27

Based on a lowest road level of 12.47mOD (from topographic survey) and maximum flood depth of 250mm (from CFRAM 0.1% AEP depth map), this equates to a flood level of 12.72mOD. Applying the Manning's equation gives a flow of 1.44m^3/s.

As noted, the boundary wall will constrict water into a narrower flow path than that presented in the CFRAM flood maps. This has been estimated as a reduction in width from c. 17.5m to c.8.3m. The Manning's equation was then recalculated with the same parameters as provided in Table 4-1, but reducing the pathway width to 8.3m whilst maintaining a flow of 1.44m^3/s. This process gave a revised flood depth of 270mm, or a 20mm increase in flood levels when compared with the CFRAM indicated levels. This indicates a possible flood level of 12.74mOD on Temple Road in the 0.1% AEP event.

The resulting 0.1% AEP flood extents are presented in Figure 4-3, including the levels used in the calculation process.

Although the gateway is being retained through the wall, ground levels on the inside (development side) of the gate are c. 12.85mOD, which is above the calculated flood level and mean that, although there may be a small area of inundation in the gate opening, water depths will not be sufficient to enter the site and form the flood extent indicated by the CFRAM mapping.

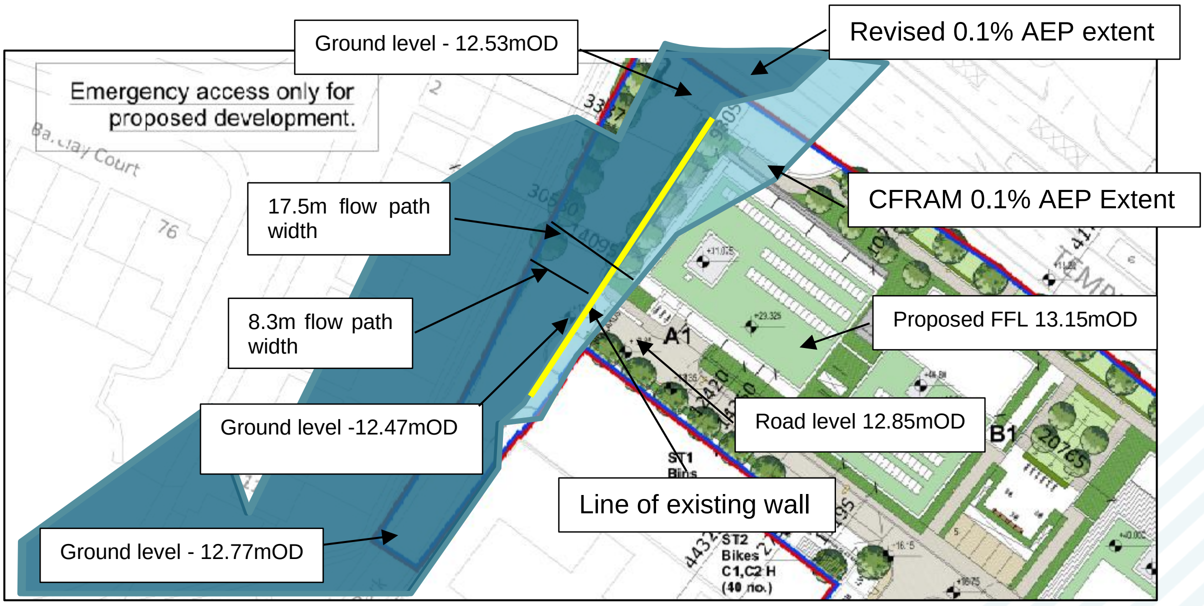


Figure 4-3 Boundary Wall

Following the above calculations, a freeboard of 410mm is available above the calculated 0.1% AEP flood level to the ground floor (non-residential) development in Block A1 (13.15m OD). Furthermore, the presence of a boundary wall, which will be retained post-development will prevent the ingress of flood waters onto the site.

Any potential floodwaters that enter the site upstream of the boundary wall will be redirected onto the access road due to the proposed ramping of the basement car park access. This is discussed further in Section 4.2.1

4.2 Flood Mitigation Measures

4.2.1 Ramping of Carpark Entrance

The Eastern CFRAM Study flood depth map indicates a maximum flood depth of 250mm, during the 0.1% AEP flood event. Following the calculations undertaken in Section 4.1, the depth has been increased to 270mm which equates to an estimated flood level of 12.74mOD. Although this depth of flooding will be retained on the road, it is prudent to ensure access to the buildings, and in particular the basement, are above this level. To achieve this, the car park entrance is ramped up from 12.5mOD to 13.35mOD, which places the car park entrance some 500mm above the 0.1% AEP flood level. Refer to Figure 4-2 for the proposed mitigation measure for the car park entrance in proximity to the Carysfort-Maretimo.

The ramping of the car park to protect the basement level from inundation will have the secondary effect of redirecting any overland flow back into the access road, as depicted in Figure 4-2. To ensure that flood waters are prevented from entering the site, the proposed kerb adjacent to the apartment block should be set at a minimum level of 12.95mOD.

As discussed above, any flood waters which enter the site from the upstream end of the boundary wall will be below the level of the ramped entrance and will be re-routed through the gateway and back onto the road.

Furthermore, all service/ ventilation openings in this area should be positioned a minimum of 400mm above the existing ground level to ensure no secondary flow pathway is provided. This will give a freeboard of approximately 150mm over the estimated flood depths of 250mm.

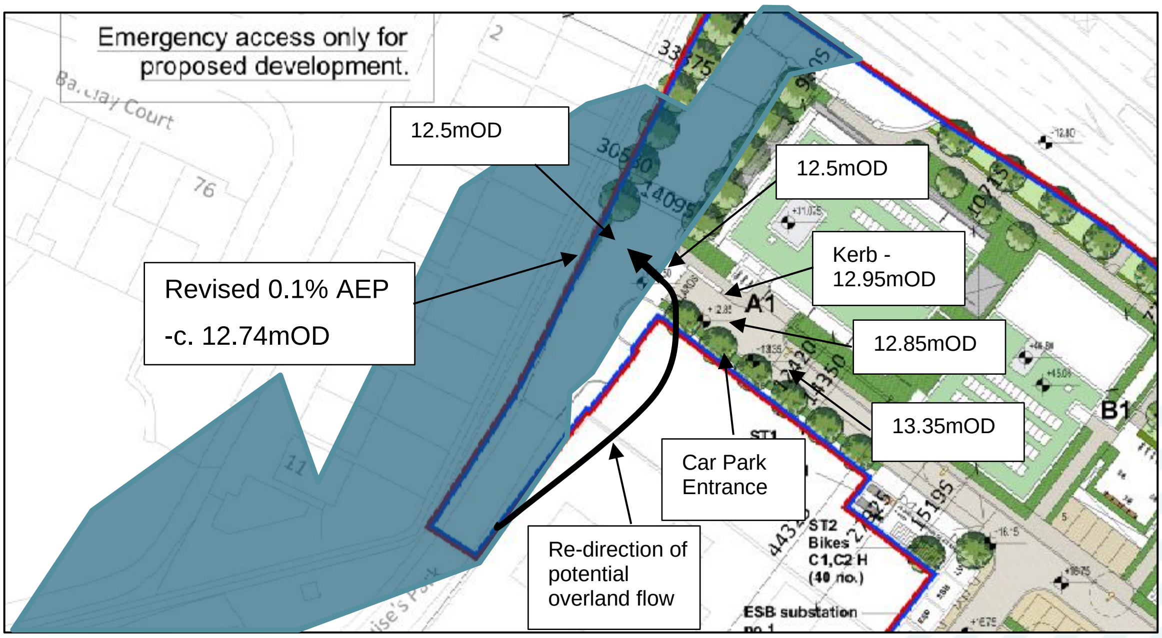


Figure 4-4 Mitigation Measures

4.3 Access

The main site entrance to the development is provided within Flood Zone C, refer to Figure 1-1. However, the emergency entrance is situated within Flood Zone A (defended). Given the estimated maximum flood depth of 250mm, access to the carpark can be maintained during a flood event, if required.

If pedestrian access to Block A1 is provided from lands within Flood Zone A/B, the access threshold should be set to 400mm above the external hardstanding area, again providing a freeboard of approximately 150mm.

In summary, as the main site entrance is located within Flood Zone C, access is not considered to be an issue during a potential flood event at the site.

4.4 Drainage Design/ Pluvial Flood Risk

A stormwater system will be incorporated within the development design to manage surface water run-off from the site. Stormwater attenuation tanks are included as part of the design to ensure that stormwater discharge is limited to its greenfield equivalent. The attenuation tank is designed to retain a 100 year rainfall event including an allowance for climate change (20%). The design discharge is 8.17 l/s while the total required attenuation volume is 1600m^3. Attenuation is provided over two attenuation structures each providing 50% of the storage volume. JBA Consulting have not review the calculations as part of this FRA and are assumed to be calculated to the best practice guidelines.

Further to the attenuation storage, additional SuDs measures have incorporated into the design. This includes the implementation of green roofs to the apartment blocks covering a minimum of 60% of the roof area. Permeable paving has also been provided which has been designed to intercept the first 5mm of runoff.

To minimise the risk to the development, all finish floor levels, thresholds or basement entrances should be raised by 100mm from the surrounding hardstanding areas to risk of inundation.

4.5 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. The flood risk assessment identifies the following as the main sources of residual risk to the proposed development:

4.5.1 Climate Change

The impacts of climate change can result in more frequent flood event with a higher volumes of river flow. The potential residual risk to the development will need to be considered in this context.

The Carysfort-Maretimo Steam flood defences includes an allowance for climate change and freeboard. This will ensure that site will remain protected from the potential increase in the occurrence and magnitude of flood events due to climate change.

The 0.1% AEP flood event will result in inundation of up to 250mm in some areas of the site. For the purpose of the FRA, the 0.1% AEP is taken to represent the 1% AEP plus climate change scenario. The proposed mitigation measures have been designed to protection against these flood events.

4.5.2 Failure of the Carysfort-Maretimo Flood Alleviation Scheme

The Carysfort-Maretimo flood defences provide protection up to the 1% AEP flood event including an allowance for climate change. During a possible failure of the flood defence scheme, the resulting flood outlines would be expected to be similar to the current modelled CFRAM results for the 0.1% AEP flood event.

The proposed flood defence measures (refer to Section 4.2.1) have been designed to provide protection above the 0.1% AEP flood level. Therefore, if the flood defences were to fail, the basement car park will remain protected.

4.5.3 Failure of the Boundary Wall

Following review of Figure 4-1, failure of the boundary wall is not considered likely. However, in the event of a failure the flood extents would be expected to be similar to the CFRAM flood map outlines presented in Figure 3-3 and Figure 4-1. The access road to basement level has been raised by 400mm to provide a freeboard of 500mm over the 0.1% AEP flood levels if failure of the boundary wall was to occur.

5 The Justification Test for Development Management

5.1 Strategy

The planning guidance appropriate to this development is, "The Planning System and Flood Risk Management" and sets out a framework within which the planning authority should consider proposals for new development in areas of flood risk. This framework is called the Justification Test for Development Management.

Although the revised calculations confirm that the site is located in Flood Zone C, since the proposed development is classified as a highly vulnerable development and is located adjacent to Flood Zone A/B, a Justification Test (JT) is provided.

In the following text, each of the criteria within the JT is responded to as they relate to the proposed residential development. For ease of reading, where the responses are supported by technical detail which is contained in later parts of the report, an appropriate chapter has been referenced.

5.2 Justification Test: Part 1

The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the Planning Guidelines.

The DLR Development Plan 2016-2022 outlines the development strategy for the area. Zonal development maps have been produced including the development site. These are based on predictive flood mapping, historical flood event data and other indicative data sets such as benefiting land maps. The Development Plan shows the site to be zoned for residential. Objective A- To protect and-or improve residential amenity. There are a number of specific policies in relation to managing flood risks, which have been incorporated into the design recommendations.

Conclusion: The development Passes Part 1 of the Justification Test. The site is zoned as residential Objective A which aims to protect and/or improve residential amenity.

5.3 Justification Test: Part 2

The proposal has been subject to an appropriate flood risk assessment that demonstrates:

(i) the development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

As part of the FRA, calculation have been undertaken to confirm that the development is not located in a flood zone or will interact with a conveyance route. The site is defended from the 1% AEP flood event, and is located outside of Flood Zone C, therefore it will have no impact on these events.

Conclusion: The site is shown to be located in Flood Zone C, and is not at risk from the 1% and 0.1% AEP flood events. The site will not impact upon the Flood Zone A (1% AEP) event as it protected by the Carysfort-Maretimo flood defences.

(ii) the development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

The proposed FFL level for the residential apartments within Block A is 16.48mOD which provides a freeboard of 3.58m over the expected Flood Zone A/B flood levels. The basement carpark entrance will be protected from inundation by raising the entrance above the expected flood depths.

Conclusion: The residential dwellings within the site are all located with Flood Zone C. Flood risks to the basement carpark have been identified and mitigation measures proposed. The car park entrance will be raised by to provide a 400mm freeboard over the expected maximum flood depth.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.

Residual risk have been assessed for the site and have been considered regards the proposed mitigation measures. Access to the development is provided within Flood Zone C via Temple Road.

Conclusion: The proposed mitigation measures have been designed to provide flood protection from the identified residual risks. Site access to the development is provided for in Flood Zone C.

(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

See supporting planning application documents for details of the urban design.

6 Conclusion

JBA Consulting were commissioned by Oval Target Ltd to undertaken a Flood Risk Assessment (FRA) for a proposed residential development located along Temple Rd, Blackrock, Dublin.

Historical flood information was reviewed and confirmed that flooding occurred along Temple Road during October 2011. If inundation occurred at the site during this flood event, it would have likely been limited to the area alongside the site's northern boundary.

Review of the Eastern CFRAM and DLR SFRA flood maps indicates that the northern boundary of the site is within Flood Zone A (defended)/B. However, based on the site visit and provided calculations, it is confirmed that the development is not at risk from the 0.1% AEP flood event. Flood defences are located along the Carysfort-Maretimo and provides protection from a 1% AEP standard. The 0.1% AEP event will result in inundation of the access road, but floodwaters will be prevented from entering the site.

A single apartment block intersects the Flood Zone A/B outline. Residential apartments are restricted to the 1st floor level at 16.48mOD. The proposed basement / ground floor car park entrance is located in Flood Zone C, with a freeboard of 600mm above the estimated 1% AEP flood level. All residential properties onsite are located in Flood Zone C.

To mitigate against the identified flood risks, it is necessary to provide a barrier to the ingress of floodwater to the basement car park. This can be achieved by raising the proposed carpark entrance to provide a 400mm freeboard of over the expected 0.1% AEP flood level. The kerbs along the car park entrance should be set to a level of 12.95mOD. All openings to the basement in this area should be raised to a minimum of 400mm over the existing ground level.

A stormwater system has been designed to manage surface water runoff from the site. An attenuation tank is included as part of the design and has a storage capacity of 1,545m^3/s to retain a 100 year rainfall event, including a 20% allowance for climate change. Stormwater discharge will be limited to the site's greenfield equivalent of 8.17l/s. In addition, green roofs have been provided in the apartment blocks cover a minimum of 60% of the roof area, which will not be connected to the stormwater system. Permeable paving has also been provided.

Residual risks have been identified as potential increase in stream flow & frequency of flooding resulting from climate change and failure of the Carysfort-Maretimo flood defences. The proposed mitigation measures above are sufficient to protect the site from the identified residual risks.

As a result of the analysis, design and mitigation measures the proposed development is considered to be in line with the core principles of the Planning Guidelines and objectives outlined in the DLR Development Plan 2016-2022.

Appendices

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval, and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

Indicative Flood Zones (OPW & DoEHLG 2009)

A.3 Consequence of Flooding

Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

B Dun Laoghaire-Rathdown Development Plan 2016-2022

B.1.1 Flood Management Policies

Policy El3: Surface Water Drainage and Appropriate Assessment It is Council policy to require that a Sustainable Drainage System (SuDS) is applied to any development and that site specific solutions to surface water drainage systems are developed, which meet the requirements of the Water Framework Directive and the associated River Basin Management Plans and 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document.

5.2.5.2 Policy CC15: Flood Risk Management. It is Council policy to support, in cooperation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks, the Flood Risk Regulations (SI No 122 of 2010) and the Department of the Environment, Heritage and Local Government and the Office of Public Works Guidelines on 'The Planning System and Flood Risk Management, (2009)' and relevant outputs of the Eastern District Catchment and Flood Risk Assessment and Management Study (ECFRAMS Study).

The Council will ensure the implementation of the DoEHLG/OPW Guidelines 'The Planning System and Flood Risk Management', (2009) and DoECLG Circular Pl2/2014 (or any updated/superseded document) in relation to flood risk management within the County. A Strategic Flood Risk Assessment of the County has been carried out as part of this County Development Plan process (Refer to Appendix 13). Implementation of the Guidelines will include the following:

- Avoid, reduce and/or mitigate, as appropriate, in accordance with the Flood Risk Management Guidelines, the risk of flooding within the flood risk areas indicated in the ECFRAM study and the Strategic Flood Risk Assessment of the County and any other flood risk areas that may be identified during the period of the Plan or in relation to a planning application (Refer to Section 6 of Appendix 13).
- Development proposals in areas where there is an identified or potential risk of flooding or that could give rise to a risk of flooding elsewhere must be accompanied by a Site-specific Flood Risk Assessment, and Justification Test where appropriate, (Refer to Development Management section 8.2.10.4 and Appendix 13 SFRA for further detail).
- Development that would be subject to an inappropriate risk of flooding or that would cause or exacerbate such a risk at other locations shall not normally be permitted.
- Where certain measures proposed to mitigate or manage the risk of flooding associated with new developments are likely to result in significant effects to the environment or European sites downstream, such measures will undergo environmental assessment and Habitats Directive Assessment, as appropriate.
- Flood Risk Management and Strategic Flood Risk Assessment (SFRA) shall be incorporated into the preparation of all Local Area Plans and any other lower tier plans.
- Regard shall be had to any future flood hazard maps, flood risk maps and flood risk management plans prepared as part of the Eastern District Catchment Flood Risk Assessment and Management Study and future iterations of other similar studies of impacts of climate change.
- Where flood protection or alleviation works take place the Council will ensure that the natural and cultural heritage and rivers, streams and watercourses are protected and enhanced.

- Existing wetland Habitats within the County which serve as flood protection/management measures shall be managed and enhanced.
- The Council will also require that all proposed flood protection or alleviation works will be subject to Appropriate Assessment (AA) to ensure there are no likely significant effects on the integrity, defined by the structure and function, of any Natura 2000 sites and that the requirements of Article 6 of the EU Habitats Directive are met.

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Appendix I – JBA – Surface Water Audit

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2019s0083
Contract	St. Teresa's Lands, Temple Hill, Monkstown, Blackrock, Co. Dublin
Client	JJ Campbell & Associates
Date	14 November 2021 – Rev 6.0
Author	Chris Wason
Subject	**Stormwater Audit - Stage 1 Report**

1 St. Teresa's Lands, Temple Hill, Monkstown, Blackrock, Co. Dublin.

1.1 Introduction

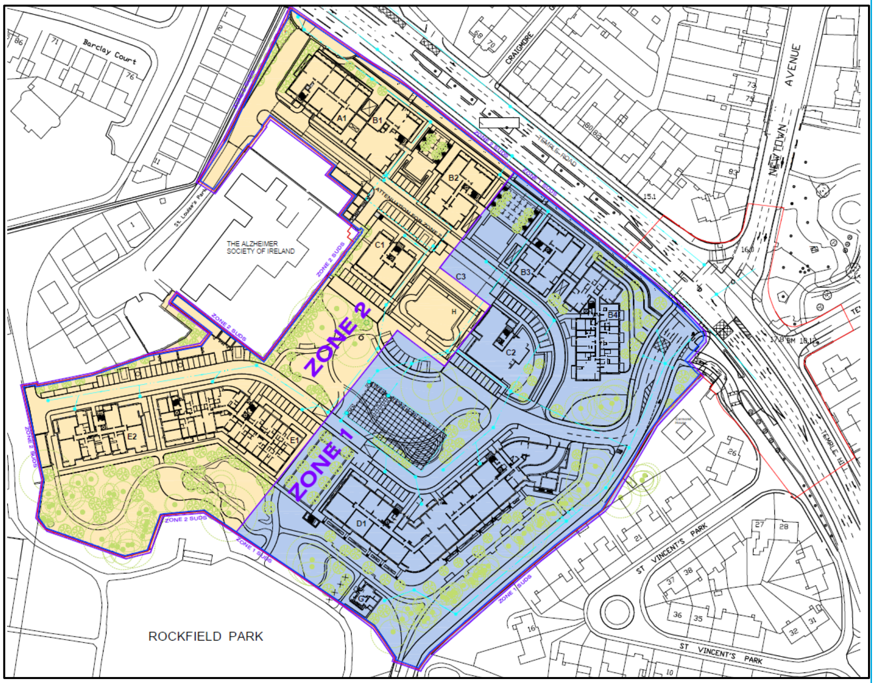
JBA have been engaged for the purposes of undertaking a Stage 1 SW Audit relating to the above development on proposals developed by JJ Campbell and Associates (JJC) for a planning application on behalf of Oval Target Limited.

The application concerns the demolition of some existing buildings and to convert St. Teresa's House into 2 & 3 bedroom apartments. In addition, 11 apartment blocks and basement car parking will be constructed to provide a total of 487 apartments. The site location is shown in Figure 1-1 below.

Figure 1-1 - Site Location – Aerial Photo taken before buildings were demolished

The audit has been completed in accordance with Dún Laoghaire Rathdown County Council's (DLRCC) Stormwater Audit Procedure (Rev 0, Jan 2012). The results of the audit are set out in the table below.

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The subject site is located within Dun Laoghaire County Development Plan 2016-2022 and is a mature site with existing buildings and associated infrastructure. The site is approximately 3.9 ha. in total, comprising a drained area of 2.1189 ha. The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development. The review is based on JJ Campbell Planning Report Rev 1, dated September 2021, and associated drawings as provided on 17 September 2021. It is proposed that site is split into two zones for SW drainage purposes as shown below 
Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • Greater Dublin Strategic Drainage Strategy (GDSDS) • Greater Dublin Regional Code of Practice for Drainage Works • The SUDs Manual (CIRIA C753) - 2015 • DLR County Development Plan 2016-2022
Key Considerations & Benefits of SUDs	The key benefits and objectives of SUDs considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.

Site Characteristics

Soil:
13 nr. soil infiltration tests were undertaken by Ground investigations Ireland. Approximately 50% passed with infiltration rates ranging from 1.824x10-5 to 2.506x10-6 m/s, and 50% failed. Generally, the eastern side of the site seemed to fair better in the infiltration tests. The UKSuds web site tool gives a value of SOIL type 4.

On the basis of the soil tests undertaken JJC have taken a SOIL value of 3 (SPR of 0.37) as being more representative of the site which seems reasonable. This would imply that the site has some ability to infiltrate runoff to ground in some areas.

Rainfall (basis for surface water pipeline network design):
Rainfall parameters can be estimated using Met Éireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Éireann method can be more representative of a site if selected correctly and this has been done by JJC. A comparison of values used by JJC and those estimated by JBA is shown below:

	JJ Campbell	**JBA Value**
Rainfall model:	Windes	Met Éireann
M5-60 (mm):	17	16.6
Ratio R:	0.3	0.275

Taken from Met Eireann data (E 321811;N 229008)
The values adopted in the Windes model are rounded up into the appropriate 'zone' and as recommended by the UKSuds site and are acceptable

JJC have increased the increased rainfall rates and storage requirement by 20% to allow for climate change in the hydraulic calculations. 10% is recommended in the GDSDS for rainfall so this is acceptable.

Qbar
From the UKSuds website the SAAR value is 900mm and for an edited value of SOIL of 3, the Qbar is 8.17 l/s

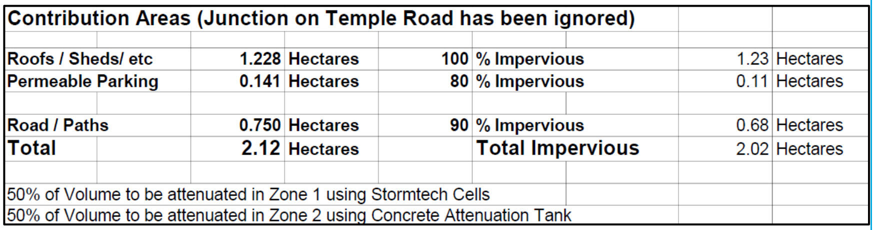
Values taken from the WWW.uksuds.com website – SAAR 900; SOIL 3 (SPR 0.37) for the site location.

Adopting the above values gives for the site south of the stream, based on 2.119 ha, the nett area of the site as required by DLRCC (see drg. 2011-07/C3);

	JJC edited value	**uksuds Default Value**
Qbar (l/s)	8.17	13.73
Q30		29.24
Q100		35.83

JJC have therefore taken a more conservative value which is acceptable.

Contributing Areas (as extracted from App D of the Planning Report)



Contribution Areas (Junction on Temple Road has been ignored)						
Roofs / Sheds/ etc	**1.228**	**Hectares**	**100**	**% Impervious**	1.23	Hectares
Permeable Parking	**0.141**	**Hectares**	**80**	**% Impervious**	0.11	Hectares
Road / Paths	**0.750**	**Hectares**	**90**	**% Impervious**	0.68	Hectares
Total	**2.12**	**Hectares**		**Total Impervious**	2.02	Hectares
50% of Volume to be attenuated in Zone 1 using Stormtech Cells						
50% of Volume to be attenuated in Zone 2 using Concrete Attenuation Tank						

Green roof area = 0.3935 ha. Providing a % of 64% which is greater than that required by DLRCC.

Drainage Calculations

A previous development layout and pre-planning report provided Microdrainage calculations for the storm network only and the storage has been assessed separately on a spreadsheet. Causeway FLOW calculations have been submitted for the revised scheme.

Although a one-hundred year storm has been used for pipe design purposes, the maximum rainfall was set at 50 mm/hr. We would normally recommend a two (or 5) year return period for design and the network checked for up to 100 year storm for flooding. Pipe sizing is not normally critical when a restricted out fall (Qbar) is applied.

Full calculations, including the storage facilities in the model, have been run for the 1 in 30 and a1 in 100 year storms + 20% climate change to ensure that adequate levels of service are achieved.

Storage Tank Assessment

Initial storage tank analysis has been done on a spreadsheet for the whole of the site and split into two equal tanks for Zone 1 and Zone 2. A total allowable outflow of 8.17 l/s has been used and a total storage required of 1600m3 (including 20% climate change) based on local rainfall data.

The tanks have been checked using FLOW
A stormtech SC740 system is proposed in Zone 1 (735 m3 and design head of 1.4m) and a RC tank under the road and adjacent to building B2 in Zone 2 (772m3 and design head of 2.166m) both with pass forward flow of 4.1 l/s. An allowance of 20% climate change has also been included in the latest assessment (v1.7).

We have the following comments on the proposals;

1. The spreadsheet, for initial sizing, assumes a constant discharge of 8.17 l/s which does not take into account a varying head/discharge relationship. The GDSDS recommends that volume should be increased by 20-30% to allow for this and a check done using a digital model at detailed design stage. However, the tanks have also been checked and designed in FLOW hydraulic model.
2. The head adopted is 1.4m for Zone 1 and 2.11m in zone 2 in the report with pass forward each of 4.1 l/s (8.2 l/s in total). The hydrobrake details provided in Appendix G provided an orifice size of 90mm and 82mm respectively which are considered adequate.
3. It is noted that Zone 2 discharges to the Carysfort stream/culvert. The 1% AEP is indicated in the FRA as 12.75m. This would mean the that the outfall could be surcharged which would affect the discharge rate and tank performance. These parameters should be checked by JJC.
4. It is noted that Zone 1 discharges to an existing DN225 public SW sewer (at Mh 9002) on Temple Hill Road, IL 12.77mm. This line could

<table>
<tr><td></td><td>also be subject to surcharge in times of flood and the tank design should be checked by JJC.
5. Are there any groundwater concerns for the stormtech unit? If GW is within 1m of the base then the unit may need to be lined to protect GW</td></tr>
<tr><td>SuDS Measures Considered</td><td>
<table>
<tr><th>SuDS Technology</th><th>Comments</th></tr>
<tr><td>Green Roofs</td><td>Proposed on all apartment blocks, even those <300m2. Overall green roof coverage exceeds the 60% requirement of DLRCC.
Total roof area on drg C11 = 6090m2 of which 3935m2 is green (65%)</td></tr>
<tr><td>Swale/ Filter Drain / Infiltration trench</td><td>Swales were considered but discounted due to the number of mature trees and possible damage to roots. Road runoff is directed into the landscaped areas except for 2 key low points. It is assumed that filter drains will be used where required for main drain runs. Detail to be provided</td></tr>
<tr><td>Permeable Paving</td><td>Proposed to intercept all impermeable areas of the site but not clear how this is achieved. Relative impermeability has been assumed. It is likely that that some infiltration will take place in some areas.
350mm is stated of stone subbase with 30% porosity. Due to the poor infiltration of the ground a high-level overflow is proposed. Is it assumed that the area below this pipe is available for interception of flow?</td></tr>
<tr><td>Soakaways</td><td>No soakaways are proposed. They could be considered in more suitable areas</td></tr>
<tr><td>Petrol Interceptor</td><td>None proposed. These should be considered where road/car park runoff is collected before discharge to the stream, or to the foul network in the case of underground car park drainage.</td></tr>
<tr><td>Other Sediment Management</td><td>Generally, road runoff to landscaped areas. No details shown of how runoff will be intercepted</td></tr>
<tr><td>Surface Water Attenuation</td><td>Attenuation will be provided by way of;
A. Green roofs – 5mm interception
B. Permeable paving – 5mm interception
C. Underground storage tanks
a. Tank 2 is an RC tank due to site constraints. RC tanks are generally not preferred. LA approval will be required.
b. Tank 1 is a Stormtech or similar unit.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Rain water harvesting</td><td>None proposed</td></tr>
<tr><td>Detention Basins, Retention Ponds, Stormwater Wetlands</td><td>No detention basins are proposed due to site geometry.</td></tr>
<tr><td>Tree Root Structural Cell Systems, Bio-retention.</td><td>None proposed. Could structural cell systems be considered for new trees?</td></tr>
</table>
</td></tr>
</table>

Interception of flow	It is a requirement of the GDSDS that a minimum of 5mm of runoff is intercepted i.e. is retained on site. This will apply to non-green roof areas and all other impermeable areas. The GDSDS allows for 80% paved and 0% permeable. CIRIA 753 Table 24.6 provided deemed to satisfy rules. The full extent of permeable paving and the contributing areas should be clarified as table 24.6 considers that only an equivalent area can be considered for interception storage for unlined pavement if infiltration capacity >1x10-6 m/s. If less, then up to 5 times the pavement area can be considered as extra contributing area. Green roofs are deemed to satisfy. JJC have provided an overall calculation for volume stored in permeable paving and green roofs but these calculations do not necessarily apply to interception of flow from all impermeable area. Also, it needs to be clear if all impermeable areas are intercepted not just a gross figure. It is not clear how the non-green roof areas are intercepted. The impermeable roof area, not counting the green roof area = (6090 - 3935) = 2155m2. Paved area excluding permeable paving = 7500m2 of which 2300m2 are paths and generally assumed to discharge to landscaped areas Impermeable area to be intercepted = (2155+5200) x0.8 = 5884m2. Permeable paving = 1200m2 therefore an additional 1200m2 can be deemed or 6000m2 if in areas with good permeability. How are all areas to be intercepted? JJC should clarify that the interception of flow satisfies the CIRIA report requirements.
Surface Water Drainage Design	The design is at planning stage and detailed design has been provided; • The site is split into two zones for drainage purposes • The discharge from tank 2 will be connected to the existing stream/culvert in the northeast corner of the site • The discharge from tank 1 will be to an existing Mh9002 located on a DN225 public sewer. • Underground car park drainage is shown connected to the foul system via a Petrol interceptor • Green roofs are proposed • SI indicated relatively poor drainage but may be acceptable in some local area. High level overflows are proposed in the permeable paving
SuDS Management Train for water quality and flood protection	The SuDs philosophy, as set out in the GDSDS, has been given consideration and, in particular, the criteria set out in Figure 6.1 of the manual. Criterion 1.1 – interception of first 5mm of rainfall – see comments above Criterion 1.2 – treatment volume of events larger than 5mm i.e. 10mm rainfall Criterion 3 – no flooding predicted for 30-year storm and no property flooding for 100 year storm. Hydraulic analysis has been undertaken. Criterion 4.3 is used for all attenuation storage Qbar pass forward flow is used for control split equally between the two tanks
Climate Change	An allowance of 20% increase in flows has been included for climate change in the latest model for the rainfall intensities for the purposes of sizing the attenuation storage in FLOW. 20% was used for initial sizing in the spreadsheet. This adequately addresses the recommendation of 10% increase for rainfall as set out in table 6.2 of the GDSDS.
Discharge Rate / Flow Control	Flow control from each tank is 4.1 l/s at a head of 1.4m & 2.11m. Outlet diameter is approximately 90mm and 83mm which is ok.

Exceedance flows	Consideration has been given to exceedance flow.
Health & Safety and Maintenance Issues	The proposed drainage system comprises SuDS devices, green roofs, traditional road gullies, manholes, attenuation systems and underground pipes. These elements, with the level of detail provided, are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. At detailed design stage, it is recommended that a maintenance regime be adopted. Particular consideration is required at detailed design stage to the design, maintenance requirements and whole life plan (and replacement) of the SuDS system as a whole. Regular maintenance of the hydrobrake will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. A bypass mechanism should be provided in case of blockage and some form of alarm for notification of same to the maintenance organisation responsible. Petrol interceptors have been provided in u/g car park areas. These should be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance is recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.
Audit Result	Please refer to the Feedback Form attached for comments and designers responses

Audit Report prepared by:	Chris Wason BEng, CEng MICE Principal Engineer
Approved by:	Michael O'Donoghue BEng CEng MIEI Senior Engineer

Note:*JBA Consulting Engineers & Scientists Ltd. role on this project is as an independent reviewer/auditor. JBA Consulting Engineers & Scientists hold no design responsibility on this project. All issues raised and comments made by JBA are for the consideration of the Design Engineer. Final design, construction supervision, with sign-off and/or commissioning of the surface water system so that the final product is fit for purpose with a suitable design, capacity and life-span, remains the responsibility of the Design Engineers.*

Appendix A – Audit Feedback Form

JBA Consulting Stormwater Audit Stage 1 - Rev 1

Project:	Residential Development at St Teres's, Temple Hill Rd, Blackrock
Project Nr.	2019s0083
Date:	22/09/2021
JBA Reviewers	Chris Wason - Principal Engineer

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
Date:	22/09/2021	22/09/2021		
	Information Provided **C1 - Existing Site C1 - Existing Site Plan.pdf** **C11 - Roof Areas.pdf** **C13 - Foul Discharge.pdf** **C14 - Diversion manhole details.pdf** **C15 - Diversion manhole details.pdf** **C2-0 - Foul and Surface Water - A0.pdf** **C2-1 - Foul and Surface Water.pdf** **C2-10- Foul Long Section.pdf** **C2-11 - Combined Long Section.pdf** **C2-2 - Foul and Surface Water.pdf** **C2-3 - Foul and Surface Water.pdf** **C2-4 - Foul and Surface Water.pdf** **C2-5 - Foul and Surface Water.pdf** **C2-6 - Foul and Surface Water.pdf** **C2-7 - Foul and Surface Water.pdf** **C2-9 - Storm Long Section.pdf** **C3 - Qbar.pdf** **C5 - Tree Root Protection.pdf** **C6-1 - Suds Zone.pdf** **C6-2 - Zone 1 Attenuation.pdf** **C6-3 - Zone 2 Attenuation.pdf** **D1 - Demolition Plan.pdf** **Development Description.docx** **F1-1 - Flood Directions Site Plan.pdf** **F1-2 - Flood Return Period.pdf** **G01 - Water Main Layout.pdf** **Planning Report - Vol 1.pdf** **Si-1 - Soakaway Tests.pdf Plan.pdf**			
	General			
1	Microdrainage Calculation Microdrainage calculations were not provided but they appear to be similar those previously reviewed at Pre planning stage which were designed on 100 year storm return but maximum 50mm/hr rainfall. Tanks were not sized in the model and no simulation runs carried out	A full design including the tank configurations and simulation runs for the 30 and 100 year storms should be provided to ensure that the required levels of service are achieved	**Updated Causeway calculations issued on the 27.09.21**	**Accepted**
2	Attenuation tanks 1 - The spreadsheet used for the storage calculation uses a fixed discharge head. GDSDS recommends that the volume should be increased by 20-30% to allow for a varying head relationship although it is acknowledged that the spreadsheet uses locally derived rainfall which is greater than that generated by the model and little difference in volume may be the result. 2 - the 100 year flood level would indicate that the flow controls and outfalls may be surcharged. 3 - the flow control head adopted for tank 1 is 1.4m and that for tank 2 is 3m in the report and drawings with pass forward flow of 4.65 l/s. The details provided in the Appendix do not tally with the proposals 4 - no details of groundwater are provided 5 - pg. 14 Qbar of 11.63 l/s should be corrected to 9.35 l/s	The tanks sizing should be confirmed at detailed design stage in the Hydraulic model. Should the the storage units and flow controls should be checked against a surcharged head? Ensure the details provided match the proposals and that TWL level on tank as shown in the drawing is as proposed. Ensure that all reporrts drawings are coordinated. Does GW affect the stormtech tank? should it be lined to protect GW? JJC to correct or clarify	**Tanks have been sized using local rainfall data which is greater than that generated by the model** **Both tanks volume includes a 20% increase in volume for climate change.** **Stormtech Tank in Zone 1 has an additional 0.6m layer of angular stone giving an additional storage volume of 100m^3** **Concrete Tank in Zone 2 has a free bore of 0.95m which gives an additional 370m^3 storage.** **Both tanks have additional storage of at least 20% for climate change and an additional 100m^3 in the Stormtch Tank and 370m^3 in the concrete tank.** **Heads have been co-ordinated on the drawings, report and hydro-Internationl design calculations.** **Trail hole has been dug to formation and left open at the Stormtech locations, no water ingress, see response to queries from DLRCoCo** **Qbar has been amended.**	**Accepted** tanks have been modelled in FLOW - No Flood 100 yr +10% CC. A final check against possible surcharge should be made in FLOW at detailed design stage. No response provided. For DLRCC to comment

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
3	Filter drains The full extent of the drainage network has not yet been fully designed and detailed. Consideration could be given for the use of filter drains where possible.	the use of filter drains/trenches will assist in the interception of runoff and could be considered in the detail design phase . Can consideration could be given to soakaways in some areas of the site where ground conditions are more suitable?	We will review the use of filter drains at detailed design stage. The mature trees being retained make the wide spread use of filter drains difficult. Similar issue arise with the traditional pipe drainage which had to be designed to avoid the heavily rooted areas. Infiltration tests indicate that the site is not suitable for soakaways.	Accepted
4	Interception and treatment interception of 5mm run off is proposed but this is via a total storage capacity calculation which does not show that each impermeable area is intercepted and compliant with CIRIA 753 table 24.6. Is it assumed that the volume beneath any overflow pipe in the permeable paving is available for interception of flow? green roofs are deemed to satisfy but how are non green roofs intercepted.	JJC to clarify how all areas are intercepted for 5mm of run off and compliance with table 24.6 of CIRIA 753. JJC to clarify and provide calculations if necessary to show areas intercepted JJC to clarify	Interception storage is split up into two separate zones, Z1 and Z2 and is split 50/50. See drawing C7 for clarification Volume below interception storage is available for interception flow. Areas are shown on drawing C7 All new building have green roofs, min 60%. Existing St Catherines Hosue has no green roof but the roof area is 330m², which is only 0.8% of the overall area of the site. The existing Gate Lodge roof will discharge to the new extesnion roof to the rear of the gate lodge, which is a green roof	Not Acceptable (see note 7) See 7 below
5	Basement Drainage No details of basement drainage provided.	Details should be provided at detailed design stage. Please confirm if basement drainage is to go to the foul network and if a PI will be used	Basement drainge drawings C4-1 and C4-1 were issued on the 27.09.21	Accepted
6	Other SuDs measures possible use of tree pits where new trees are to be introduced	Consider using tree pits for new trees if they are to bring any additional benefits.	To be investigated with Mitchell and Associates (Landscape Architects)	Accepted
	12/10/2021			08/11/2021
7	Interception of 5mm is required from all impermeable surfacing. A high level of interception provided in some area does not compensate for no interception in other areas. A total volume calculation of the site interception does not demonstrate how all areas are adequatelky intercepted in accordance with guidance given in Table 24.7 of the CIRIA manual	JJC to demonstarate how ALL areas are adequately intercepted and in accordance with guidance given in table 24.7. Green roofs are deemed to satisfy for the area covered. It is not clear from table 24.7 if non green roofs can also be considered to contribute to green roofs and JJC should eleborate on this aspect and/or seek LA approval.	See updated Interception Drawing C7. Interception is broken in Z1 and Z2, roughly 43% / 57% in each Zone. Interception within Zones 1 and Zone 2 is broken down into a further 13 zones. Direction of flow from paved areas into Interception with the 13 zones is shown on drawing C7. Because of mature trees the widespread use of Swales / Infiltration trenches was examined but could not be implemented but swales / infiltarion trenches have been intoduced where they do not damage existing mature trees, see C7 and C2.	Accepted (see revised Planning Report. Non-green roofs to discharge to green roof element)

Appendix J – Irish Water– Confirmation of Feasibility

A pre-connection enquiry for 521 units was made to IW - Confirmation of Feasibility for 521 units was received from IW on 10th June 2020. Units in scheme has been reduced to 493.

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

Lisa Rocca
Oval Target Ltd
First Floor
55 Percy Place
Dublin 4
D04E1W7

10 June 2020

Dear Lisa Rocca,

Re: Connection Reference No CDS20002536 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 521 unit(s) at St Teresa's Lands, Templehill, Blackrock, Co. Dublin

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at St Teresa's Lands, Templehill, Blackrock, Co. Dublin.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the networks, 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 networks can be facilitated.

Water:

New connection to the existing network is feasible without upgrade.

Connection should be via a new 200mm ID pipe main to be laid to connect the site development to the existing 400mm DI main and a bulk meter to be installed on the connection main. This meter will be connected up to telemetry online.

A secondary connection main of 200mm ID pipe main may be laid to connect the site development to the existing 150mm DI main. For resilience purposes, so a control valve should be present on this connection main and set to closed during normal operations.

This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water cannot guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you may need to provide adequate fire storage capacity within your development.

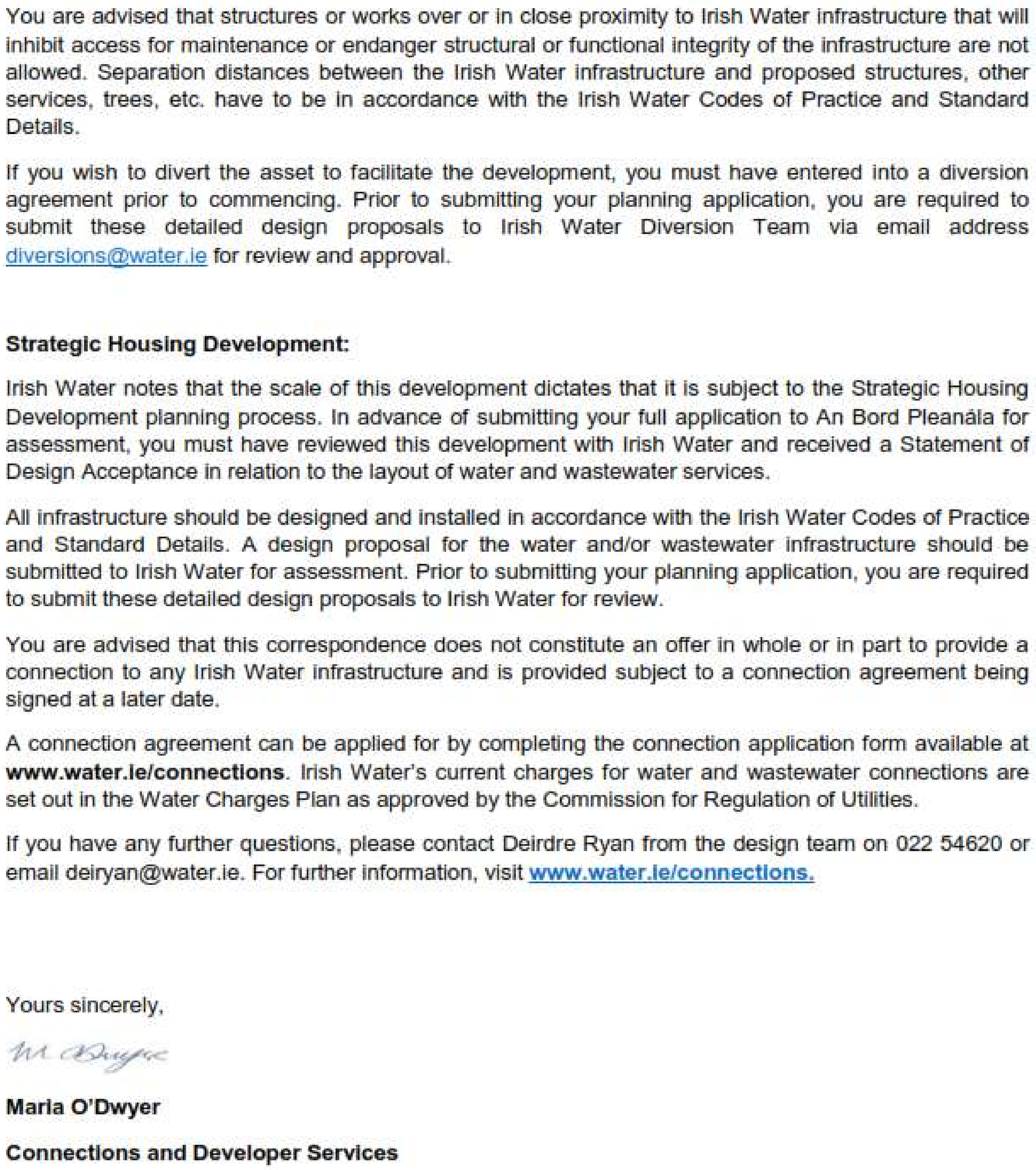
In order to determine the potential flow that could be delivered during normal operational conditions, an onsite assessment of the existing network is required.

Wastewater:

New connection to the existing network is feasible without upgrade.

There are Irish Water pipes within and in close proximity of the site boundaries. The Developer will be required to survey the site to determine the exact location of the pipes. Any trial investigations should be carried out with the agreement and in the presence of the Local Authority Inspector.

Stiúrthóirí / Directors: Cathal Marley (Chairman), Niall Gleeson, Eamon Gallen, Yvonne Harris, Brendan Murphy, Maria O'Dwyer
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



You are advised that structures or works over or in close proximity to Irish Water infrastructure that will inhibit access for maintenance or endanger structural or functional integrity of the infrastructure are not allowed. Separation distances between the Irish Water infrastructure and proposed structures, other services, trees, etc. have to be in accordance with the Irish Water Codes of Practice and Standard Details.

If you wish to divert the asset to facilitate the development, you must have entered into a diversion agreement prior to commencing. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water Diversion Team via email address diversions@water.ie for review and approval.

Strategic Housing Development:

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

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

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

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

If you have any further questions, please contact Deirdre Ryan from the design team on 022 54620 or email deiryan@water.ie. For further information, visit **www.water.ie/connections.**

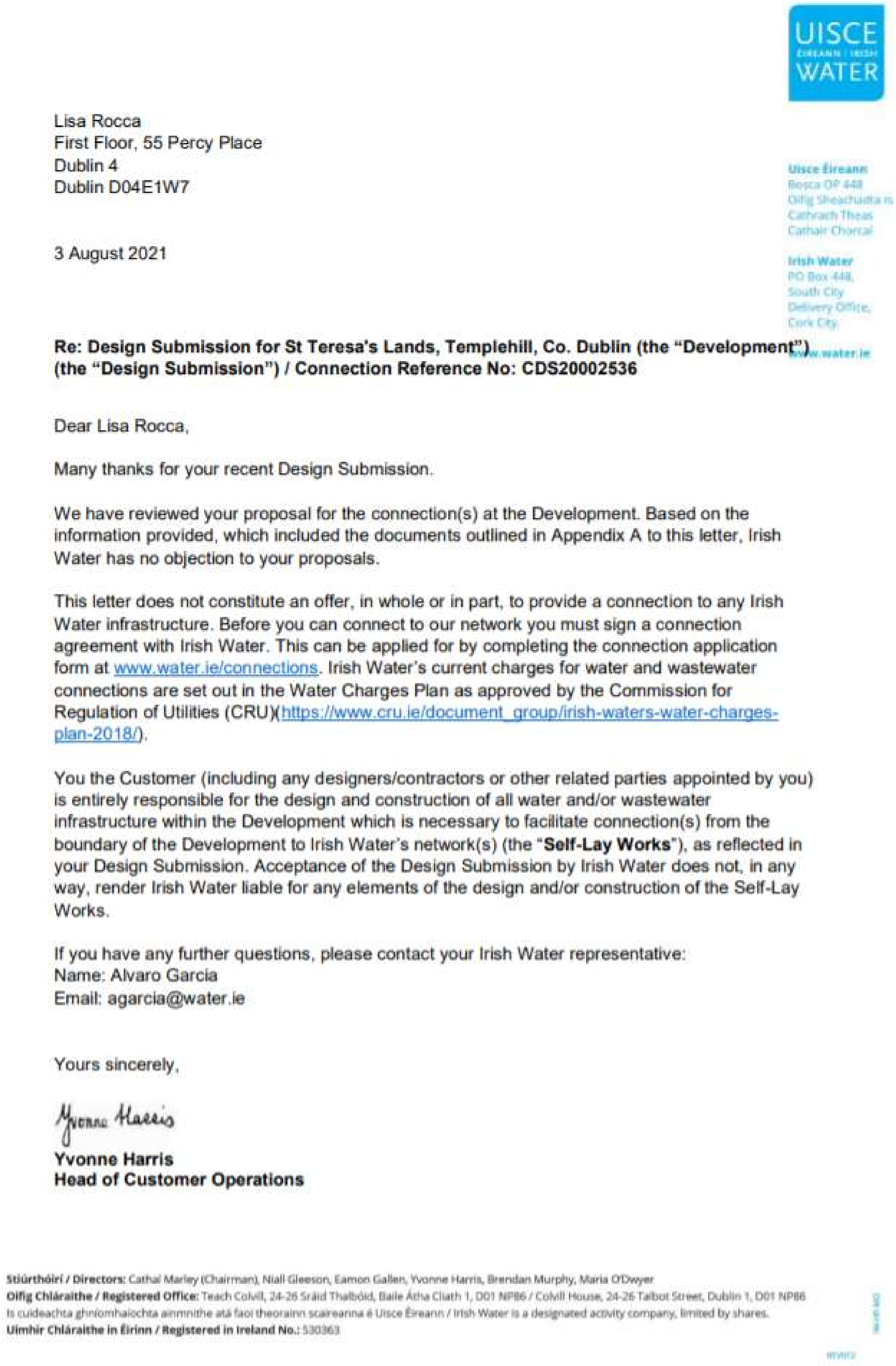
Yours sincerely,

M O'Dwyer

Maria O'Dwyer

Connections and Developer Services

Appendix K – Irish Water– Statement of Design Acceptance



UISCE ÉIREANN / IRISH WATER

Lisa Rocca
First Floor, 55 Percy Place
Dublin 4
Dublin D04E1W7

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

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

www.water.ie

3 August 2021

Re: Design Submission for St Teresa's Lands, Templehill, Co. Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS20002536

Dear Lisa Rocca,

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.

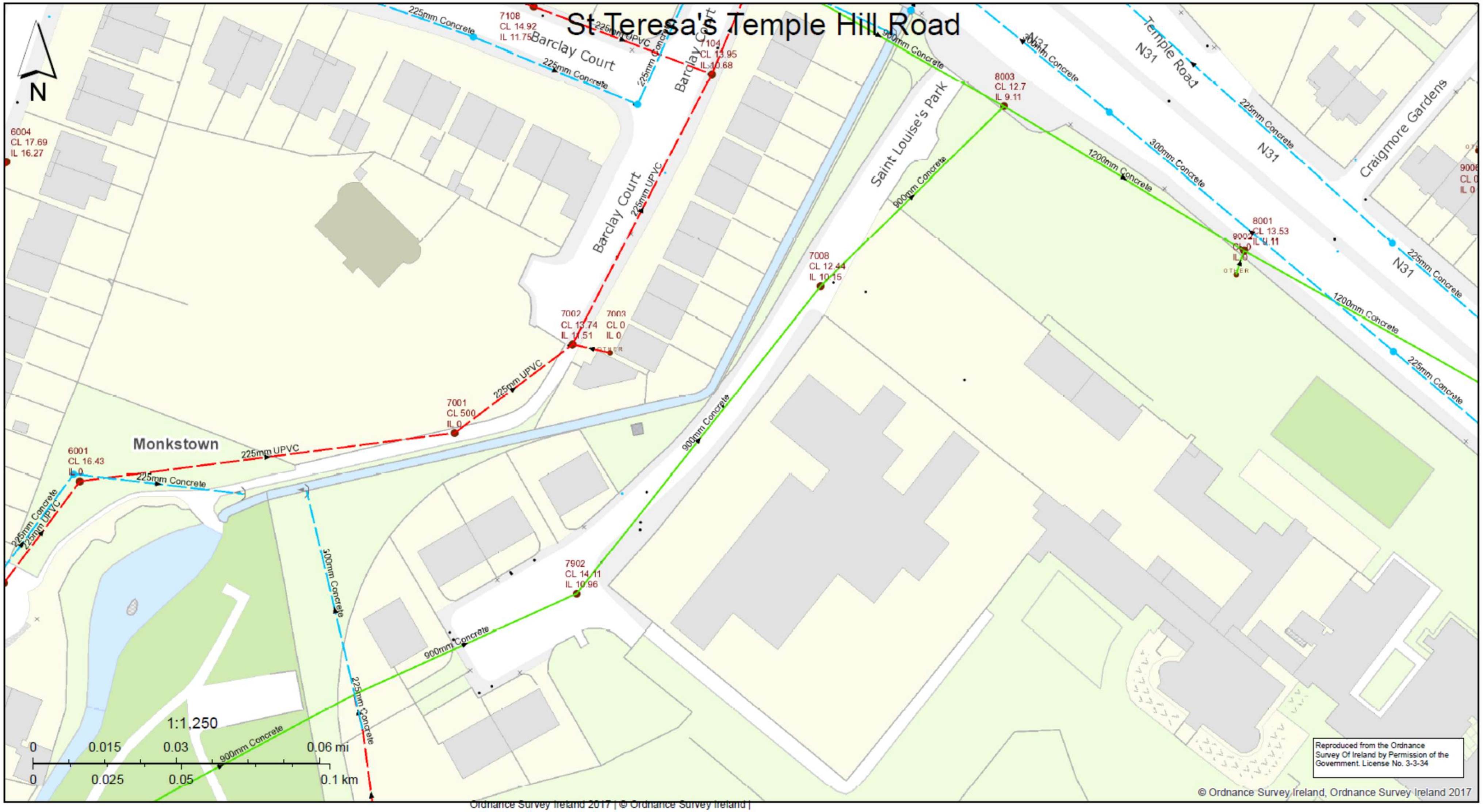
If you have any further questions, please contact your Irish Water representative:
Name: Alvaro Garcia
Email: agarcia@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix L – Irish Water Drawings, 4 Number Drawings



1/16/2018 2:46:40 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

UISCE ÉIREANN : IRISH WATER

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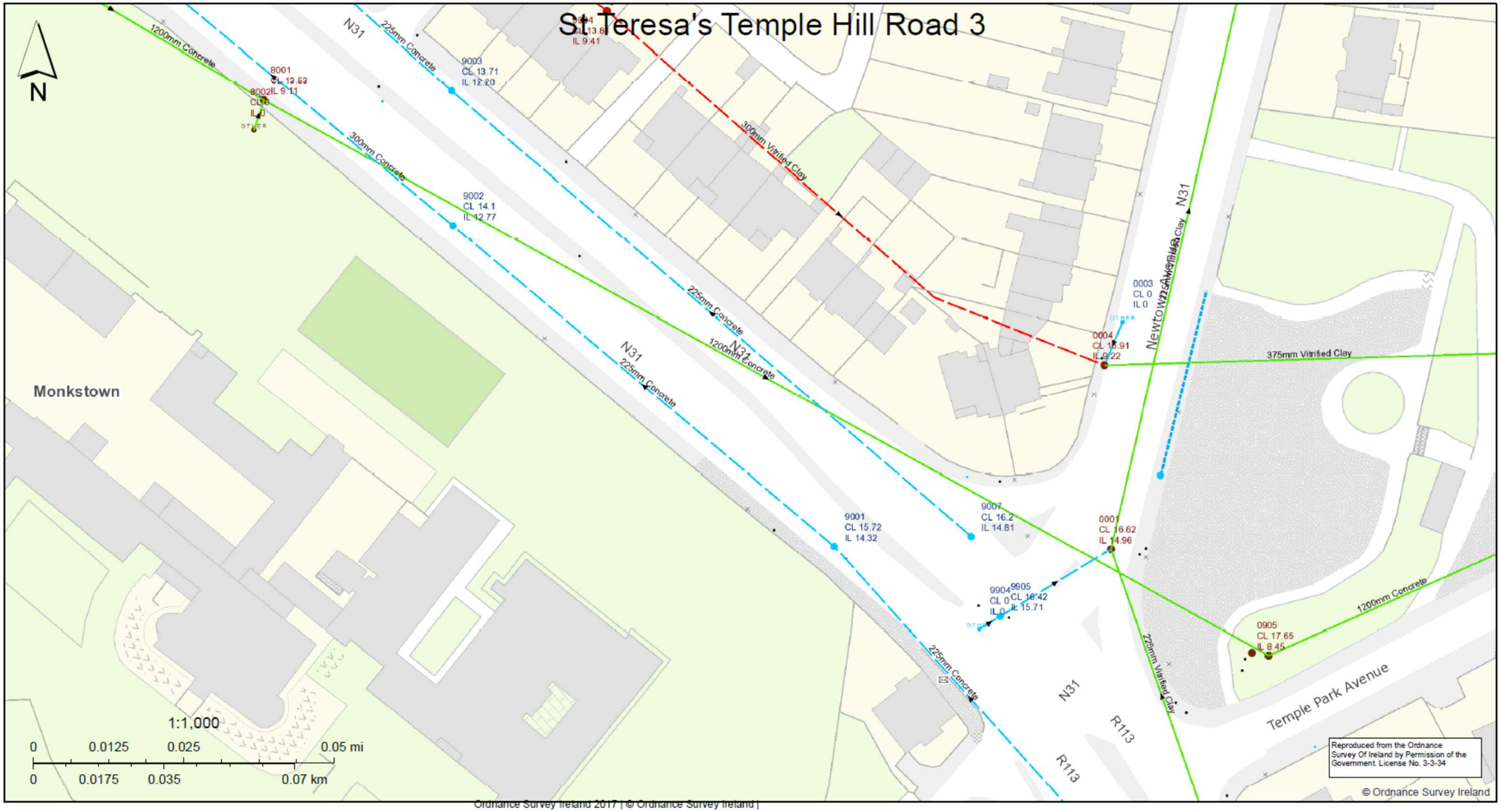
St Teresa's Temple Hill Road 3



1/16/2018 2:56:50 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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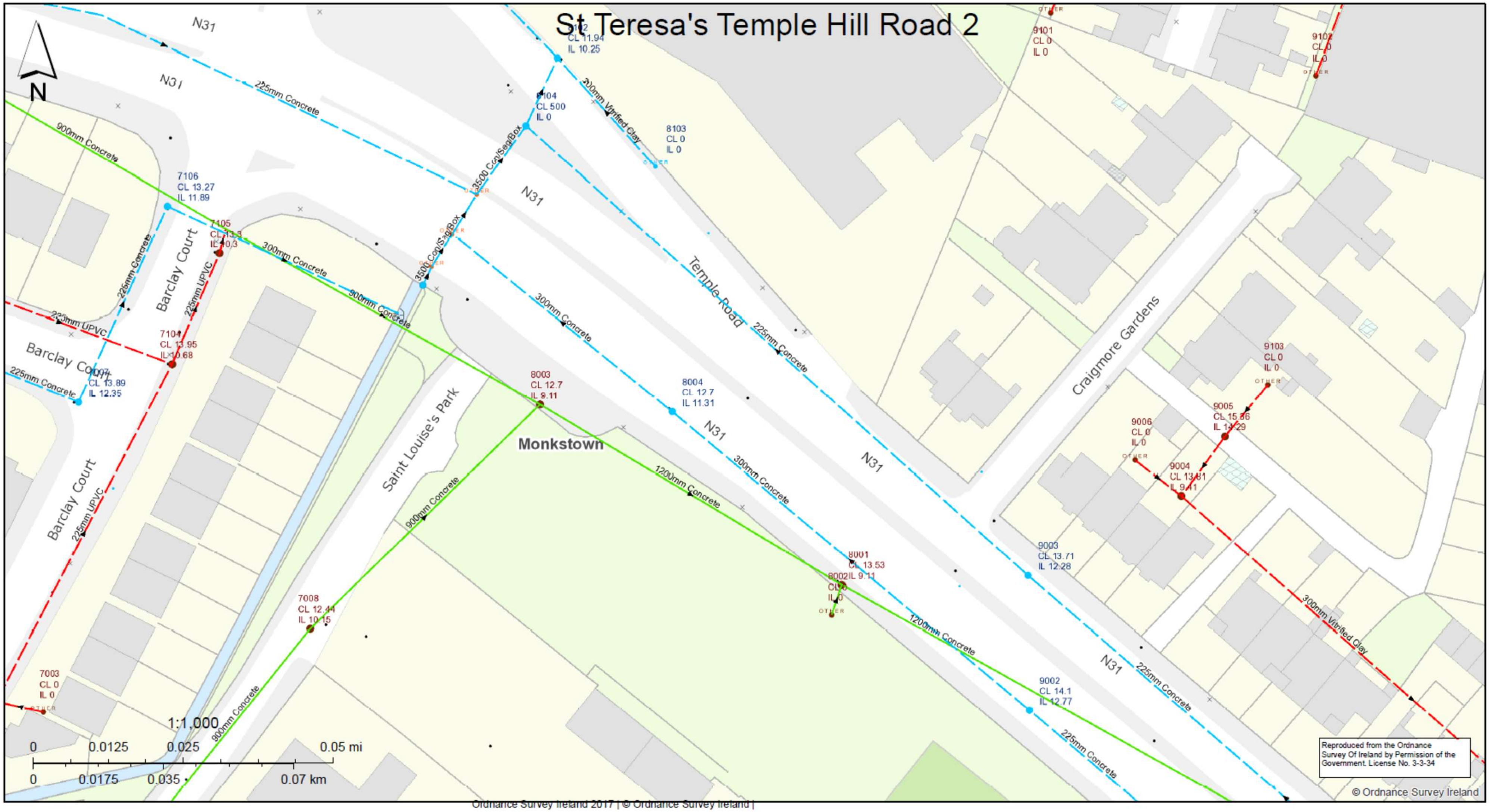
St Teresa's Temple Hill Road 2



1/16/2018 2:50:13 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

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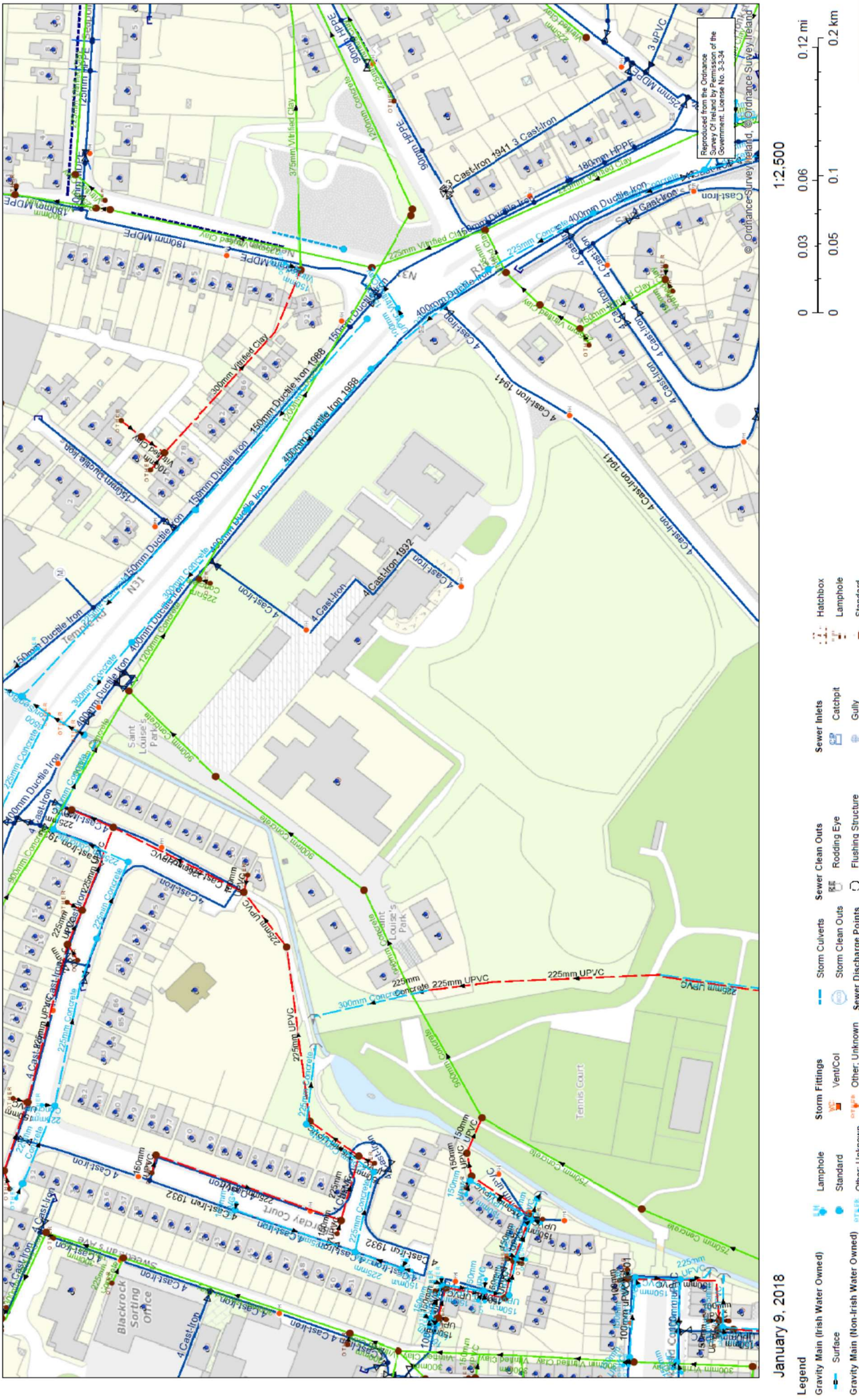
Temple Hill Area Overview



Appendix M – Site Investigation Reports

Ground Investigations Ireland Ltd.,
Catherinestown House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Ground Investigations Ireland

St Teres'a Lands Temple Hill, Monkstown, Blackrock, Co Dublin

Ground Investigation Report

DOCUMENT CONTROL SHEET

Project Title	St Teresa'sLands Temple Hill, Monkstown, blackrock, Co Dublin
Engineer	JJ Campbell & Associates
Project No	7405-01-18
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
0	Draft	J Cashen	A McDonnell	A McDonnell	Dublin	22 February 2018

CONTENTS

APPENDICES

1.0 Preamble

On the instructions of JJ Campbell & Associates, a site investigation was carried out by Ground Investigations Ireland Ltd., in February 2018 at the site of the proposed residential development at St Teresa's Lands, Monkstown, Blackrock, Co Dublin.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently occupied by a convent and is situated in Blackrock, Co. Dublin. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 13 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising’s upon completion. The soakaway test results are provided in Appendix 2, with associated photographs in Appendix 3 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil
- Made Ground or Cohesive Deposits

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.20m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil in DS01A and SS01. These deposits were described generally as *brown slightly gravelly sandy CLAY with occasional cobbles and contained occasional polished stone, bricks, concrete, lean mix and plastic fragments.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Topsoil in the majority of exploratory holes and were described typically as *brown slightly sandy slightly gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth. These deposits had some, occasional or many cobble and boulder content where noted on the exploratory hole logs.

4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Soakaway Design

Deep Soakaway Locations:
Infiltration rates of 2.903 x 10^{-6} and 2.506 x 10^{-6} m/s respectively were calculated for the soakaway locations DS01 and DS06. At the locations of DS02, DS03, DS04 and DS05, the water level dropped too slowly to allow calculation of 'f' the soil infiltration rate. These locations are therefore unsuitable for soakaway design and construction.

Shallow Soakaway Locations:
Infiltration rates of 1.675 x 10^{-5}, 1.042 x 10^{-5}, 1.119 x 10^{-5}, 1.824 x 10^{-5}, and 5.290 x 10^{-6} m/s respectively were calculated for the soakaway locations SS01, SS03, SS04, SS05, and SS07. At the locations of SS02 and SS06, the water level dropped too slowly to allow calculation of 'f' the soil infiltration rate. These locations are therefore unsuitable for soakaway design and construction.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan


Temple Hill Road Blackrock
SS01
DS06
SS02
SS04
SS03
DS04
DS05
DS03
SS05
SS07
DS01
DS02
SS06
DS01A
Google Earth
© 2018 Google
100 m
N

APPENDIX 2 – Soakaway Testing Records

Ground Investigations Ireland Ltd www.gii.ie		**Site** Temple Hill Road Blackrock	**Trial Pit Number** **DS01**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.80m X 0.40m X 0.90m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.70) 0.90	Soft to firm brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles and boulders Obstruction: presumed granite bedrock		
						Complete at 0.90m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Temple Hill Road Blackrock		**Trial Pit Number**	DS01A
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.80m X 0.40m X 1.40m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▧	
			medium ingress(1) at 1.30m.		(1.30) 1.40	MADE GROUND: Dark brown slightly gravelly sandy CLAY with occasional subangular cobbles, polished stone, bricks and plastic	▩	∇1
						Complete at 1.40m		

Plan

Remarks

Groundwater encountered 1.30m BGL
Trial pit stable
Unable to carry out soakaway test due to groundwater
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS01A

Ground Investigations Ireland Ltd
www.gii.ie

Site Temple Hill Road Blackrock				**Trial Pit Number** DS02
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.70m X 0.40m X 1.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
0.50-1.50	B				(0.65) 0.85	Firm brown slightly sandy slightly gravelly CLAY	░	
					(0.65) 1.50	Stiff light brown slightly gravelly sandy CLAY with some subangular to subrounded cobbles and boulders	▒	
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS02

Ground Investigations Ireland Ltd

www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.00m X 0.35m X 1.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock **Client**	**Trial Pit Number** **DS03** **Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.80) 1.00	Firm brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and tree roots		
1.00	B				(0.50) 1.50	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and boulders		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS03

Ground Investigations Ireland Ltd

www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.90m X 0.35m X 1.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock		**Trial Pit Number** **DS04**
	Location	**Dates** 07/02/2018	**Client**		**Job Number** 7405-01-18
			Engineer JJ Campbell & Associates		**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.95) 1.05	Firm to stiff brown slightly sandy slightly gravelly CLAY with tree roots		
					(0.45) 1.50	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and boulders		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS04

Ground Investigations Ireland Ltd

www.gii.ie

Site Temple Hill Road Blackrock

Trial Pit Number DS05

Machine : JCB 3CX

Method : Trial Pit

Dimensions 1.80m X 0.40m X 1.50m

Ground Level (mOD)

Client

Job Number 7405-01-18

Location

Dates 06/02/2018

Engineer JJ Campbell & Associates

Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(1.30) 1.50	Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS05

Ground Investigations Ireland Ltd www.gii.ie		**Site** Temple Hill Road Blackrock	**Trial Pit Number** **DS06**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.80m X 0.40m X 1.50m	**Ground Level (mOD)**	**Client**
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates

Job Number 7405-01-18

Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.90) 1.00	Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and tree roots	▨	
					(0.50) 1.50	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles	▨	
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS06

Ground Investigations Ireland Ltd

www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.10m X 0.40m X 0.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock	**Trial Pit Number** **SS01**
	Location	**Dates** 06/02/2018	**Client**	**Job Number** 7405-01-18
			Engineer JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.20) 0.30	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles, with nails, mortar fragments and stone blocks	▩	
0.50	B				(0.20) 0.50	MADE GROUND: Brown clayey gravelly fine to coarse SAND with occasional subangular cobbles, with lean mix, concrete and mortar fragments	▩	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.SS01

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS02

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.20m X 0.40m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
06/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.40) 0.50	Firm brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles (possibly Made Ground)	▨	
0.50	B					Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS02

Ground Investigations Ireland Ltd
www.gii.ie

Site Temple Hill Road Blackrock

Trial Pit Number SS03

Machine : JCB 3CX

Method : Trial Pit

Dimensions 1.20m X 0.40m X 0.50m

Ground Level (mOD)

Client

Job Number 7405-01-18

Location

Dates 06/02/2018

Engineer JJ Campbell & Associates

Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	▒	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS03

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS04

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.30m X 0.30m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
07/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Soft to firm brown slightly sandy slightly gravelly CLAY Large boulders of granite at base of pit	▒	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS04

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS05

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.40m X 0.35m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
06/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Soft to firm brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles	▨	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS05

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS06

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.40m X 0.40m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
06/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	▒	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS06

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.30m X 0.35m X 0.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock **Client**	**Trial Pit Number** **SS07** **Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	▤	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.SS07

DS01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m x 0.90m (L x W x D)

Date	**Time**	**Water level (m bgl)**	
07/02/2018	0	0.000	
07/02/2018	1	-0.030	
07/02/2018	2	-0.050	
07/02/2018	48	-0.150	
07/02/2018	111	-0.230	
07/02/2018	171	-0.270	
07/02/2018	244	-0.330	
07/02/2018	302	-0.400	
07/02/2018	800	-0.675	*Data Extrapolated

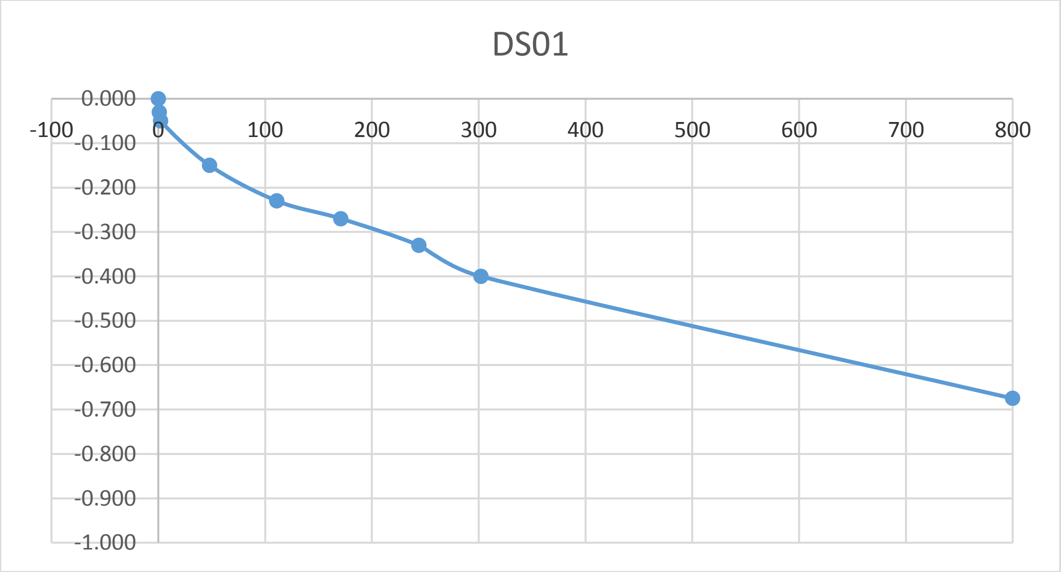
Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.00	**0.900**	**0.900**	**0.225**	**0.675**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.800	0.400	0.450	0.32

Tp75-25 (from graph) (s) **41340**

50% Eff Depth	ap50 (m2)
0.450	2.7

f = 2.903E-06 m/s



DS02

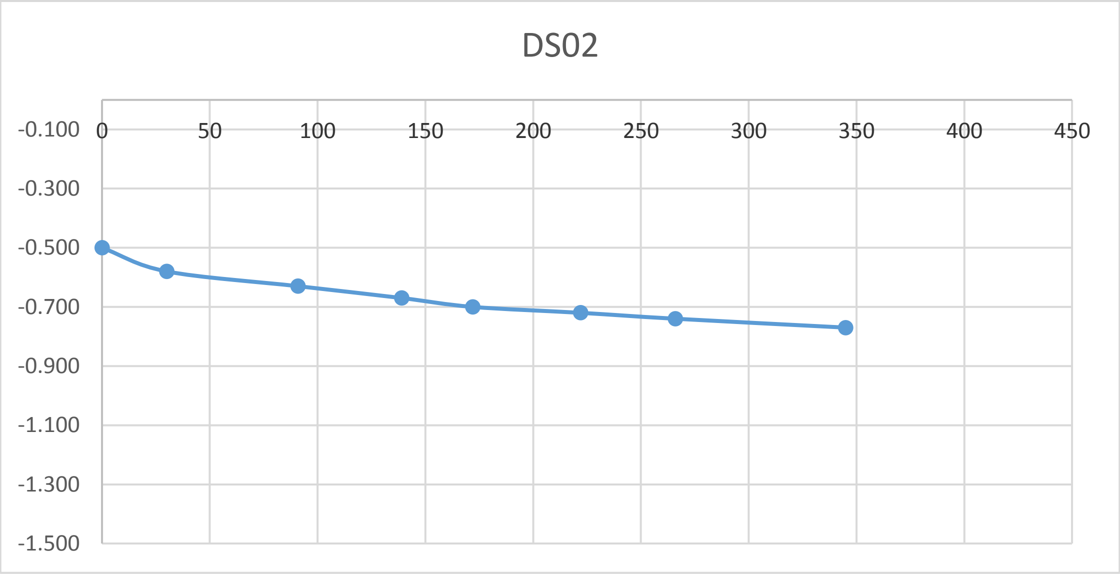
Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.70m x 0.40m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	-0.500
06/02/2018	30	-0.580
06/02/2018	91	-0.630
06/02/2018	139	-0.670
06/02/2018	172	-0.700
06/02/2018	222	-0.720
06/02/2018	266	-0.740
06/02/2018	345	-0.770

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	**1.500**	**1.000**	**0.75**	**1.25**



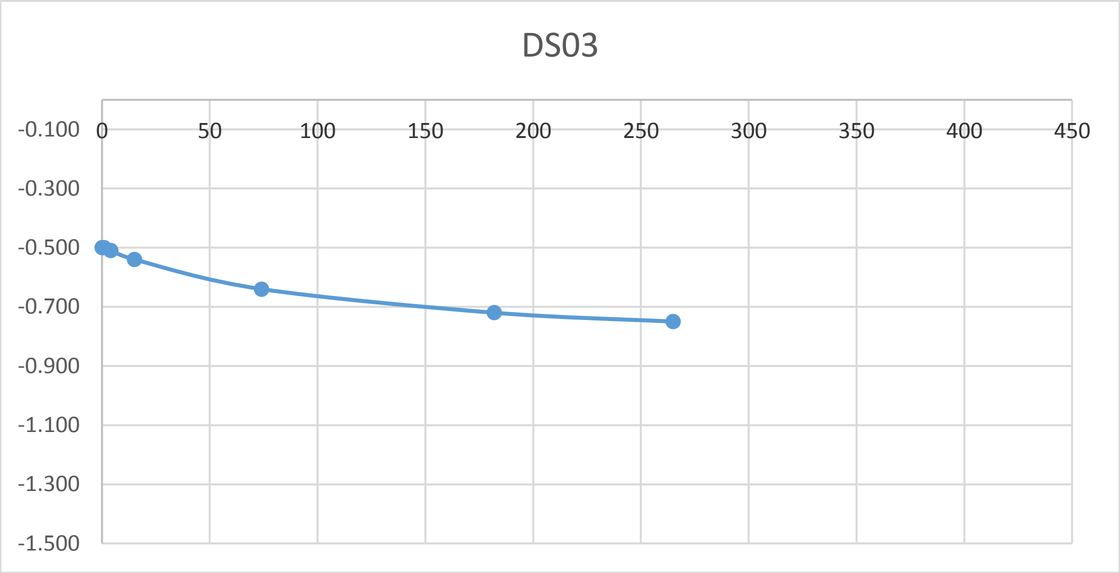
DS03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.00m x 0.35m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	-0.500
06/02/2018	1	-0.500
06/02/2018	4	-0.510
06/02/2018	15	-0.540
06/02/2018	74	-0.640
06/02/2018	182	-0.720
06/02/2018	265	-0.750
06/02/2018	333	-0.770

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.00	0.500	0.500	0.125	0.375



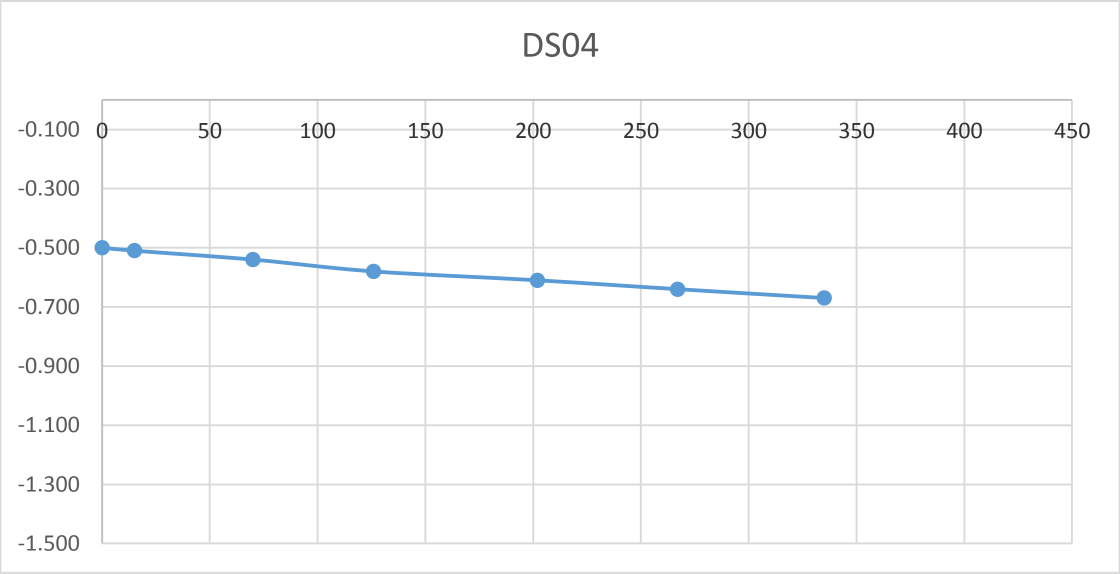
DS04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.90m x 0.35m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
07/02/2018	0	-0.500
07/02/2018	15	-0.510
07/02/2018	70	-0.540
07/02/2018	126	-0.580
07/02/2018	202	-0.610
07/02/2018	267	-0.640
07/02/2018	335	-0.670

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	**1.500**	**1.000**	**0.75**	**1.25**



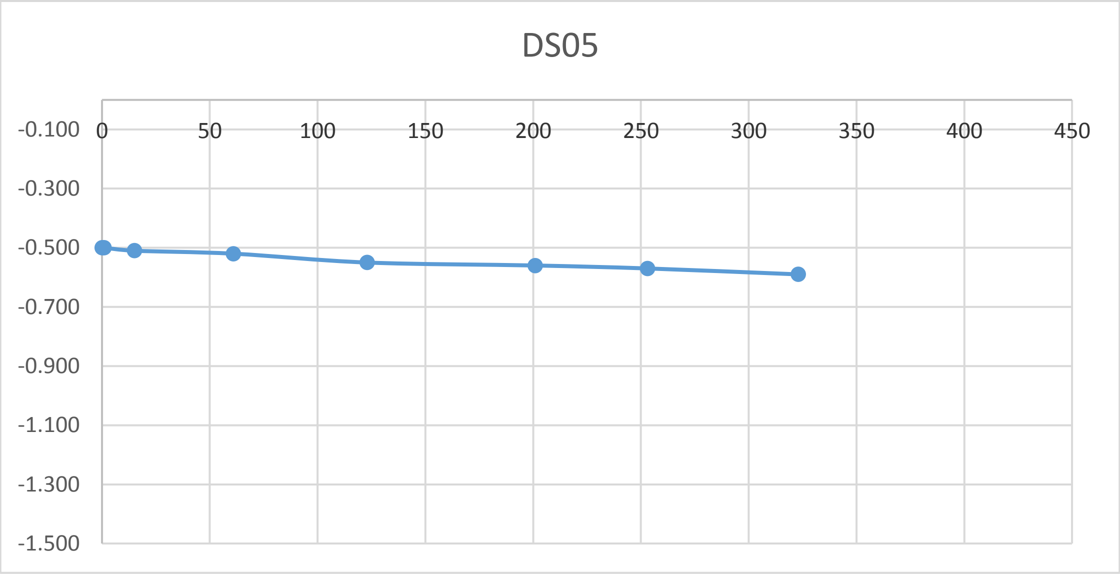
DS05

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	-0.500
06/02/2018	1	-0.500
06/02/2018	15	-0.510
06/02/2018	61	-0.520
06/02/2018	123	-0.550
06/02/2018	201	-0.560
06/02/2018	253	-0.570
06/02/2018	323	-0.590

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	**1.500**	**1.000**	**0.75**	**1.25**



DS06

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m x 1.50m (L x W x D)

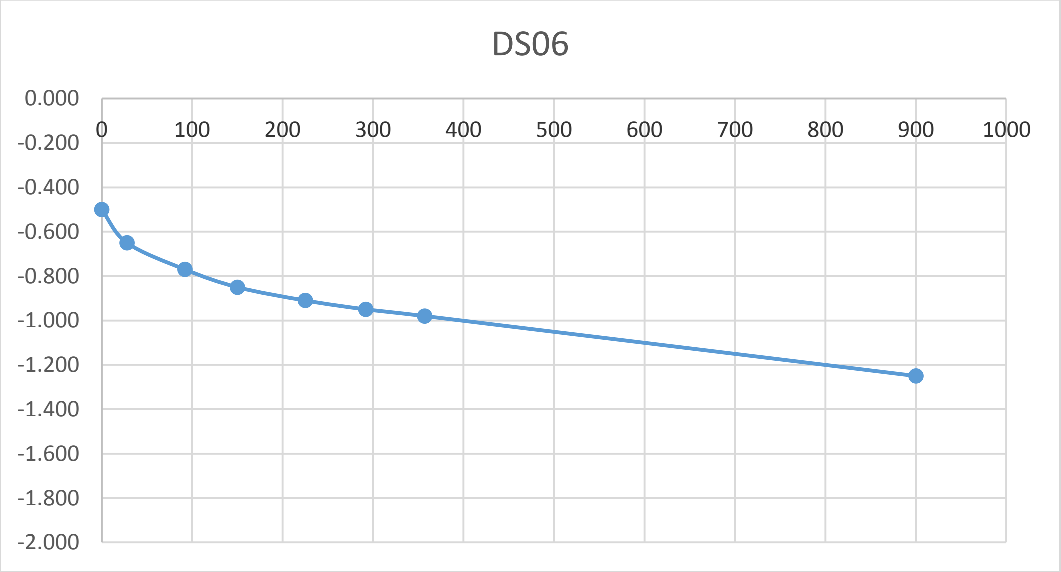
Date	Time	Water level (m bgl)	
07/02/2018	0	-0.500	
07/02/2018	28	-0.650	
07/02/2018	92	-0.770	
07/02/2018	150	-0.850	
07/02/2018	225	-0.910	
07/02/2018	292	-0.950	
07/02/2018	357	-0.980	
07/02/2018	900	-1.250	*Data Extrapolated

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	**1.500**	**1.000**	**0.75**	**1.25**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.800	0.400	0.500	0.36

Tp75-25 (from graph) (s)	**49200**	50% Eff Depth	ap50 (m2)
		0.500	2.92

f = 2.506E-06 m/s



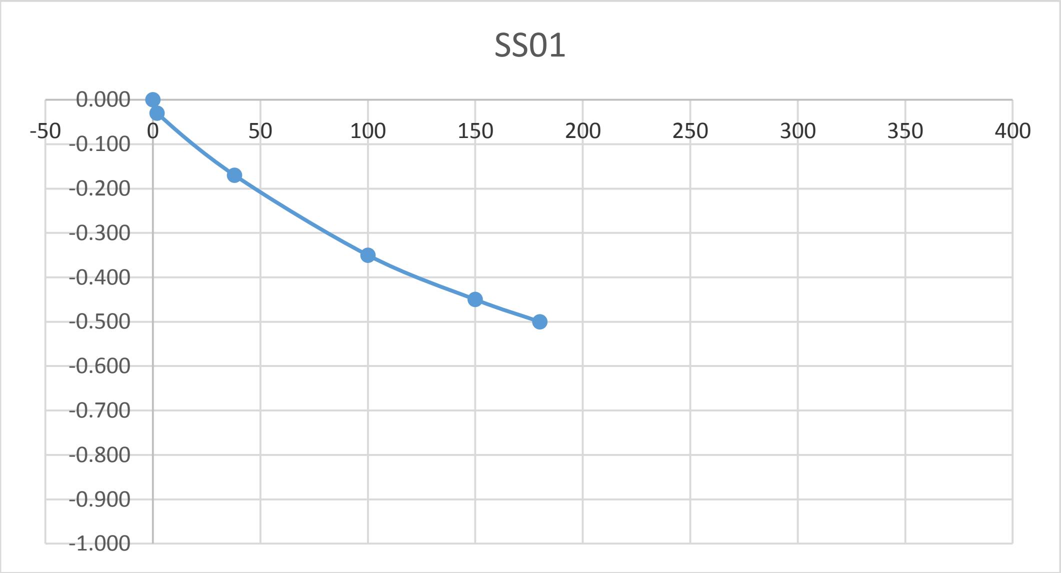
SS01

Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.10m x 0.40m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
06/02/2018	0	0.000
06/02/2018	2	-0.030
06/02/2018	38	-0.170
06/02/2018	100	-0.350
06/02/2018	150	-0.450
06/02/2018	180	-0.500

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.00	**0.500**		**0.500**	**0.125**	**0.375**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
1.100	0.400			0.250	0.11
Tp75-25 (from graph) (s)		**5520**		50% Eff Depth	ap50 (m2)
				0.250	1.19
f =	**1.675E-05**	**m/s**			



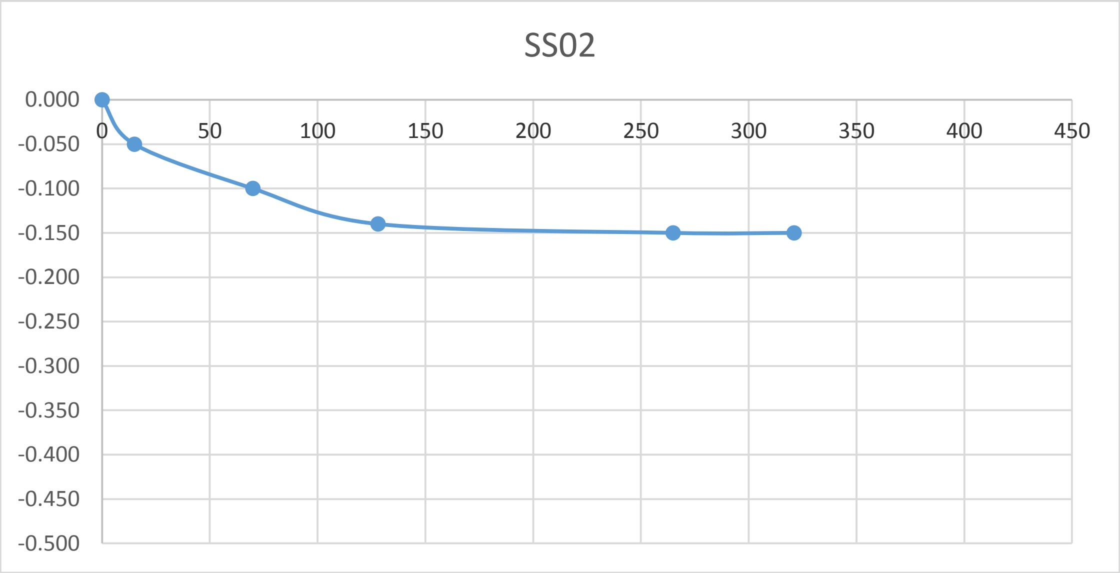
SS02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.20m x 0.40m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	15	-0.050
06/02/2018	70	-0.100
06/02/2018	128	-0.140
06/02/2018	265	-0.150
06/02/2018	321	-0.150

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**



SS03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.20m x 0.40m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	10	-0.050
06/02/2018	18	-0.150
06/02/2018	47	-0.230
06/02/2018	110	-0.300
06/02/2018	189	-0.390
06/02/2018	240	-0.450
06/02/2018	380	-0.500

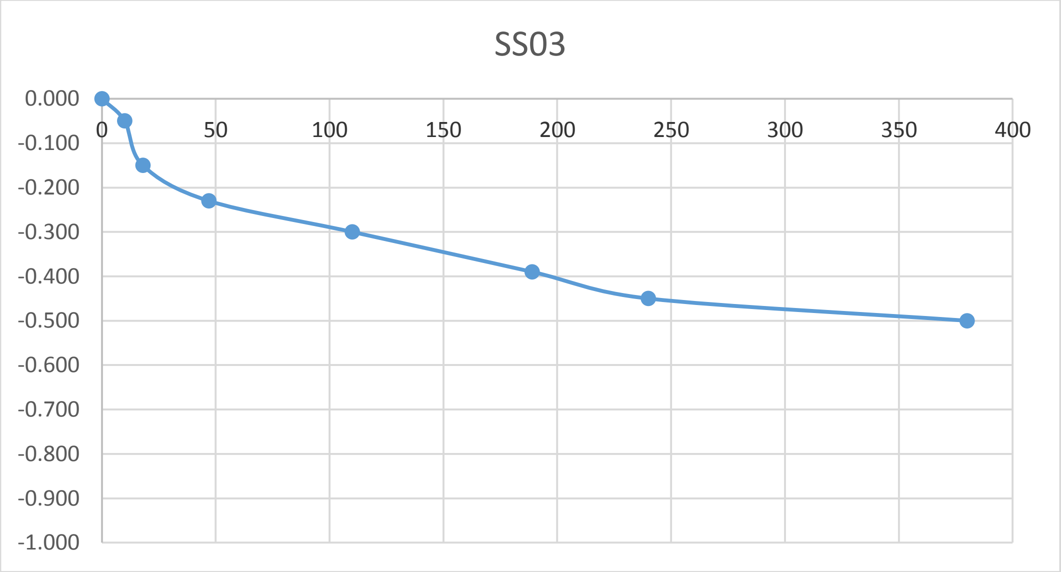
Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.200	0.400	0.250	0.12

Tp75-25 (from graph) (s) **9000**

50% Eff Depth	ap50 (m2)
0.250	1.28

f = 1.042E-05 m/s

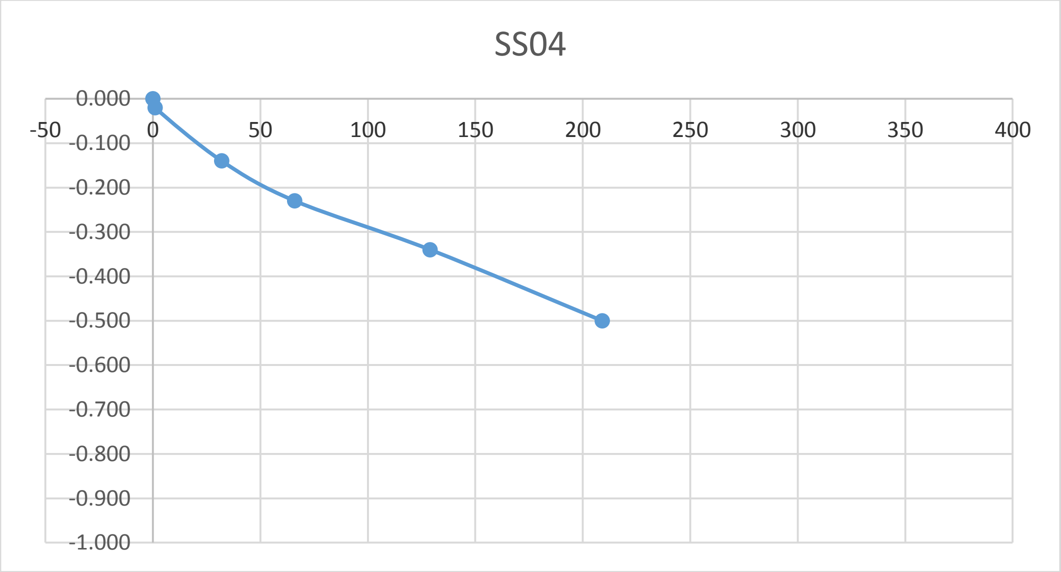


SS04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.30m x 0.30m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
07/02/2018	0	0.000
07/02/2018	1	-0.020
07/02/2018	32	-0.140
07/02/2018	66	-0.230
07/02/2018	129	-0.340
07/02/2018	209	-0.500

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.00	**0.500**		**0.500**	**0.125**	**0.375**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
1.300	0.300			0.250	0.10
Tp75-25 (from graph) (s)		**7320**		50% Eff Depth	ap50 (m2)
				0.250	1.19
f =	**1.119E-05**	**m/s**			

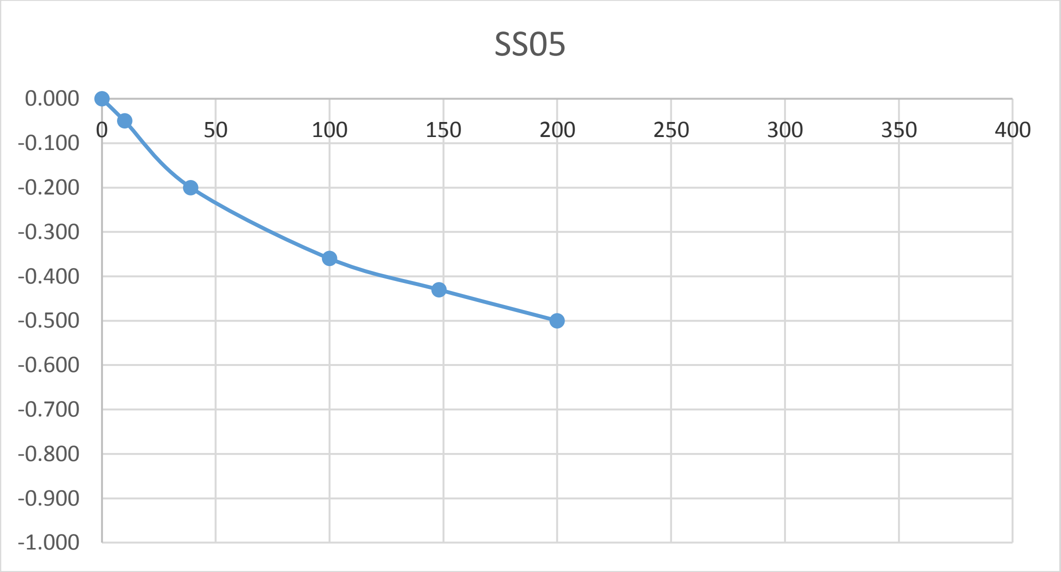


SS05

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.40m x 0.35m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	10	-0.050
06/02/2018	39	-0.200
06/02/2018	100	-0.360
06/02/2018	148	-0.430
06/02/2018	200	-0.500

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.00	**0.500**		**0.500**	**0.125**	**0.375**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
1.400	0.350			0.250	0.12
Tp75-25 (from graph) (s)		**4920**		50% Eff Depth	ap50 (m2)
				0.250	1.365
f =	**1.824E-05**	**m/s**			



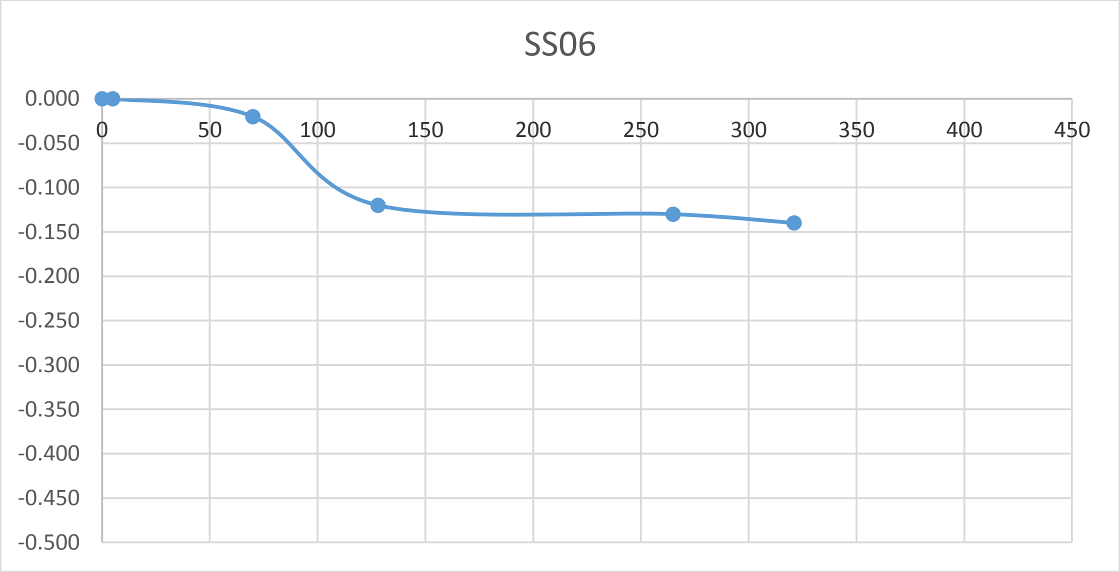
SS06

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.40m x 0.40m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	5	0.000
06/02/2018	70	-0.020
06/02/2018	128	-0.120
06/02/2018	265	-0.130
06/02/2018	321	-0.140

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**

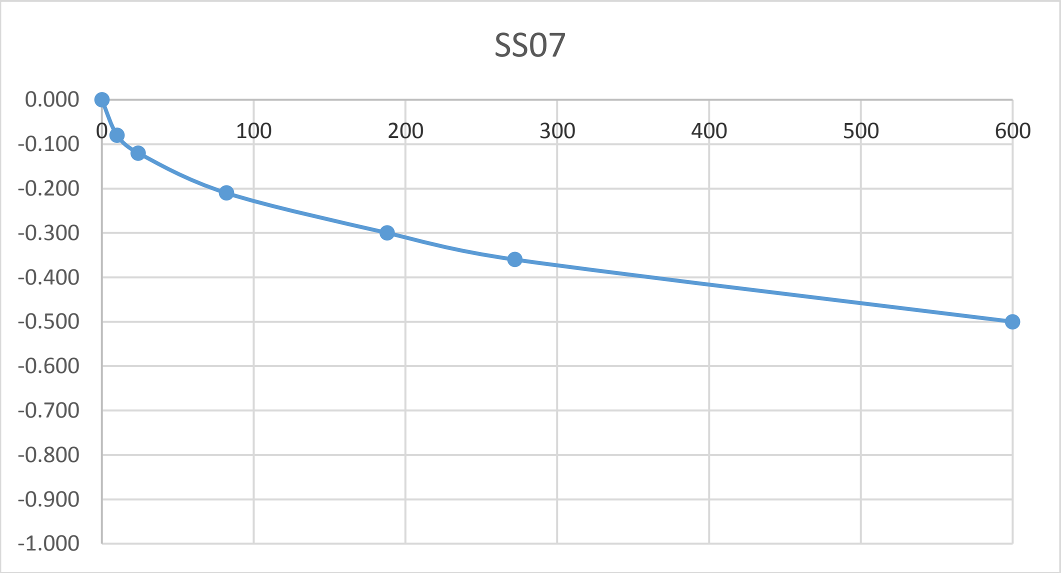


SS07

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.30m x 0.35m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**	
06/02/2018	0	0.000	
06/02/2018	10	-0.080	
06/02/2018	24	-0.120	
06/02/2018	82	-0.210	
06/02/2018	188	-0.300	
06/02/2018	272	-0.360	
06/02/2018	600	-0.500	***Data Extrapolated**

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.00	**0.500**		**0.500**	**0.125**	**0.375**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
1.300	0.350			0.250	0.11
Tp75-25 (from graph) (s)		**16800**		50% Eff Depth	ap50 (m2)
				0.250	1.28
f =	**5.290E-06**	**m/s**			



APPENDIX 3 – Soakaway Testing Photographs

Temple Hill Road Blackrock Soakaway Testing Photographs

DS01

DS01

DS01

DS01

DS01A

DS01A

DS01A

DS01A

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Ground Investigations Ireland Ltd

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Site
Temple Hill Road Blackrock

Trial Pit Number
DS01

Machine : JCB 3CX

Method : Trial Pit

Dimensions
1.80m X 0.40m X 0.90m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
07/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.70) 0.90	Soft to firm brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles and boulders Obstruction: presumed granite bedrock	▨	
						Complete at 0.90m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS01

Ground Investigations Ireland Ltd
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Site
Temple Hill Road Blackrock

Trial Pit Number
DS01A

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.80m X 0.40m X 1.40m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
07/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▧	
			medium ingress(1) at 1.30m.		(1.30) 1.40	MADE GROUND: Dark brown slightly gravelly sandy CLAY with occasional subangular cobbles, polished stone, bricks and plastic	▩	∇1
						Complete at 1.40m		

Plan

Remarks

Groundwater encountered 1.30m BGL
Trial pit stable
Unable to carry out soakaway test due to groundwater
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS01A

Ground Investigations Ireland Ltd
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Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.70m X 0.40m X 1.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock **Client**	**Trial Pit Number** **DS02** **Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
0.50-1.50	B				(0.65) 0.85	Firm brown slightly sandy slightly gravelly CLAY	▨	
					(0.65) 1.50	Stiff light brown slightly gravelly sandy CLAY with some subangular to subrounded cobbles and boulders	▨	
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS02

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.00m X 0.35m X 1.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock **Client**	**Trial Pit Number** **DS03** **Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.80) 1.00	Firm brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and tree roots		
1.00	B				(0.50) 1.50	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and boulders		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.DS03

Ground Investigations Ireland Ltd www.gii.ie		**Site** Temple Hill Road Blackrock	**Trial Pit Number** **DS04**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.90m X 0.35m X 1.50m	**Ground Level (mOD)**	**Client**
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates

Job Number	**Sheet**
7405-01-18	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10 (0.10)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					1.05 (0.95)	Firm to stiff brown slightly sandy slightly gravelly CLAY with tree roots		
					1.50 (0.45)	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and boulders		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS04

Ground Investigations Ireland Ltd
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Site	Temple Hill Road Blackrock		**Trial Pit Number**	**DS05**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.80m X 0.40m X 1.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(1.30) 1.50	Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles	▨	
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS05

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.80m X 0.40m X 1.50m	**Ground Level (mOD)**	**Site** Temple Hill Road Blackrock	**Trial Pit Number** **DS06**
			Client	**Job Number** 7405-01-18
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.90) 1.00	Firm to stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles and tree roots		
					(0.50) 1.50	Stiff brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
						Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.DS06

Ground Investigations Ireland Ltd
www.gii.ie

Site	Temple Hill Road Blackrock		**Trial Pit Number**	**SS01**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.10m X 0.40m X 0.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.20) 0.30	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles, with nails, mortar fragments and stone blocks	▩	
0.50	B				(0.20) 0.50	MADE GROUND: Brown clayey gravelly fine to coarse SAND with occasional subangular cobbles, with lean mix, concrete and mortar fragments	▩	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.SS01

Ground Investigations Ireland Ltd

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Site Temple Hill Road Blackrock				**Trial Pit Number** SS02
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.20m X 0.40m X 0.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.40) 0.50	Firm brown slightly sandy slightly gravelly CLAY with occasional subangular cobbles (possibly Made Ground)	▨	
0.50	B					Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS02

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS03

Machine : JCB 3CX
Method : Trial Pit

Dimensions
1.20m X 0.40m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
06/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	░	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS03

Ground Investigations Ireland Ltd
www.gii.ie

Site Temple Hill Road Blackrock				**Trial Pit Number** **SS04**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.30m X 0.30m X 0.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 07/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Soft to firm brown slightly sandy slightly gravelly CLAY Large boulders of granite at base of pit	⁘	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS04

Ground Investigations Ireland Ltd
www.gii.ie

Site Temple Hill Road Blackrock				**Trial Pit Number** **SS05**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.40m X 0.35m X 0.50m	**Ground Level (mOD)**	**Client**	**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets		
					(0.30) 0.50	Soft to firm brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.SS05

Ground Investigations Ireland Ltd
www.gii.ie

Site
Temple Hill Road Blackrock

Trial Pit Number
SS06

Machine : JCB 3CX

Method : Trial Pit

Dimensions
1.40m X 0.40m X 0.50m

Ground Level (mOD)

Client

Job Number
7405-01-18

Location

Dates
06/02/2018

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	⁘	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	7405-01-18.SS06

Ground Investigations Ireland Ltd www.gii.ie			**Site** Temple Hill Road Blackrock		**Trial Pit Number** **SS07**
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 1.30m X 0.35m X 0.50m	**Ground Level (mOD)**	**Client**		**Job Number** 7405-01-18
	Location	**Dates** 06/02/2018	**Engineer** JJ Campbell & Associates		**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets	▨	
					(0.30) 0.50	Firm brown slightly sandy slightly gravelly CLAY	▒	
						Complete at 0.50m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Soakaway test carried out in pit
Trial pit backfilled on completion of test

Scale (approx)	**Logged By**	**Figure No.**
1:25	JC	7405-01-18.SS07

DS01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m x 0.90m (L x W x D)

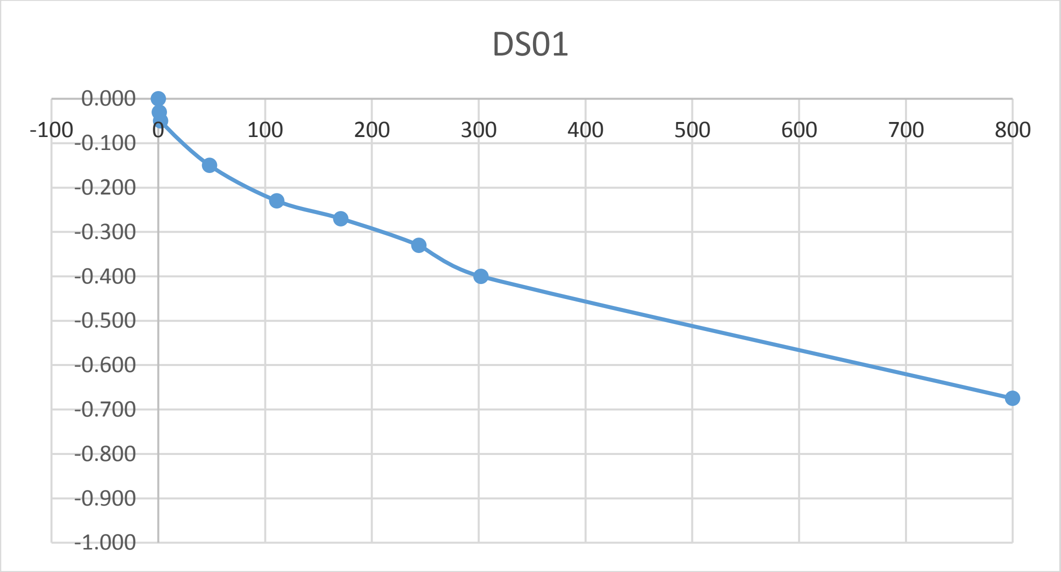
Date	**Time**	**Water level (m bgl)**	
07/02/2018	0	0.000	
07/02/2018	1	-0.030	
07/02/2018	2	-0.050	
07/02/2018	48	-0.150	
07/02/2018	111	-0.230	
07/02/2018	171	-0.270	
07/02/2018	244	-0.330	
07/02/2018	302	-0.400	
07/02/2018	800	-0.675	*Data Extrapolated

Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.00	**0.900**	**0.900**	**0.225**	**0.675**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.800	0.400	0.450	0.32

Tp75-25 (from graph) (s)	**41340**	50% Eff Depth	ap50 (m2)
		0.450	2.7

f = 2.903E-06 m/s



DS02

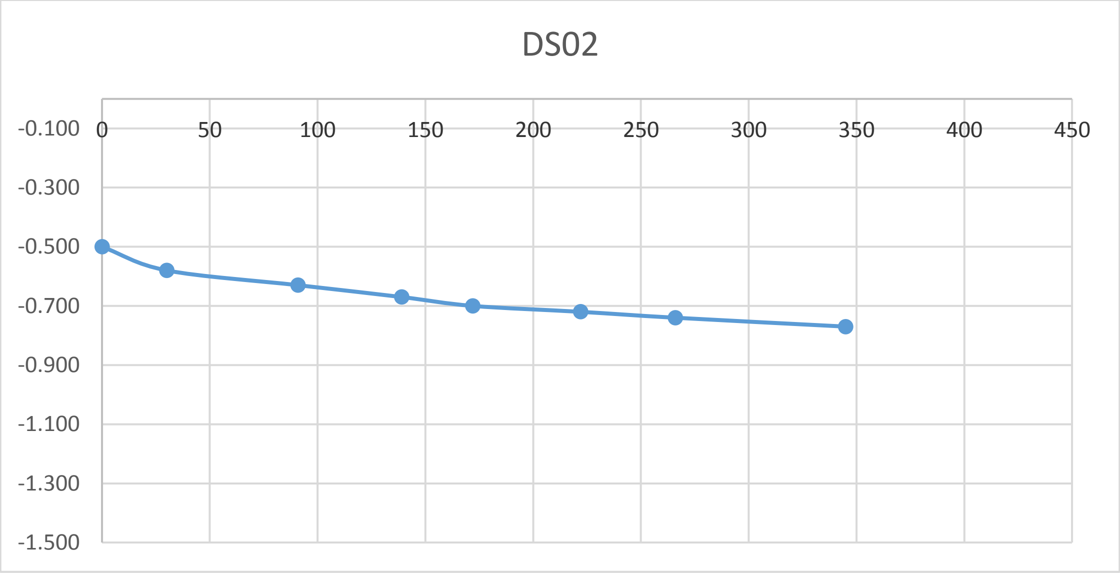
Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.70m x 0.40m 1.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
06/02/2018	0	-0.500
06/02/2018	30	-0.580
06/02/2018	91	-0.630
06/02/2018	139	-0.670
06/02/2018	172	-0.700
06/02/2018	222	-0.720
06/02/2018	266	-0.740
06/02/2018	345	-0.770

***Soakaway failed - Pit backfilled**

Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.50	**1.500**	**1.000**	**0.75**	**1.25**



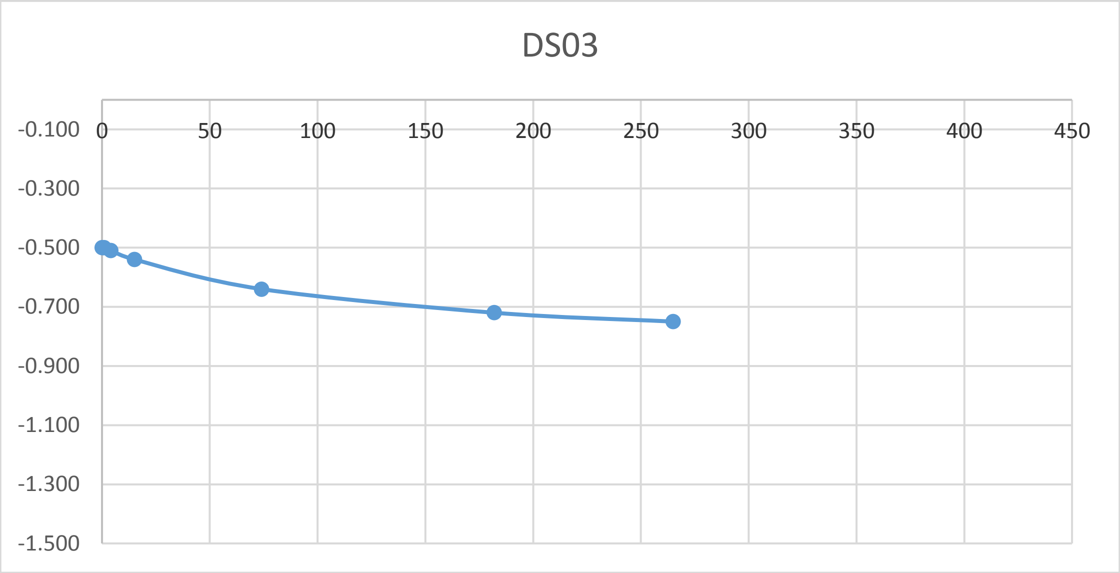
DS03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.00m x 0.35m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	-0.500
06/02/2018	1	-0.500
06/02/2018	4	-0.510
06/02/2018	15	-0.540
06/02/2018	74	-0.640
06/02/2018	182	-0.720
06/02/2018	265	-0.750
06/02/2018	333	-0.770

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**



DS04

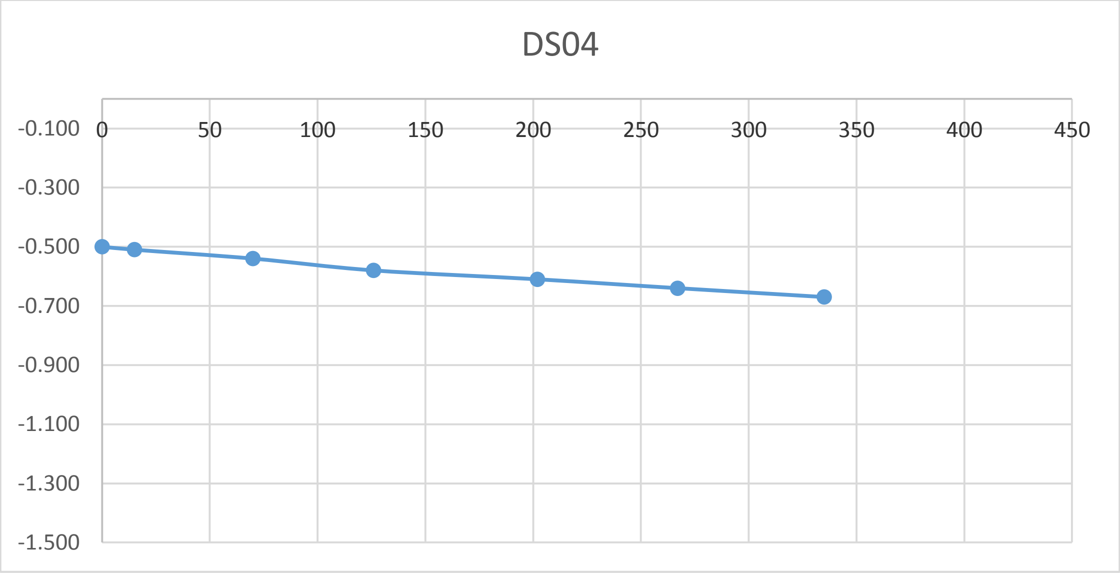
Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.90m x 0.35m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
07/02/2018	0	-0.500
07/02/2018	15	-0.510
07/02/2018	70	-0.540
07/02/2018	126	-0.580
07/02/2018	202	-0.610
07/02/2018	267	-0.640
07/02/2018	335	-0.670

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	1.500	1.000	0.75	1.25



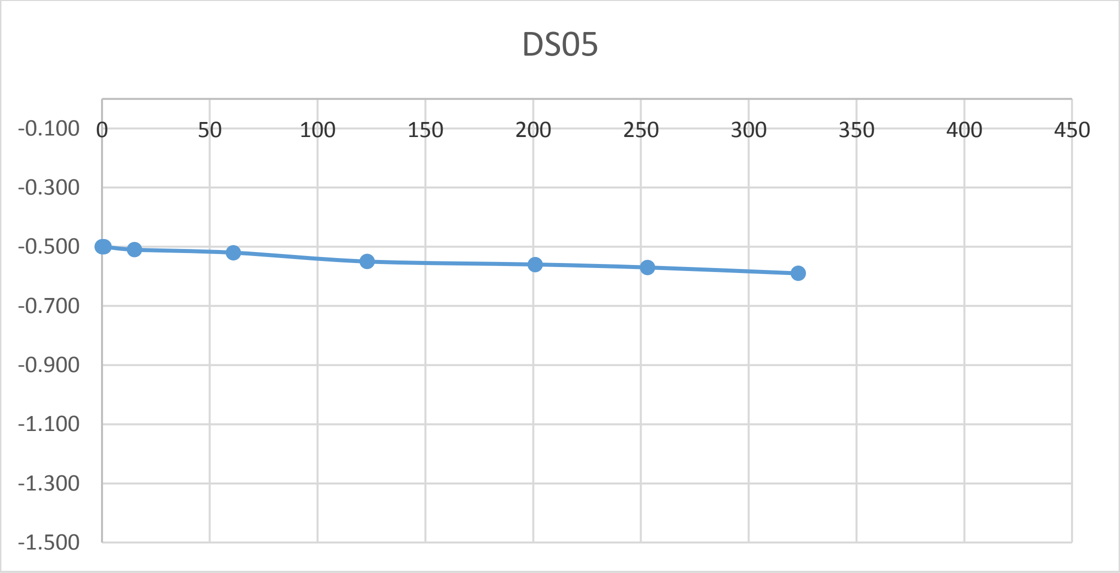
DS05

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	-0.500
06/02/2018	1	-0.500
06/02/2018	15	-0.510
06/02/2018	61	-0.520
06/02/2018	123	-0.550
06/02/2018	201	-0.560
06/02/2018	253	-0.570
06/02/2018	323	-0.590

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	**1.500**	**1.000**	**0.75**	**1.25**



DS06

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.80m x 0.40m x 1.50m (L x W x D)

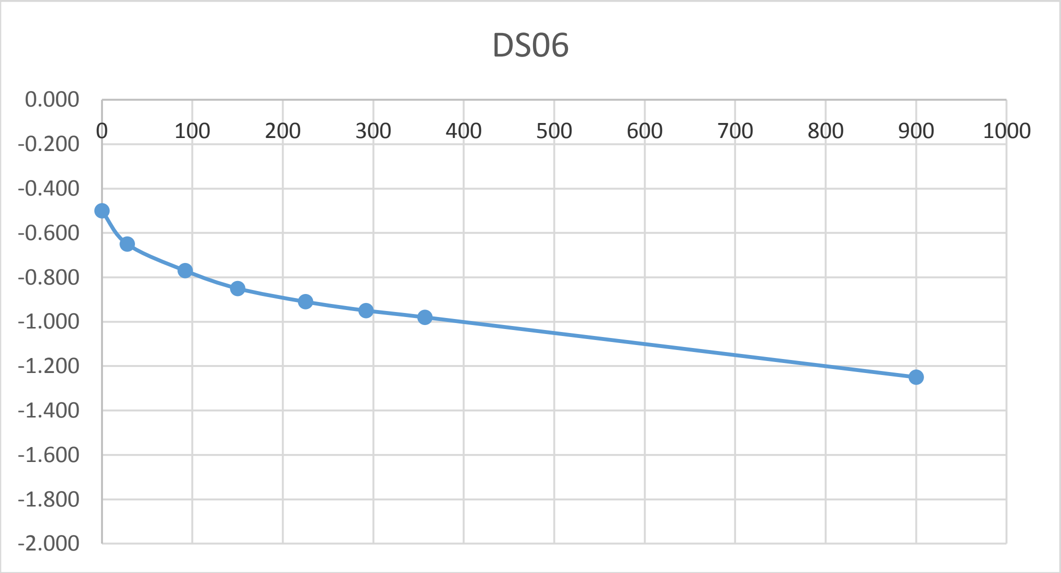
Date	Time	Water level (m bgl)	
07/02/2018	0	-0.500	
07/02/2018	28	-0.650	
07/02/2018	92	-0.770	
07/02/2018	150	-0.850	
07/02/2018	225	-0.910	
07/02/2018	292	-0.950	
07/02/2018	357	-0.980	
07/02/2018	900	-1.250	*Data Extrapolated

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	1.500	1.000	0.75	1.25

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.800	0.400	0.500	0.36

Tp75-25 (from graph) (s)		50% Eff Depth	ap50 (m2)
	49200	0.500	2.92

f = 2.506E-06 m/s



SS01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.10m x 0.40m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	2	-0.030
06/02/2018	38	-0.170
06/02/2018	100	-0.350
06/02/2018	150	-0.450
06/02/2018	180	-0.500

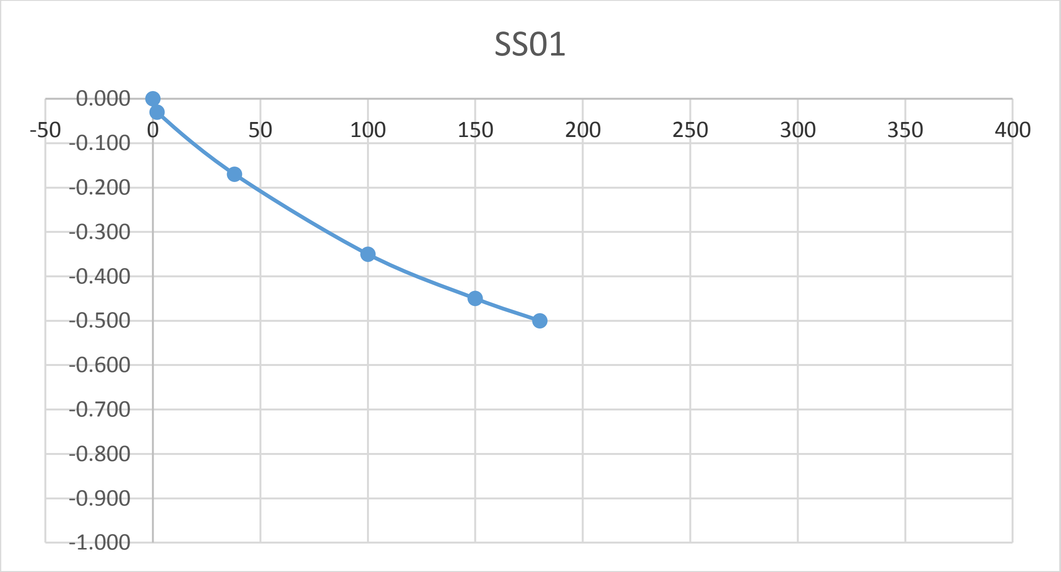
Start depth	Depth of Pit	Diff	75% full	25%full
0.00	0.500	0.500	0.125	0.375

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.100	0.400	0.250	0.11

Tp75-25 (from graph) (s) **5520**

50% Eff Depth	ap50 (m2)
0.250	1.19

f = 1.675E-05 m/s



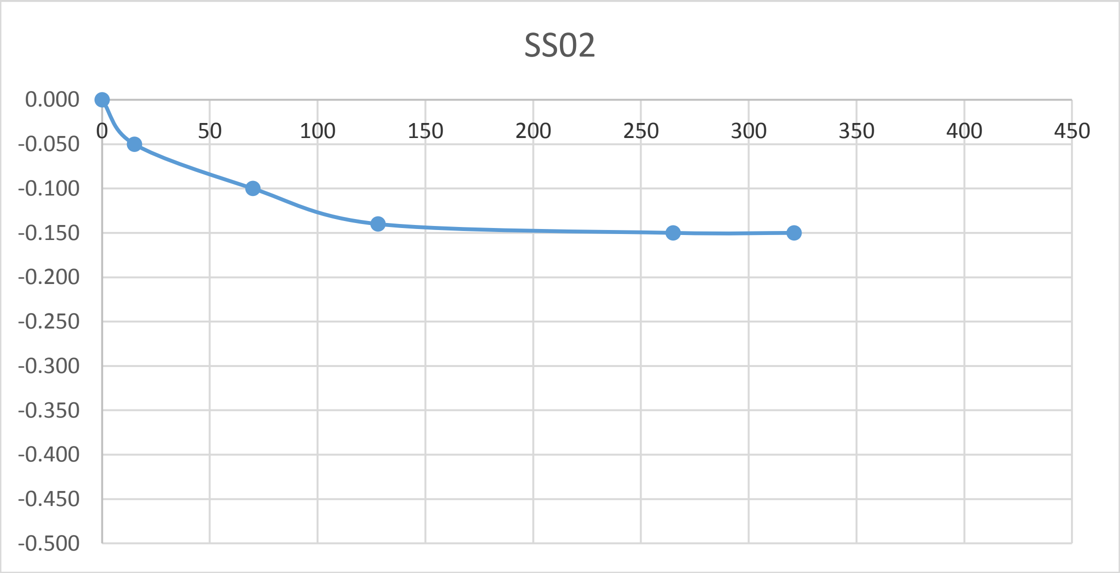
SS02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.20m x 0.40m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	15	-0.050
06/02/2018	70	-0.100
06/02/2018	128	-0.140
06/02/2018	265	-0.150
06/02/2018	321	-0.150

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**



SS03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.20m x 0.40m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
06/02/2018	0	0.000
06/02/2018	10	-0.050
06/02/2018	18	-0.150
06/02/2018	47	-0.230
06/02/2018	110	-0.300
06/02/2018	189	-0.390
06/02/2018	240	-0.450
06/02/2018	380	-0.500

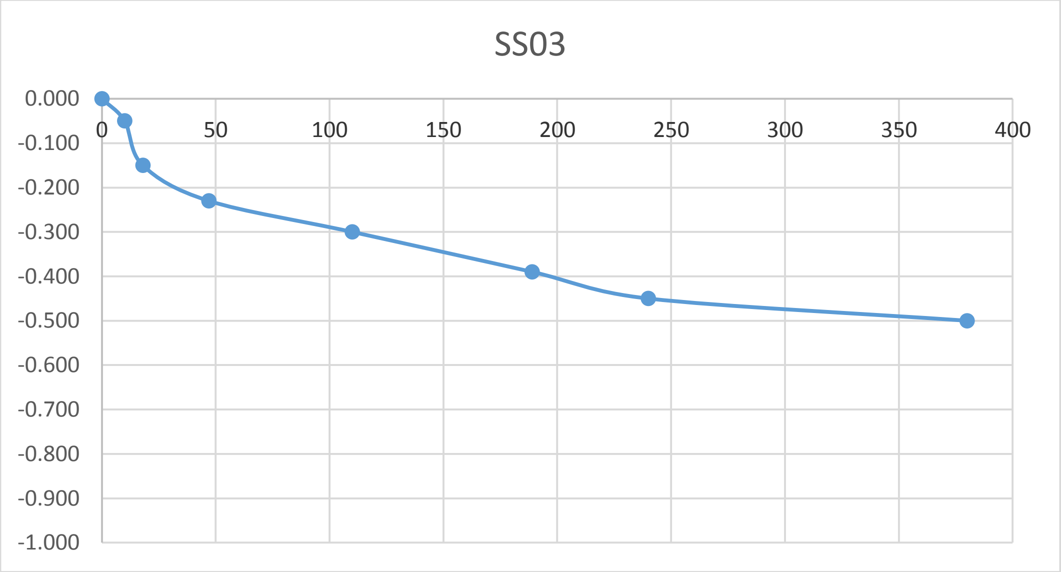
Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.00	**0.500**	**0.500**	**0.125**	**0.375**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.200	0.400	0.250	0.12

Tp75-25 (from graph) (s) **9000**

50% Eff Depth	ap50 (m2)
0.250	1.28

f = 1.042E-05 m/s



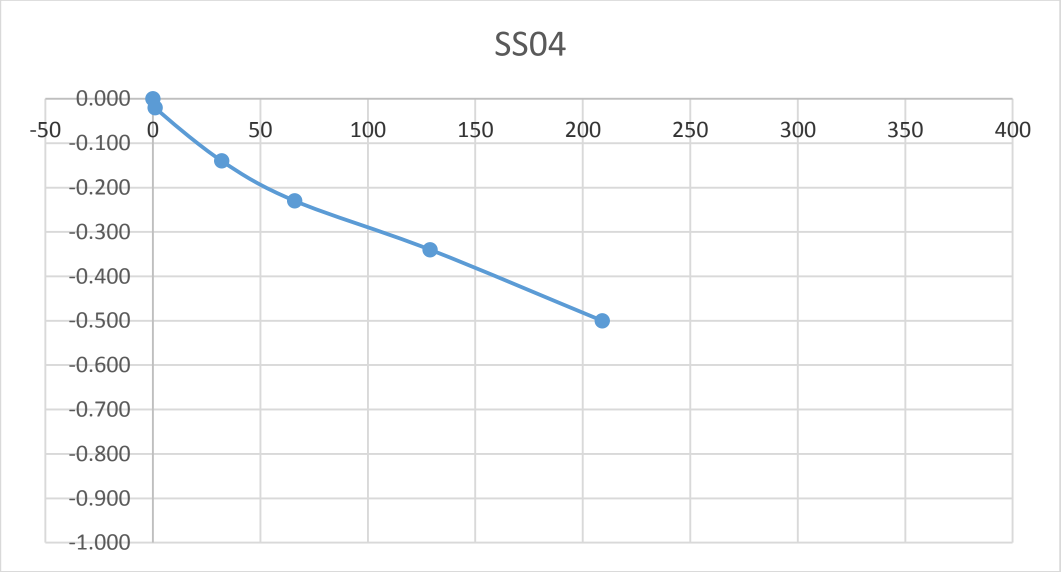
SS04

Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.30m x 0.30m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
07/02/2018	0	0.000
07/02/2018	1	-0.020
07/02/2018	32	-0.140
07/02/2018	66	-0.230
07/02/2018	129	-0.340
07/02/2018	209	-0.500

Start depth	**Depth of Pit**		**Diff**	**75% full**	**25%full**
0.00	**0.500**		**0.500**	**0.125**	**0.375**
Length of pit (m)	Width of pit (m)			75-25Ht (m)	Vp75-25 (m3)
1.300	0.300			0.250	0.10
Tp75-25 (from graph) (s)		**7320**		50% Eff Depth	ap50 (m2)
				0.250	1.19
f =	**1.119E-05**	**m/s**			



SS05

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.40m x 0.35m 0.50m (L x W x D)

Date	Time	Water level (m bgl)
06/02/2018	0	0.000
06/02/2018	10	-0.050
06/02/2018	39	-0.200
06/02/2018	100	-0.360
06/02/2018	148	-0.430
06/02/2018	200	-0.500

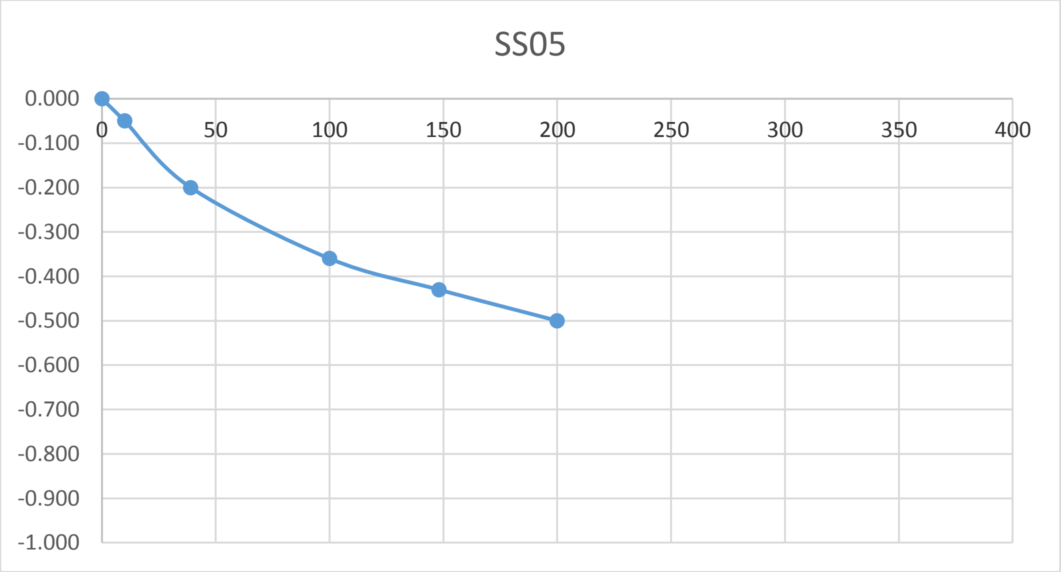
Start depth	Depth of Pit	Diff	75% full	25%full
0.00	**0.500**	**0.500**	**0.125**	**0.375**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.400	0.350	0.250	0.12

Tp75-25 (from graph) (s) **4920**

50% Eff Depth	ap50 (m2)
0.250	1.365

f = 1.824E-05 m/s



SS06

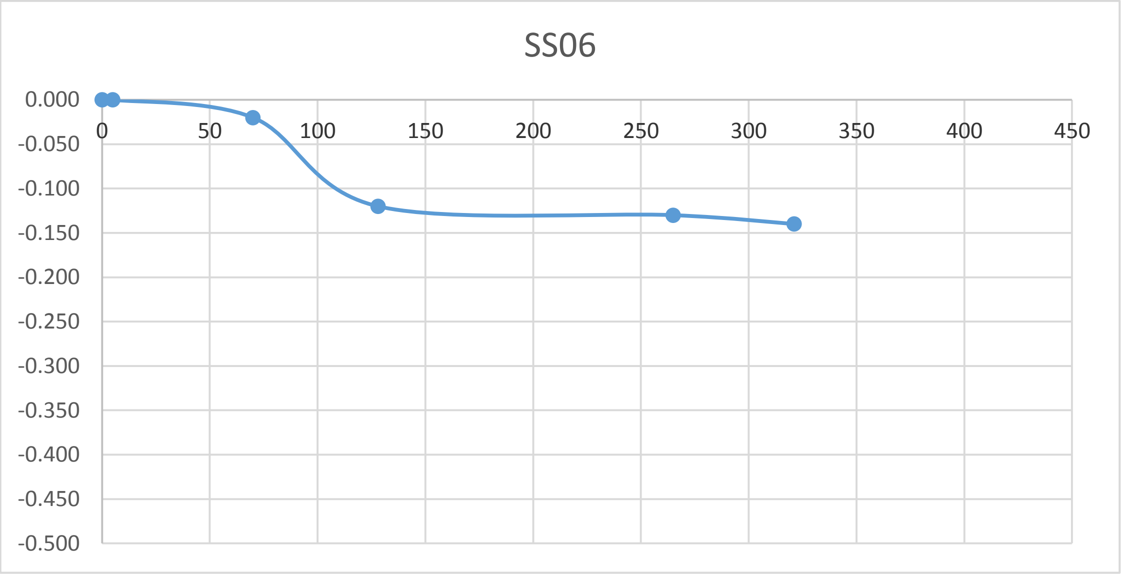
Soakaway Test to BRE Digest 365

Trial Pit Dimensions: 1.40m x 0.40m 0.50m (L x W x D)

Date	**Time**	**Water level (m bgl)**
06/02/2018	0	0.000
06/02/2018	5	0.000
06/02/2018	70	-0.020
06/02/2018	128	-0.120
06/02/2018	265	-0.130
06/02/2018	321	-0.140

***Soakaway failed - Pit backfilled**

Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.00	**0.500**	**0.500**	**0.125**	**0.375**



SS07

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.30m x 0.35m 0.50m (L x W x D)

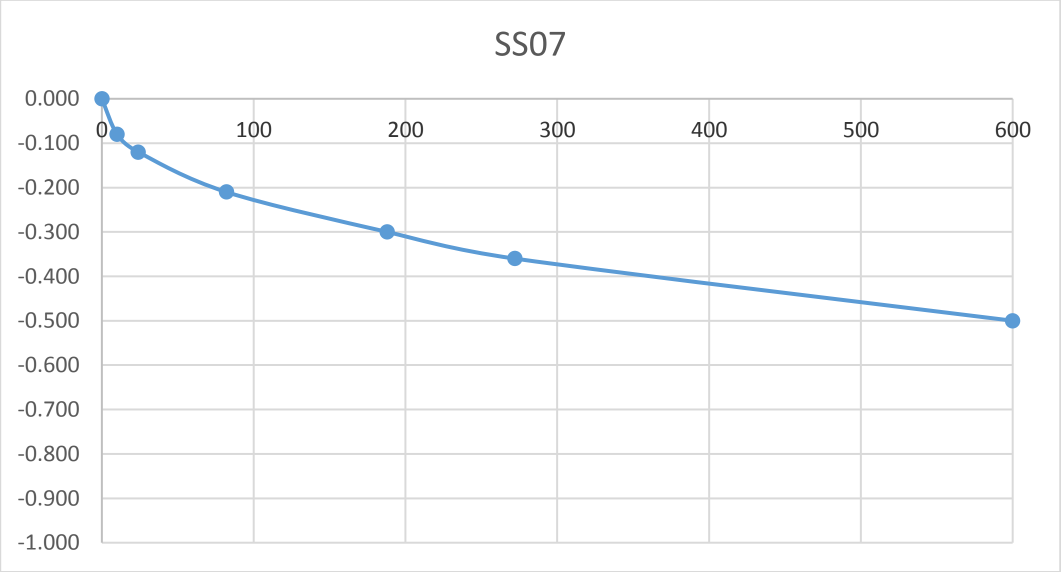
Date	Time	Water level (m bgl)	
06/02/2018	0	0.000	
06/02/2018	10	-0.080	
06/02/2018	24	-0.120	
06/02/2018	82	-0.210	
06/02/2018	188	-0.300	
06/02/2018	272	-0.360	
06/02/2018	600	-0.500	***Data Extrapolated**

Start depth	**Depth of Pit**	**Diff**	**75% full**	**25%full**
0.00	**0.500**	**0.500**	**0.125**	**0.375**

Length of pit (m)	Width of pit (m)	75-25Ht (m)	Vp75-25 (m3)
1.300	0.350	0.250	0.11

Tp75-25 (from graph) (s)		50% Eff Depth	ap50 (m2)
	16800	0.250	1.28

f = 5.290E-06 m/s



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Ground Investigations Ireland

St Teresas Lands Temple Hill, Monkstown, Blackrock, Co Dublin

Ground Investigation Report

DOCUMENT CONTROL SHEET

Project Title	St Teresas Lands Temple Hill, Monkstown, Blackrock, Co Dublin
Engineer	JJ Campbell & Associates
Project No	8236-11-18
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
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CONTENTS

APPENDICES

Appendix 1	**Site Location Plan**
Appendix 2	**Rotary Core Records**
Appendix 3	**Groundwater Monitoring**

1.0 Preamble

On the instructions of JJ Campbell & Associates, a site investigation was carried out by Ground Investigations Ireland Ltd., in December 2018 at the site of the proposed residential development at
St Teresas Lands Temple Hill, Monkstown, Blackrock, Co Dublin

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently greenfield partially vegetated in palaces with a convent building over a portion of the site in Blackrock, Co. Dublin. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 2 No. Rotary Core Boreholes to a maximum depth of 13.5m BGL
- Installation of 2 No. Groundwater monitoring wells
- Groundwater monitoring
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 2 of this Report.

3.3. Groundwater Monitoring Installations

Groundwater and or Gas Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil
- Made Ground
- Cohesive Deposits
- Bedrock

TOPSOIL: Topsoil was encountered in BH-B and was present to a maximum depth of 0.1m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil in BH-B and was present to a depth of 1.0m BGL. These deposits were described generally as *brown sandy gravelly CLAY with frequent cobbles and contained occasional fragments of concrete, red brick, glass and plastic.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground and were described typically as *brown sandy gravelly CLAY with occasional cobbles and boulders* overlying a *stiff black sandy gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits typically increased with depth and was firm to stiff or stiff below 2.0m BGL in the majority of the exploratory holes. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

BEDROCK: The rotary core boreholes recovered strong to very strong phaneritic Granite in BH-A. The rotary core recovered extremely weak (residual) to Medium strong phaneritic Granite in BH-B.
The depth to rock in BH-A is 8.0m and in BH-B depth to rock is6.8m BGL. The total core recovery is good, typically 100% with some of the uppermost runs dropping to 80 or 90%. The SCR and RQD both are relatively poor in the upper weathered zone, mainly in BH-B, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Groundwater

No groundwater was noted during the investigation however we would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in BH-A and BH-B to allow the equilibrium groundwater level to be determined.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

Based on the limited number of investigative points compared to the size of the site, the recommendations are preliminary and should be verified by further ground investigation to ensure the depth of the founding strata don't vary significantly over the area of the proposed building. A previous investigation to complete soakaway testing indicated shallow rock at the location of DS01 which is in the eastern portion of the site closest to the tennis ground.

An allowable bearing capacity in the location of BH-A where a single basement is proposed, of 250 kN/m^2 is recommended for conventional strip or pad foundations on the stiff cohesive deposits at a depth of 4.0m BGL. An allowable bearing capacity in the location of BH-B, where a double basement is proposed, of 350 kN/m^2 is recommended for conventional strip or pad foundations on the weak granite at a depth of 8.0m BGL.

In any part of the site, should part of the foundation be on rock we would recommend that all the foundations of the unit in question be lowered to the competent rock stratum to avoid differential settlement. The possibility for variation in the depth of the made ground in the vicinity of these foundations should be considered and foundation inspections should be carried out. Any soft spots encountered at the proposed foundation depths should be excavated and replaced with lean mix concrete.

A ground bearing floor slab is recommended to be based on the stiff cohesive deposits or weak bedrock with an appropriate depth of compacted hardcore specified by the consulting engineer and in accordance with the limits and guidelines in SR21:2014+ A1:2016 and/or NRA SRW CL808 Type E granular stone fill.

5.1. Excavations

Excavations in the Made Ground will require to be appropriately battered or the sides supported due to the low strength of these deposits. Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.

Any excavations which penetrate the granular or weathered bedrock deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.

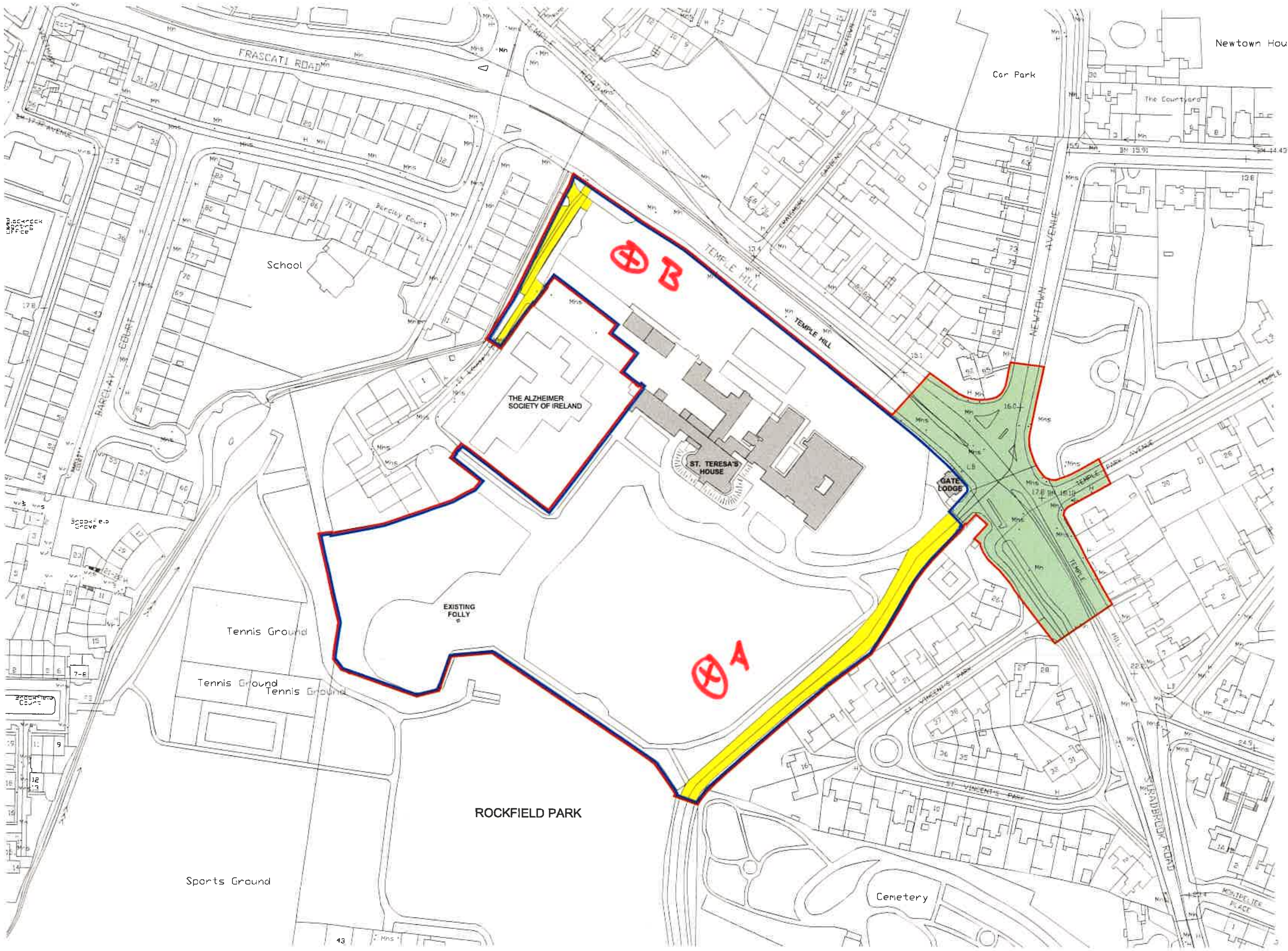
Generally, where significant excavations are required in water bearing granular deposits a cut-off wall may be more cost effective than extensive dewatering. An assessment by a specialist dewatering contractor is recommended to determine the most cost effective approach to the proposed excavation. A retaining wall is recommended to extend into the intact granite bedrock to enable the construction of the double basement, particularly if the weathered granite is persistent across the basement footprint. The groundwater level is above the basement depth at both locations and dewatering may be required to enable the construction of the basement in a dry environment.

The excavations proposed are estimated to be 8.0m BGL for Block B which will penetrate into the weathered Granite between 6.8m and the base of the excavation. Excavations in the upper cohesive and weathered rock deposits are expected to be excavatable with conventional excavation equipment, with zones of more intact bedrock below this depth requiring specialist techniques. Where the rock is present in such weathered state it should be excavatable with conventional excavation techniques however where more competent rock is encountered specialist hydraulic splitting equipment can be utilised to eliminates shocks and vibrations associated with rock breaking with impact hammers. This technique has been used successfully in the strong granite bedrock in the South Dublin area in the vicinity of existing structures and services. The excavation for Block A may not encounter bedrock which was not found until a depth of 8.0m BGL and therefore should be excavatable with conventional excavation equipment. Large boulders which can be present in the glacial till may require specialist techniques to split and permit excavation and removal from site.

Any material to be removed off site should be disposed of to a suitably licenced landfill.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



Site Location Plan

OS MAP SERIES: 1:1000 / datum - Malin Head
OS MAP REF: 3393-03, 3393-02, 3330-22, 3330-23
ITM Centre Point Co-ordinate: X,Y = 721758,729006
Copyright Ordnance Survey Ireland and Government of Ireland
Ordnance Survey Ireland License No. AR 0005018

All levels (in meters) are related to Malin Head levelling datum. All dimensions in millimetres. figured dimensions only are to be taken from this drawing. All work to be carried out in accordance with the current building regulations. All dimensions to be checked on site before work is carried out. All consultants are to be notified of any discrepancies.

🟥	Application site outlined in red (4.55 Ha)
🟦	Lands in the ownership of the applicant and/or landowner (3.97 Ha)
🟩	Area of land for which consent is being sought that is in the ownership of the Local Authority (DLRCC)
🟨	Wayleave Access to be retained

Revision Description	Date	Rev. No.	Issued by

Figured dimensions only to be used. This drawing is copyright of O'Mahony Pike Architects Ltd. All information is shared as per approved use in accordance with BS1192(2007) + A2(2016), Table 5; Standard Codes for Suitability of Models and Documents. If 'Information Approval Check' is empty, this information has been shared at S0 - WIP.

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Project No.: 1706
Scale @ A1: 1:1,000
Project Lead: DM
Date Printed: 19-09-2018
Drawn By: DÓS
Current Rev.:
Model No.: 1706-OMP-00-00-M2-A-XX-01000
Purpose: Pre-Planning

Project: Residential Development
Location: St. Teresa's, Temple Road, Blackrock
Client: Oval Target Ltd

Drawing Title: Site Location Plan
Drawing No.: 1706-OMP-00-000-DR-A-XX-01001

APPENDIX 2 –Rotary Core Records

Ground Investigations Ireland Ltd

www.gii.ie

Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter**	**Ground Level (mOD)**	**Site** Rotary Core, St Teresas' School	**Borehole Number** **BH-A**
			Client	**Job Number** 8236-11-18
	Location Blackrock, Dublin	**Dates** 01/01/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00	24						(2.30)	Poor Recovery of brown slightly sandy gravelly CLAY with occasional gravelly lenses. Driller notes: Stiff brown sandy gravelly Clay			
2.30 2.30-2.75	20				3,4/6,5,5,5 SPT N=21		2.30 (1.40)	Poor Recovery of brown black slightly sandy gravelly CLAY with occasional gravelly lenses. Driller notes: Stiff black sandy gravelly Clay			
3.70 3.70-3.72	75				23,2/50 SPT 25*/10 50/10		3.70 (1.10)	Granite BOULDER			
							4.80 (3.20)	Poor Recovery of black slightly sandy gravelly CLAY. Driller notes: Stiff to very stiff black gravelly Clay			
5.30 5.30-5.75	20				4,6/7,5,7,9 SPT N=28						
6.80 6.80-7.25	40	17	17		7,10/8,6,9,7 SPT N=30						
8.00							8.00	Strong to very strong white grey mottled pink phaneritic GRANITE, partially to unweathered			
8.30	100	97	97								
9.80											

Remarks	**Scale (approx)** 1:50	**Logged By** TMI
	Figure No. 8236-11-18.BH-B	

Ground Investigations Ireland Ltd

www.gii.ie

Site Rotary Core, St Teresas' School

Borehole Number BH-A

Machine : Beretta T44

Flush :

Core Dia : mm

Method : Rotary Cored

Casing Diameter

Ground Level (mOD)

Client

Job Number 8236-11-18

Location Blackrock, Dublin

Dates 01/01/2019

Project Contractor Ground Investigations Ireland

Sheet 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	100	100	2			(5.50)	8.0m - 13.5m Fractures are 40 to 50 degrees, planar, rough, medium to widely spaced, slight staining on fracture surfaces			
	100	100	0								
11.20 11.30											
	100	100	100								
12.80											
	100	100	100								
13.50							13.50	Complete at 13.50m			

Remarks

Scale (approx) 1:50

Logged By TMI

Figure No. 8236-11-18.BH-B

Ground Investigations Ireland Ltd
www.gii.ie

Site
Rotary Core, St Teresas' School

Borehole Number
BH-B

Machine : Beretta T44
Flush :
Core Dia : mm
Method : Rotary Cored

Casing Diameter

Ground Level (mOD)

Client

Job Number
8236-11-18

Location
Blackrock, Dublin

Dates
11/12/2018

Project Contractor
Ground Investigations Ireland

Sheet
1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00	15						0.10	TOPSOIL			
							(2.20)	Driller Notes: MADE GROUND consisting of brown Clay. Recovery consists of medium to coarse Gravel and cobble fragments			
2.30 2.30-2.75	30				4,6/6,8,5,7 SPT N=26		2.30 (4.50)	Poor Recovery of grey sub rounded to sub angular fine to coarse Gravel with occasional sandy lenses. Driller notes: gravelly cobbly CLAY			
3.80	40										
5.30 5.30-5.75	27				6,9/9,15,26 SPT N=50						
6.80 6.80-6.82	70	30	10	12	25/50 SPT 25*/10 50/10		6.80 (1.20)	Very weak white brown mottled orange phaneritic GRANITE, distinctly weathered 6.8m - 8.0m - Fractures are sub horizontal 10 to 20 degrees, undulating, rough, closely spaced with sandy infill.			
8.00				NI			8.00 (1.50)	Exrtemely weak brownish grey GRANITE, residual rock			
8.30	87	13	7								
9.50							9.50	Weak to medium strong white brown mottled orange phaneritic GRANITE, distinctly to partially weathered			
9.80											

Remarks

Scale (approx)
1:50

Logged By
TMI

Figure No.
8236-11-18.BH-B

Ground Investigations Ireland Ltd www.gii.ie			**Site** Rotary Core, St Teresas' School		**Borehole Number** **BH-B**
Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter**	**Ground Level (mOD)**	**Client**		**Job Number** 8236-11-18
	Location Blackrock, Dublin	**Dates** 11/12/2018	**Project Contractor** Ground Investigations Ireland		**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	87	57	50	13			(2.00)	9.5m - 11.5m - Two Fracture sets. F1) 40 to 50 degrees, planar, smooth to rough, close to very close spaced with oxiation on fracture surfaces. F2) Sub horizontal 25 to 35 degrees, undulating, rough, closely spaced			
11.30	100	60	53								
11.50				10			11.50	Medium strong white brown mottled orange phaeritic GRANITE, partially weathered			
							(2.00)	11.5m - 13.5m - Two Fracture sets. F1) 40 to 50 degrees, planar, smooth, close spaced with oxiation on fracture surfaces. F2) Sub vertical 60 to 70 degrees, undulating, rough, close to medium spaced and oxidation on fracture surfaces			
12.80	100	71	14								
13.50							13.50	Complete at 13.50m			

Remarks	**Scale (approx)** 1:50	**Logged By** TMI
	Figure No. 8236-11-18.BH-B	

St Teresas' School, Blackrock – Rotary Core Photographs

BH-A – Box 1 of 3

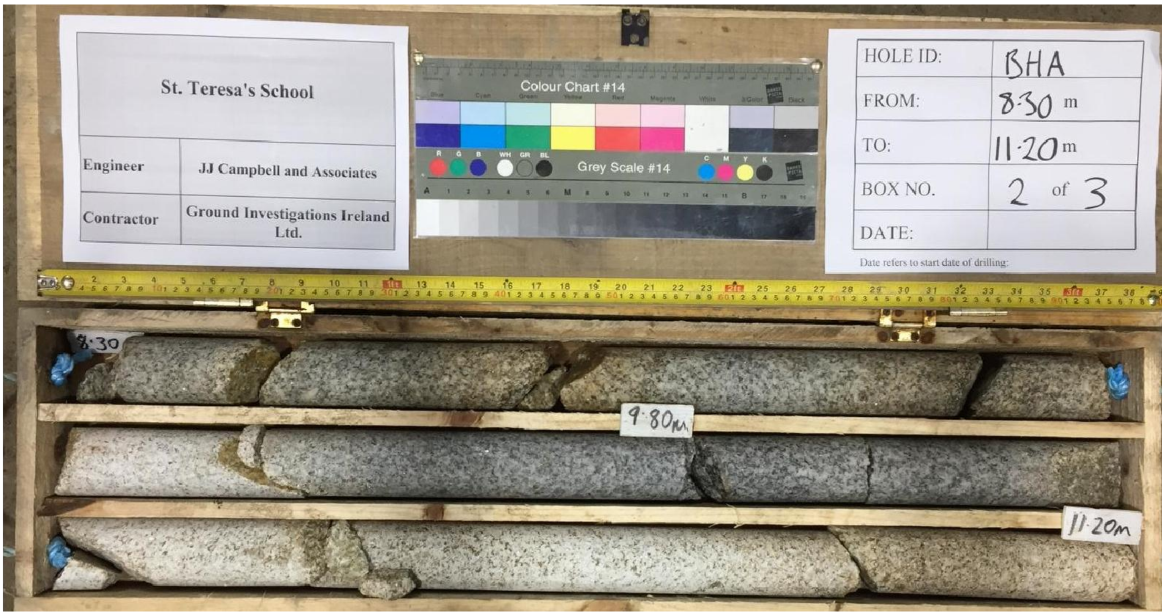
St. Teresa's School

Engineer	JJ Campbell and Associates
Contractor	Ground Investigations Ireland Ltd.

HOLE ID:	BHA
FROM:	0.00 m
TO:	8.30 m
BOX NO.	1 of 3
DATE:	

Date refers to start date of drilling:

BH-A – Box 2 of 3



St. Teresa's School

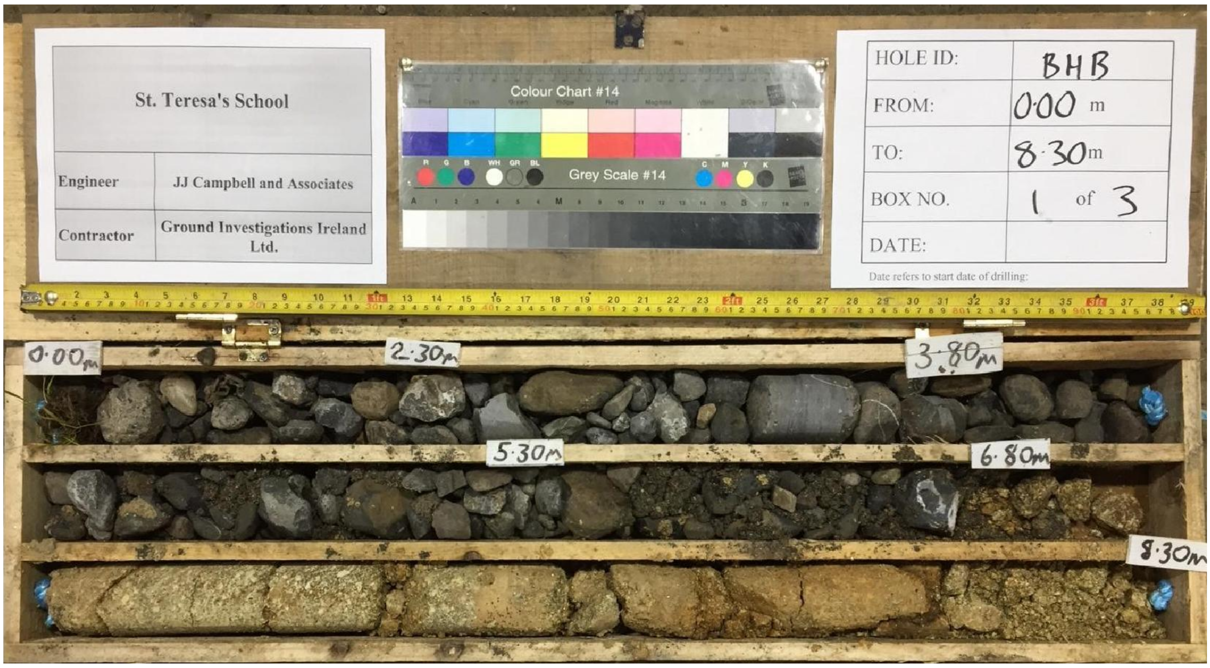
Engineer	JJ Campbell and Associates
Contractor	Ground Investigations Ireland Ltd.

HOLE ID:	BHA
FROM:	8.30 m
TO:	11.20 m
BOX NO.	2 of 3
DATE:	

Date refers to start date of drilling:

BH-A – Box 3 of 3

BH-B – Box 1 of 3



BH-B – Box 2 of 3

BH-B – Box 3 of 3

APPENDIX 3 –Groundwater Monitoring

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Newcastle, Co Dublin.
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Email: info@gii.ie | Web: gii.ie

GROUNDWATER MONITORING

St Teresa's Blackrock

BOREHOLE	DATE	TIME	GROUNDWATER (mBGL)	Comments
BHA	14/01/2019	11.00	1.02	
BHB	14/01/2019	11.15	3.74	

Ground Investigations Ireland Ltd.,
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GROUNDWATER MONITORING

St Teresa's Blackrock

BOREHOLE	DATE	TIME	GROUNDWATER (mBGL)	Comments
BHA	14/01/2019	11.00	1.02	
BHB	14/01/2019	11.15	3.74	

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Ground Investigations Ireland

St. Teresa’s Lands Temple Hill, Monkstown

Blackrock, Co Dublin

Ground Investigation Report

December 2020

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DOCUMENT CONTROL SHEET

Project Title	St. Teresa's Lands Temple Hill, Monkstown, Blackrock, Co Dublin
Engineer	JJ Campbell & Associates
Client	Oval Target Ltd
Project No	10069-10-20
Document Title	Ground Investigation Report

Rev.	**Status**	**Author(s)**	**Reviewed By**	**Approved By**	**Office of Origin**	**Issue Date**
B	Final	E Byrne	S Kealy	C Finnerty	Dublin	16 December 2020

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.

CONTENTS

APPENDICES

Appendix 1	Site Location Plan
Appendix 2	Trial Pit Records
Appendix 3	Cable Percussion and Rotary Core Records
Appendix 4	Slit Trench Records
Appendix 5	Laboratory Testing

1.0 Preamble

On the instructions of JJ Campbell & Associates, a site investigation was carried out by Ground Investigations Ireland Ltd., November 2020 at the site of the proposed residential development at St Teresa's Lands Temple Hill, Monkstown, Blackrock, Co Dublin.

2.0 Overview

2.1. Background

The proposed development comprises 493 residential units with underground car parkingand the relocation of exisitng Gate Lodge.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 6 No. Trial Pits to a maximum depth of 3.20m BGL
- Carry out 6 No. Slit Trenches to ascertain existing service details
- Carry out 3 No. Cable Percussion boreholes to a maximum depth of 2.50m BGL
- Carry out 2 No. Rotary Core Boreholes to a maximum depth of 8.50m BGL
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Slit Trenching

The slit trenches were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The soil was slowly stripped using a spotter on the trench to alert the driver if any services were seen, to avoid damage to any underlying services. The slit trenches were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the slit trench records which are provided in Appendix 4 of this Report.

3.4. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata.

Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 3 of this Report.

3.5. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 3 of this Report.

3.6. Surveying

The exploratory hole locations have been recorded using a Trimble R10 GNSS System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.7. Groundwater Installations

A Groundwater Monitoring Installation was installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.8. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical testing to assist in the classification of soils and to provide information for the proposed design.
Chemical testing as required by the specification, including the pH and sulphate testing was carried out by Element Materials Technology Laboratory in the UK.
Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD), hydrometer tests were carried out in NMTL's Geotechnical Laboratory in Carlow. Specialist shear strength testing consisting of quick undrained, consolidated undrained triaxial, shear box and consolidation testing was carried out on undisturbed U100 or piston samples where recovered.
Rock strength testing including Point Load (Is_{50}) and Unconfined Compressive Strength (UCS) testing was carried out in James Fischer's Geotechnical Laboratory. The results of the laboratory testing are included in Appendix 5 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil/Surfacing
- Made Ground
- Granular Deposits
- Cohesive Deposits
- Bedrock

TOPSOIL: Topsoil was encountered in most of the exploratory holes and was present to a maximum depth of 0.40m BGL. Tarmac surfacing was present typically to a depth of 0.10m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to a relatively consistent depth of between 0.70m and 1.20m BGL. These deposits were described generally as *brown slightly sandy slightly gravelly Clay with occasional fragments of red brick.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground and were described typically as *brown/light brown slightly sandy gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

GRANULAR DEPOSITS: The granular deposits were encountered at the base of the cohesive deposits and were typically described as *Grey/brown clayey sandy sub rounded to sub angular fine to coarse GRAVEL with occasional cobbles and rare boulders.* The secondary sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble and boulder content also present where noted on the exploratory hole logs.

Based on the SPT N values the deposits are typically dense. It should be noted that many of the trial pits where granular deposits were encountered, experienced instability. This was described either as side wall spalling or as side wall collapse in the remarks section at the base of the trial pit logs.

BEDROCK: The rotary core boreholes recovered *Medium strong to strong light brownish grey coarsely crystalline GRANITE*.

The depth to rock varies from 2.10m BGL in BH03 to a maximum of 5.05m BGL in BH02. The total core recovery is good, typically 100% with some of the uppermost runs dropping to 80 or 90%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors. For this reason, a standpipe was installed in BH2019 allow the equilibrium groundwater level to be determined. The groundwater monitoring is included in Appendix 6 of this Report.

4.3. Laboratory Testing

4.3.1. Chemical Laboratory Testing

The pH and sulphate testing carried out indicate that pH results are near neutral and that the water soluble sulphate results is low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.

4.3.2. Rock Laboratory Testing

The rock testing carried out on samples recovered from the boreholes reported point load testing gave Is_{50} values ranging between 1.66 to 1.93 MPa. The Is_{50} results correlate to the UCS values using a factor of approximately 20, giving values of 33.2 MPa and 38.6 MPa. The results from the completed laboratory testing is included in Appendix 5 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

An allowable bearing capacity of 250 kN/m^2 is recommended for conventional strip or pad foundations on the dense granular deposits at a depth of 4.0m BGL at the location of BH02. Should a higher bearing capacity be required at this depth we would recommend an allowable bearing capacity of 1000 kN/m^2 on the medium strong Granite deposits encountered at 5.0m BGL. Where the granite deposits are shallower, such as at the location of BH03 an allowable bearing capacity of 1000 kN/m^2 is recommended on the medium strong Granite deposit at a depth of 2.10m BGL.

In any part of the site, should part of the foundation be on rock we would recommend that all the foundations of the unit in question be lowered to the competent rock stratum to avoid differential settlement.

The pH and sulphate testing completed on samples recovered from the exploratory holes indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack. The samples tested were below the limits of DS1 in the BRE Special Digest 1:2005.

5.3. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.

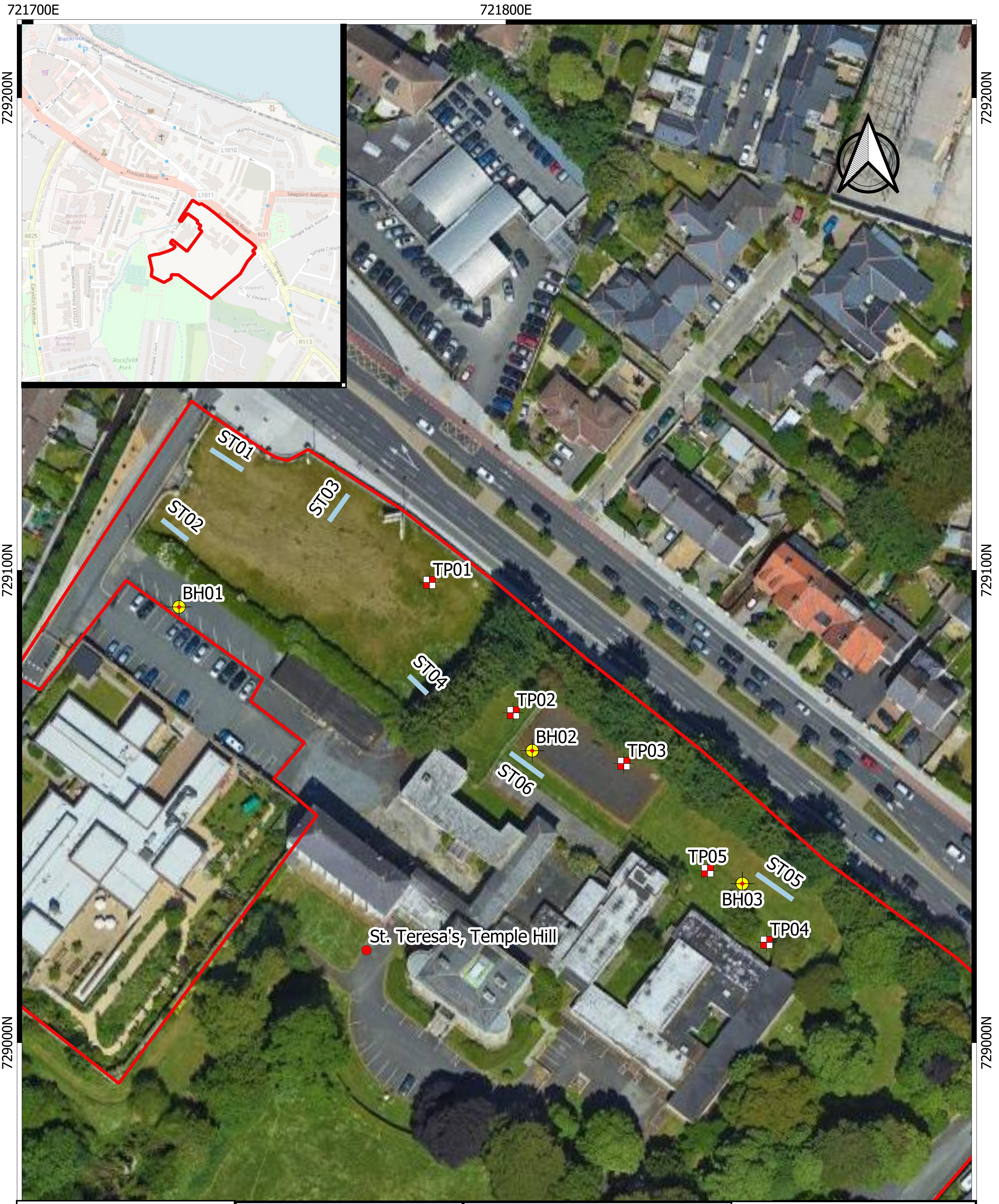
Excavations in the Made Ground or soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.

Excavations in the upper cohesive and weathered rock deposits are expected to be excavatable with conventional excavation equipment, with zones of more intact bedrock below this depth requiring rock breaking techniques. If rock breaking is required, we would recommend carrying out a rock rippability test or trial excavation.

Any waste material to be removed off site should be disposed of to a suitably licenced landfill.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

Client:

JJ CAMPBELL & ASSOCIATES
CONSULTING CIVIL & STRUCTURAL ENGINEERS

0 20 40 m

Project Title:
St. Teresa's, Temple Hill,

Drawing Title:
Figure 1 Site Location

GII Project Reference:
10069-10-20

Drawn By:
EB

Date:
13/11/2020

Legend
- ⊕ Borehole
- ▨ Trial Pit
- — Slit Trench
- ▭ Inidicative Site Boundary

APPENDIX 2 – Trial Pit Records

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.00x0.65x3.20m	**Ground Level (mOD)** 14.75	**Client**	**Job Number** 10069-10-20
	Location 721783.8 E 729097.2 N	**Dates** 09/11/2020	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Site
St. Teresa's Lands, Temple Hill, Blackrock

Trial Pit Number
TP01

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL	▨	
				14.45	0.30	MADE GROUND: Brown slightly sandy gravelly Clay with red brick fragments	▩	
0.50	B							
					(0.90)			
1.00	B							
				13.55	1.20	Soft light brown slightly sandy slightly gravelly CLAY	⁘	
					(0.50)			
				13.05	1.70	Brown clayey very sandy fine to coarse angular to subrounded GRAVEL with some cobbles and boulders	⁘	
2.00	B							
					(1.50)			
				11.55	3.20	Complete at 3.20m		

Plan

Remarks

Trial Pit collapsing from 1.70m BGL
No groundwater encountered
Trial Pit backfilled upon completion

Scale (approx)	Logged By	Figure No.
1:25	EB	10069-10-20.TP01

Ground Investigations Ireland Ltd

www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.80x0.65x3.00m	**Ground Level (mOD)** 16.81	**Site** St. Teresa's Lands, Temple Hill, Blackrock **Client**	**Trial Pit Number** **TP02** **Job Number** 10069-10-20
	Location 721801.6 E 729069.6 N	**Dates** 09/11/2020	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	Brown slightly sandy slightly gravelly TOPSOIL	▨	
				16.46	0.35 (0.35)	MADE GROUND: Brown slightly sandy gravelly Clay with red brick fragments	▩	
				16.11	0.70 (0.50)	Grey/brown very clayey sandy fine to coarse angular to subrounded GRAVEL with some cobbles and boulders	∴	
				15.61	1.20 (1.80)	Grey clayey very sandy fine to coarse angular to subrounded GRAVEL with some cobbles and boulders	∴	
				13.81	3.00	Complete at 3.00m		

Plan

Remarks

Trial Pit stable
No groundwater encountered
Trial Pit backfilled upon completion

Scale (approx)	Logged By	Figure No.
1:25	EB	10069-10-20.TP02

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.00x0.65x3.10m	**Ground Level (mOD)** 16.96	**Site** St. Teresa's Lands, Temple Hill, Blackrock	**Client**	**Trial Pit Number** TP03
	Location 721824.9 E 729058.9 N	**Dates** 09/11/2020	**Engineer** JJ Campbell & Associates		**Job Number** 10069-10-20
					Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				16.86	(0.10) 0.10	TARMACADAM	▨	
				16.61	(0.25) 0.35	MADE GROUND: Brown grey angular fine to coarse crushed rock FILL	▨	
0.50	B							
				16.16	(0.45) 0.80	MADE GROUND: Grey/brown slightly sandy gravelly Clay	▨	
1.00	B							
				15.86	(0.30) 1.10	Grey/brown clayey very sandy fine to coarse angular to subrounded GRAVEL with some cobbles and boulders	⁖	
2.00	B							
				13.86	(2.00) 3.10	Grey very sandy fine to coarse angular to subrounded GRAVEL with some cobbles and boulders	⁖	
						Complete at 3.10m		

Plan

Remarks

Trial Pit stable
No groundwater encountered
Trial Pit backfilled upon completion

Scale (approx)	Logged By	Figure No.
1:25	EB	10069-10-20.TP03

Ground Investigations Ireland Ltd
www.gii.ie

Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.50x0.65x3.10m	**Ground Level (mOD)** 18.46	**Site** St. Teresa's Lands, Temple Hill, Blackrock	**Trial Pit Number** **TP04**	
	Location 721855.2 E 729021 N	**Dates** 09/11/2020	**Client**	**Job Number** 10069-10-20	
			Engineer JJ Campbell & Associates	**Sheet** 1/1	

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	Brown slightly gravelly TOPSOIL	▨	
				18.06	0.40 (0.45)	MADE GROUND: Brown slightly sandy gravelly Clay with a gas pipe	▨	
0.50	B							
				17.61	0.85 (0.35)	Stiff reddish brown slightly sandy gravelly CLAY	∴	
1.00	B							
				17.26	1.20	Stiff grey/brown slightly sandy gravelly CLAY with some angular to subrounded cobbles and boulders	∴	
2.00	B				(1.90)			
				15.36	3.10	Complete at 3.10m		

Plan

Remarks

Trial Pit stable
No groundwater encountered
Trial Pit backfilled upon completion
0.10m diameter Gas Pipe encountered at 0.55m BGL

Scale (approx)	Logged By	Figure No.
1:25	EB	10069-10-20.TP04

Ground Investigations Ireland Ltd
www.gii.ie

Site	St. Teresa's Lands, Temple Hill, Blackrock			**Trial Pit Number**	TP05
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.80x0.65x2.80m	**Ground Level (mOD)** 17.84	**Client**	**Job Number**	10069-10-20
	Location 721842.7 E 729036.2 N	**Dates** 09/11/2020	**Engineer** JJ Campbell & Associates	**Sheet**	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly gravelly TOPSOIL	▨	
				17.54	0.30 (0.30)	MADE GROUND: Brown slightly sandy gravelly Clay with a gas pipe	▩	
				17.24	0.60 (0.40)	POSSIBLE MADE GROUND: Brown slightly sandy gravelly Clay with occasional subrounded cobbles	▩	
				16.84	1.00 (0.50)	Stiff brown slightly sandy gravelly CLAY with some angular to subrounded cobbles and boulders	⁙	
				16.34	1.50 (1.30)	Grey/brown very clayey sandy fine to coarse angular to subrounded GRAVEL with many cobbles and boulders	⁙	
				15.04	2.80	Complete at 2.80m		

Plan

Remarks

Trial Pit stable
No groundwater encountered
Trial Pit backfilled upon completion

Scale (approx)	**Logged By**	**Figure No.**
1:25	EB	10069-10-20.TP05

St. Teresa’s Temple Hill Blackrock Trial Pit Photographs

TP01

TP01

TP01

TP02

TP02

TP02

TP02

TP03

TP03

TP03

TP04

TP04

TP04

TP05

TP05

TP05

APPENDIX 3 – Cable Percussion & Rotary Borehole Records

Ground Investigations Ireland Ltd
www.gii.ie

Site
St. Teresa's Lands, Temple Hill, Blackrock

Borehole Number
BH01

Machine : Dando 2000
Method : Cable Percussion

Casing Diameter
200mm to 2.20m

Ground Level (mOD)
13.41

Client

Job Number
10069-10-20

Location
721730.9 E 729092.2 N

Dates
09/11/2020

Engineer
JJ Campbell & Associates

Sheet
1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					13.21	(0.20) 0.20	TARMACADAM	▨	
					12.96	(0.25) 0.45	Grey angular fine to coarse crushed rock FILL	▨	
0.50	B				12.66	(0.30) 0.75	MADE GROUND: Grey slightly sandy fine to coarse angular Gravel	▨	
0.80	B				12.41	(0.25) 1.00	MADE GROUND: Dark grey sandy slightly gravelly Clay	▨	
1.00-1.45 1.30	SPT(C) N=9 B			1,2/2,2,2,3	11.71	(0.70) 1.70	MADE GROUND: Brown slightly sandy gravelly Clay with red brick fragments	▨	
1.80 2.00-2.20	B SPT(C) 50/50			11,14/50	11.21	(0.50) 2.20	Stiff brown sandy slightly gravelly CLAY with occasional subrounded cobbles	⁘	
							Complete at 2.20m		

Remarks
Chiselling from 2.20m to 2.20m for 1 hour.

Scale (approx)
1:50

Logged By
EB

Figure No.
10069-10-20.BH01

Ground Investigations Ireland Ltd
www.gii.ie

Site: St. Teresa's Lands, Temple Hill, Blackrock

Borehole Number: BH02

Machine : Dando 2000 & Beretta T44

Method : Cable Percussion & Rotary Coring

Casing Diameter:
200mm to 2.30m
100mm to 8.50m

Ground Level (mOD): 17.10

Client:

Job Number: 10069-10-20

Location: 721805.6 E 729061.8 N

Dates: 05/11/2020-11/11/2020

Engineer: JJ Campbell & Associates

Sheet: 1/1

Depth (m)	Sample / Tests	TCR	SCR	RQD	FI	Field Records
0.60	B					
1.00-1.45	SPT(C) N=34					6,7/6,9,10,9
1.30	B					
2.00	B					
2.00-2.30	SPT(C) 50/150					10,18/20,22,8
2.30		48				
3.50-3.95						8,14/14,17,19 SPT N=50
3.50		45				
5.00-5.45						10,12/12,38 SPT N=50
5.00		83	43	21		
5.05					10	
6.50		100	55	47	7	
8.00		98	46	46		
8.50						

Level (mOD)	Depth (m)	(Thickness)	Description	Legend	Water
17.07	0.03		TARMACADAM		
16.80	0.30	(0.27)	Grey angular fine to coarse crushed rock FILL		
16.55	0.55	(0.25)	MADE GROUND: Grey slightly sandy fine to coarse angular Gravel		
16.00	1.10	(0.55)	Brown/grey slightly sandy gravelly CLAY		
14.80	2.30	(1.20)	Stiff brown sandy slightly gravelly CLAY with occasional subrounded cobbles		
13.60	3.50	(1.20)	Poor recovery. Recovery consists of dark brown to grey slightly sandy fine to coarse subangular to subrounded Gravel. Driller notes brown sandy gravelly Clay (Very Stiff).		
12.05	5.05	(1.55)	Poor recovery. Recovery consists of fine to coarse subangular to subrounded Gravel with frequent cobbles and boulder fragments. Driller notes brown sandy cobbly Gravel (Dense).		
10.60	6.50	(1.45)	Medium strong to strong light brownish grey coarsely crystalline GRANITE. Partially weathered. 5.05m - 6.50m BGL: 2 Fracture sets. F1: 5 - 10 degrees, very closely to closely spaced, undulating, rough, clay smearing, orange oxidation staining. F2: 25 - 35 degrees, closely spaced, undulating to planar, rough, clay smearing, orange oxidation staining.		
8.60	8.50	(2.00)	Strong light brownish grey coarsely crystalline GRANITE. Partially weathered. 6.50m - 8.50m BGL: 2 Fracture sets. F1: 5 - 30 degrees, closely to widely spaced, undulating, rough, clay smearing, orange oxidation staining. F2: 70 - 80 degrees, closely to widely spaced, undulating to planar, rough, clay smearing, orange oxidation staining. 7.27m - 7.36m BGL: Non intact zone.		
			Complete at 8.50m		

Remarks
Cable percussion to 2.30m BGL. Rotary core follow on from 2.30m to 8.50m BGL.
Borehole complete at 8.50m BGL.
Plain pipe with bentonite seal from GL to 1.00m BGL, slotted pipe with pea gravel surround from 1.00m BGL to 8.50m BGL. Finished with a flush cover.
Chiselling from 2.30m to 2.30m for 1 hour.

Scale (approx): 1:50

Logged By: EB & JMD

Figure No.: 10069-10-20.BH02

Ground Investigations Ireland Ltd
www.gii.ie

Site	St. Teresa's Lands, Temple Hill, Blackrock		**Borehole Number**	**BH03**
Machine : Dando 2000 & Beretta T44 **Method :** Cable Percussion & Rotary Coring	**Casing Diameter** 200mm to 2.10m 100mm to 6.50m	**Ground Level (mOD)** 17.54	**Client**	**Job Number** 10069-10-20
	Location 721850.1 E 729033.6 N	**Dates** 03/11/2020- 11/11/2020	**Engineer** JJ Campbell & Associates	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records
0.40	B			
0.80	B			
1.00-1.45	SPT(C) N=48			4,6/6,11,14,17
1.80	B			
2.00-2.41	SPT(C) 50/260			11,15/15,15,15,5 25/50
2.30	B			
2.50-2.51				SPT(C) 25*/10 50/0

Depth (m)	TCR	SCR	RQD	FI
2.50	100	46	26	4
3.00				NI
3.34				4
3.50	100	25	7	
3.79				NI
4.24				7
5.00	93	74	74	
5.50				3
6.50				

Level (mOD)	Depth (m) (Thickness)	Description
17.44	0.10	Brown slightly sandy TOPSOIL
	(0.60)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with red brick fragments
16.84	0.70 (0.30)	Light brown slightly sandy slightly gravelly CLAY
16.54	1.00 (0.60)	Stiff brown slightly sandy gravelly CLAY with occasional subrounded cobbles
15.94	1.60 (0.50)	Stiff brown sandy slightly gravelly CLAY with occasional subrounded cobbles
15.44	2.10 (2.55)	Medium strong light brownish grey coarsely crystalline GRANITE. Partially to distinctly weathered. 2.50m - 5.50m BGL: 3 Fracture sets. F1: 5 - 10 degrees, closely to medium spaced, undulating, roguh, clay smearing, orange oxidation staining. F2: 40 - 50 degrees, medium to widely spaced, undulating, rough, clay smearing, orange oxidation staining. F3: 65 - 80 degrees, medium to widely spaced, undulating to planar, rough, clay smearing, orange oxidation staining.
12.89	4.65 (1.85)	Strong light brownish grey coarsely crystalline GRANITE. Partially weathered. 5.50m - 6.50m BGL: 1 Fracture set at 65 - 80 degrees, medium to widely spaced, planar to undulating, rough, slight clasy smearing, orange oxidation staining.
11.04	6.50	Complete at 6.50m

Remarks
Cable percussion to 2.10m BGL. Rotary core follow on from 2.10m to 6.50m BGL.
Borehole complete at 6.50m BGL.
Borehole backfilled on completion.
Chiselling from 2.50m to 2.50m for 1 hour.

Scale (approx)	**Logged By**
1:50	EB & JMD

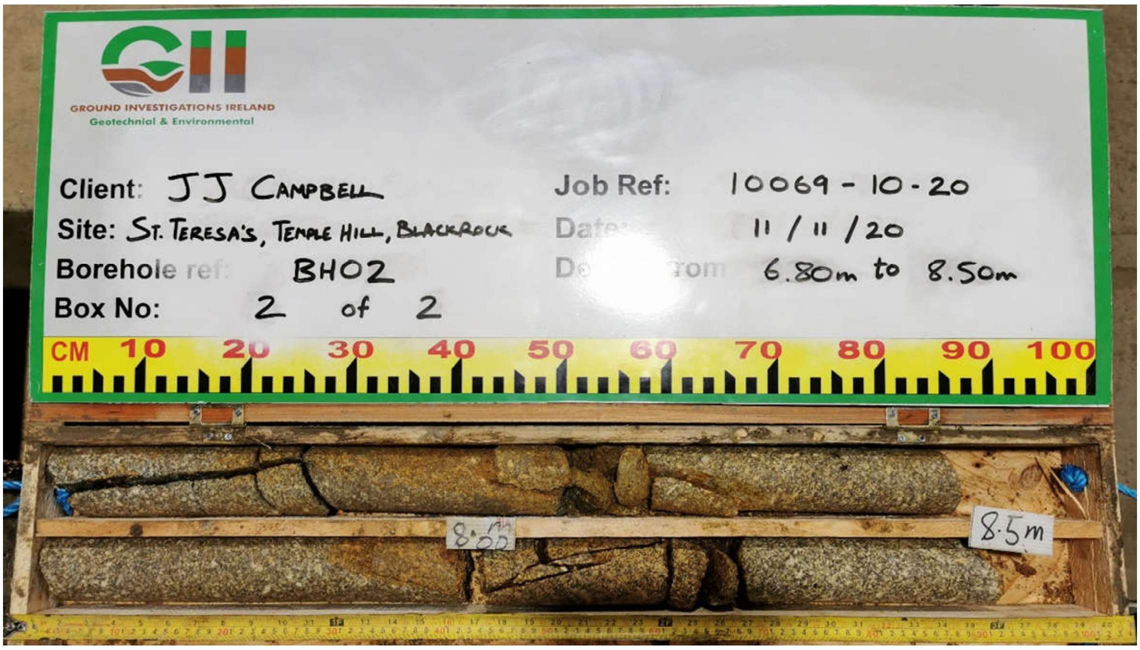
Figure No.
10069-10-20.BH03

St. Teresas Lands Temple Hill Blackrock – Rotary Core Photographs

BH02

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Client: JJ Campbell
Site: St. Teresa's, Temple Hill, Blackrock
Borehole ref: BH02
Box No: 1 of 2
Job Ref: 10069-10-20
Date: 11/11/20
Depth: From 2.30m to 6.80m

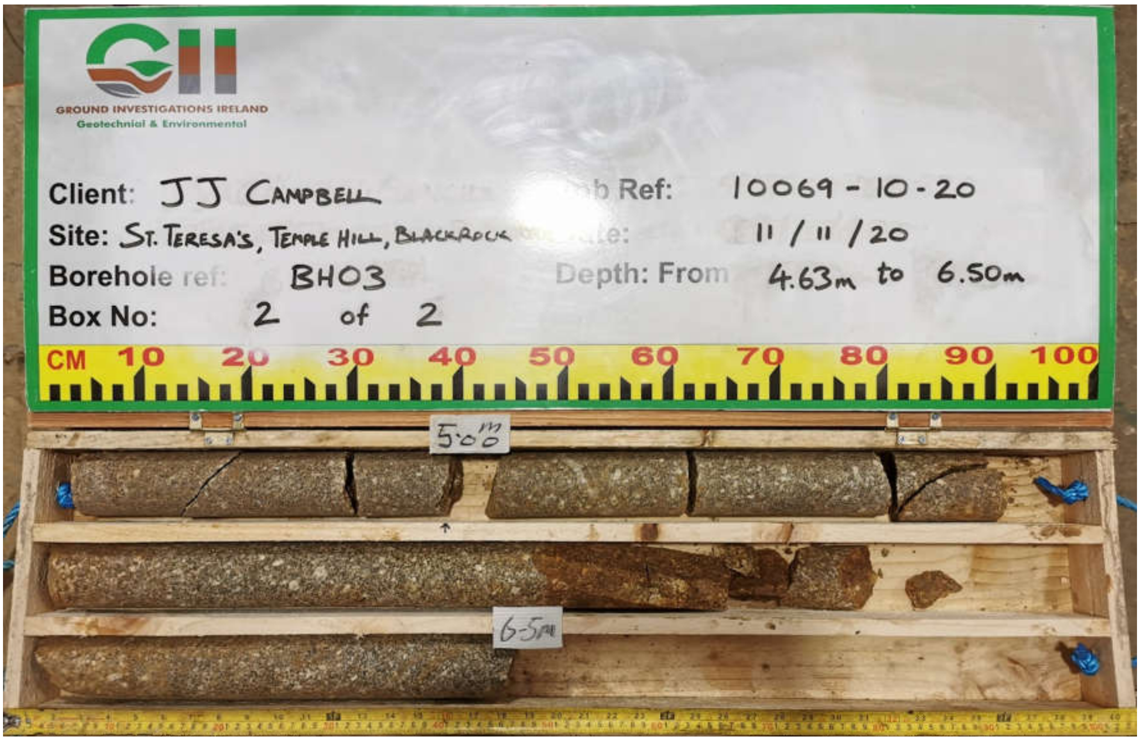


GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

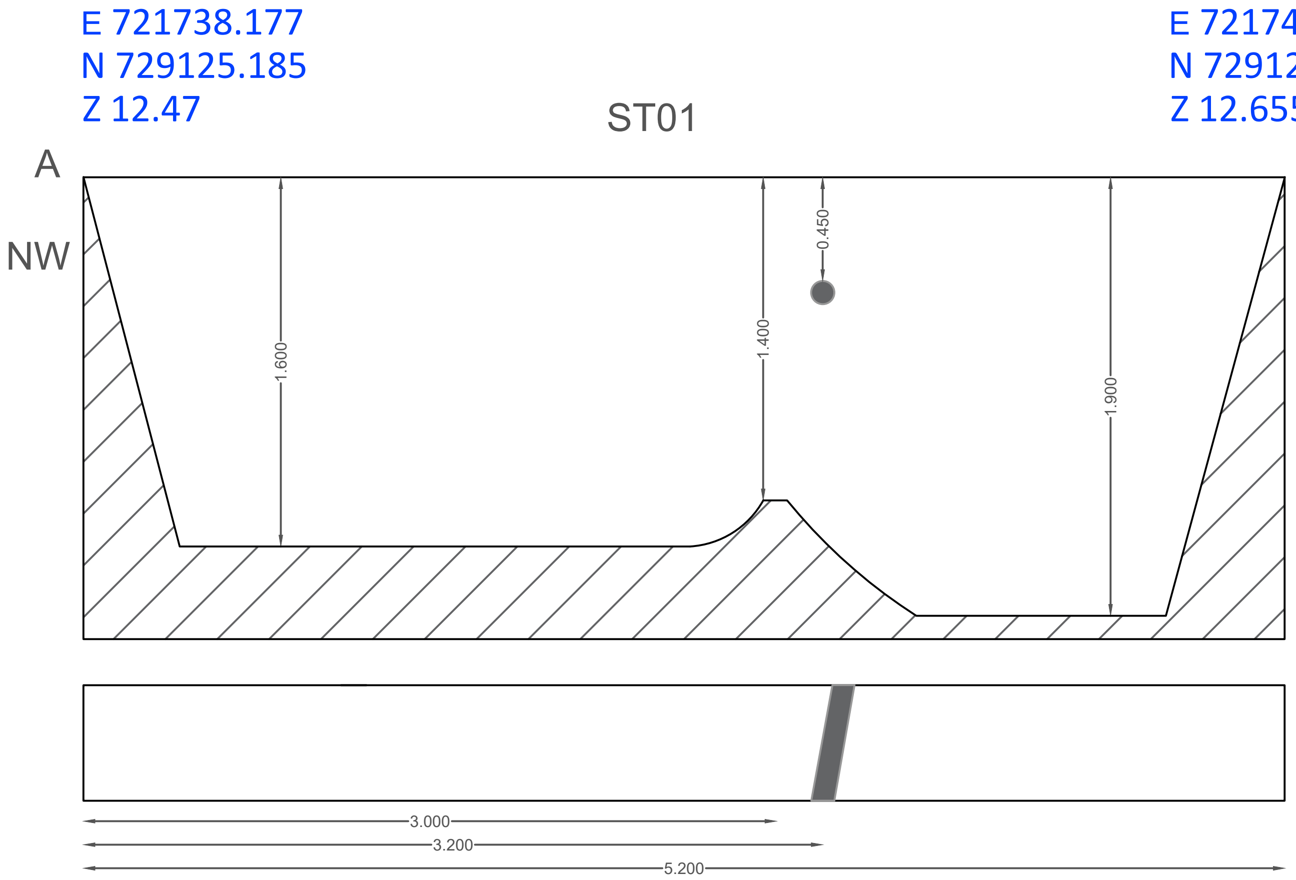
Client: JJ Campbell
Site: St. Teresa's, Temple Hill, Blackrock
Borehole ref: BH02
Box No: 2 of 2
Job Ref: 10069-10-20
Date: 11/11/20
Depth: From 6.80m to 8.50m

BH03


GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental
Client: JJ CAMPBELL
Site: ST. TERESA'S, TEMPLE HILL, BLACKROCK
Borehole ref: BH03
Box No: 1 of 2
Job Ref: 10069 - 10 - 20
Date: 11 / 11 / 20
Depth: From 0.00m to 4.63m
CM 10 20 30 40 50 60 70 80 90 100
0.00m
2.1m
3.5m


GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental
Client: JJ CAMPBELL
Site: ST. TERESA'S, TEMPLE HILL, BLACKROCK
Borehole ref: BH03
Box No: 2 of 2
Job Ref: 10069 - 10 - 20
Date: 11 / 11 / 20
Depth: From 4.63m to 6.50m
CM 10 20 30 40 50 60 70 80 90 100
5.00m
6.5m

APPENDIX 4 – Slit Trench Records



From (m)	To (m)	Description
0.00	0.20	Grey angular fine to coarse crushed rock FILL
0.20	0.90	MADE GROUND: Brown slightly sandy gravelly Clay with ceramic fragments
0.90	1.40	POSSIBLE MADE GROUND: Brown slightly sandy slightly gravelly Clay
1.40	1.70	Firm brown slightly sandy gravelly CLAY with subrounded occasional cobbles and boulders
1.70	1.90	Brown very clayey very sandy fine to coarse angular GRAVEL with some cobbles and boulders

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation
S1	0.100	Yellow Plastic	Old Foul	80	721740.651 729123.572	12.21

Sample Type	Sample Depth
Bag	0.50
Bag	1.00

Groundwater	Y/N	Depth
	N	

Surface from/to		Surface type
0.00	5.20	804

DATE OF EXCAVATION : 06/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

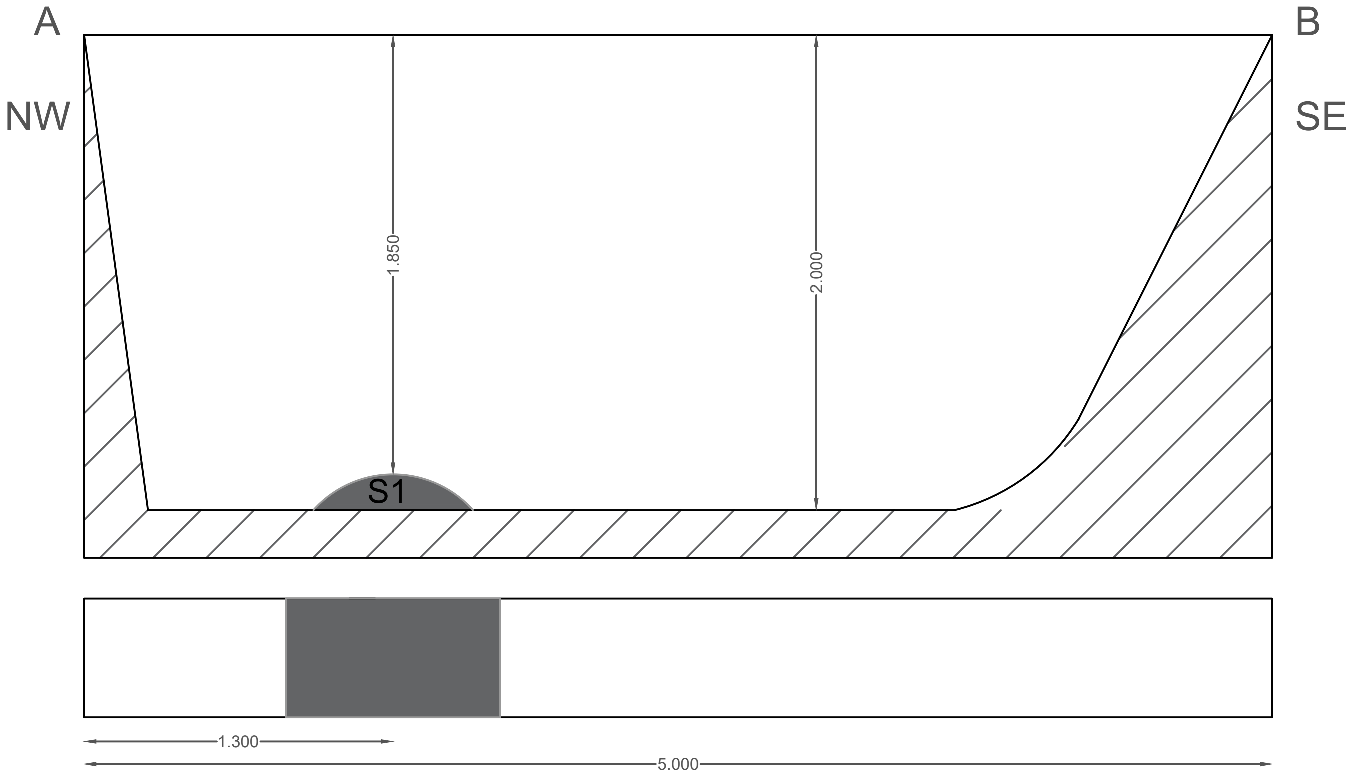
PROJECT:	St. Teresa's, Temple Hill
DRAWING No.:	10069-10-20 ST 01
DATE:	November 2020
CLIENT:	JJ Campbell & Associates
SCALE:	NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK

E 721727.775
N 729110.263
Z 12.581

ST02

E 721732.106
N 729106.876
Z 12.61



From (m)	To (m)	Description
0.00	0.20	Grey angular fine to coarse crushed rock FILL
0.20	1.50	MADE GROUND: Brown slightly sandy gravelly Clay with red brick fragments
1.50	2.00	MADE GROUND: Light brown slightly sandy gravelly Clay with occasional red brick and concrete fragments

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation
S1	0.900	Concrete	Sewer	90	721728.831 729109.333	10.812

Sample Type	Sample Depth

Groundwater	Y/N	Depth
	N	

Surface from/to		Surface type
0.00	5.00	804

DATE OF EXCAVATION : 06/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

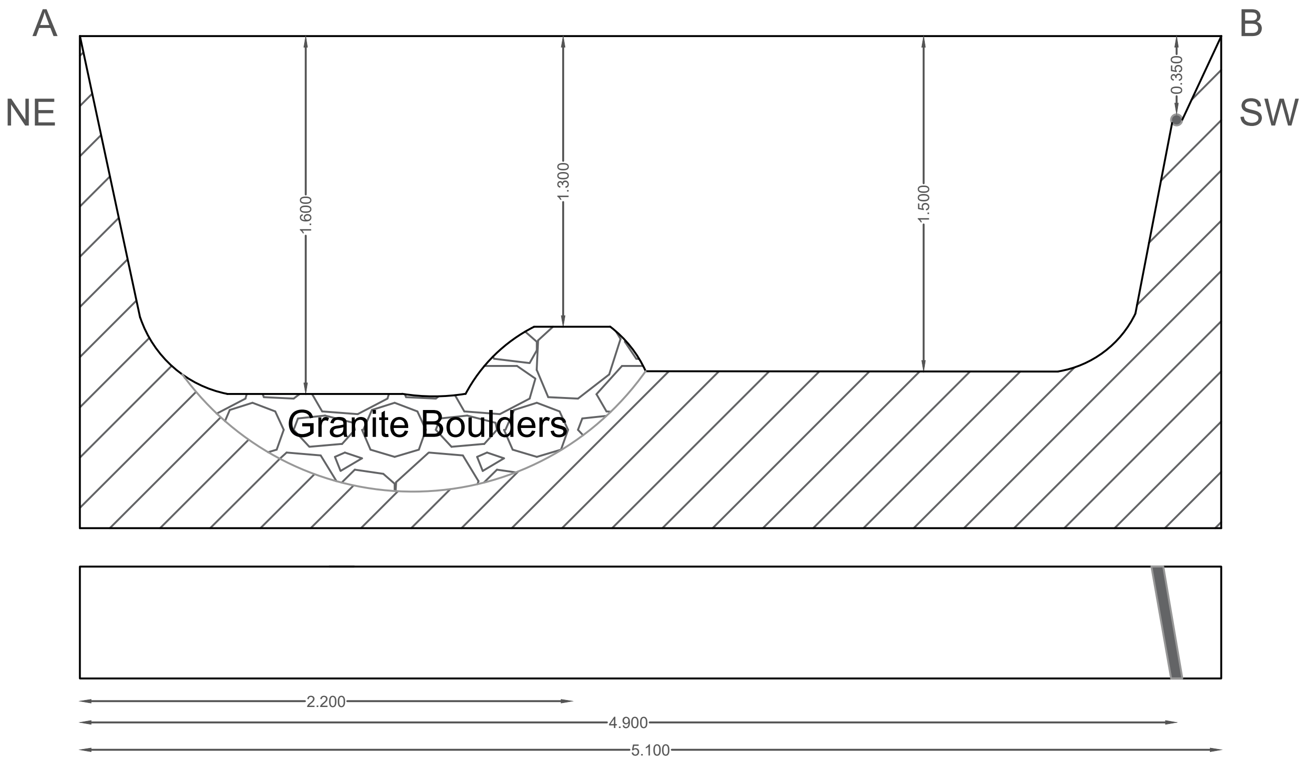
PROJECT:	St. Teresa's, Temple Hill
DRAWING No.:	10069-10-20 ST 02
DATE:	November 2020
CLIENT:	JJ Campbell & Associates
SCALE:	NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK

E 721766.298
N 729115.445
Z 13.052

E 721763.009
N 729110.969
Z 13.064

ST03



From (m)	To (m)	Description
0.00	0.25	Grey angular fine to coarse crushed rock FILL
0.25	0.26	Waterproof membrane
0.26	1.00	MADE GROUND: Brown slightly sandy gravelly Clay with ceramic fragments
1.00	1.30	Firm brown slightly sandy gravelly CLAY with occasional cobbles and boulders
1.30	1.50	Brown very clayey very sandy fine to coarse angular GRAVEL with some cobbles and boulders

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation
S1	0.050	Red Plastic	Streetlight	100	721763.234 729111.262	12.863

Sample Type	Sample Depth

	Y/N	Depth
Groundwater	N	

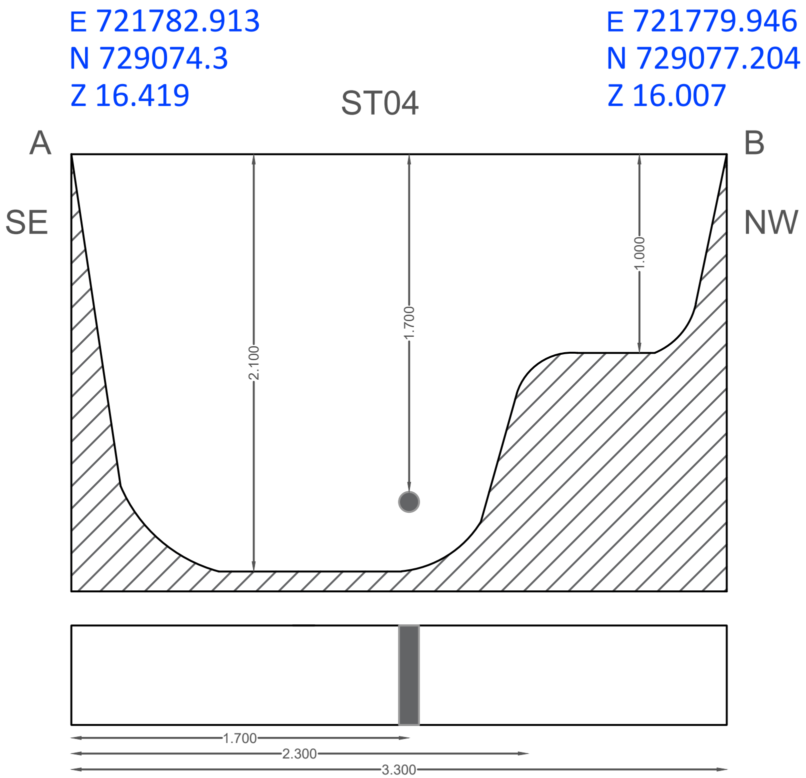
Surface from/to		Surface type
0.00	5.10	804

DATE OF EXCAVATION : 09/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

PROJECT:	St. Teresa's, Temple Hill
DRAWING No.:	10069-10-20 ST 03
DATE:	November 2020
CLIENT:	JJ Campbell & Associates
SCALE:	NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK



From (m)	To (m)	Description
0.00	0.10	Brown slightly sandy slightly gravelly TOPSOIL with some grass rootlets
0.10	0.70	MADE GROUND: Dark brown slightly sandy slightly gravelly Clay with occasional red brick fragments
0.70	1.10	MADE GROUND: Brown slightly sandy gravelly Clay with wavin pipe
1.10	2.00	Soft sandy slightly gravelly CLAY

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation
S1	0.100	Yellow Wavin	Water	90	721781.641 729075.419	14.521

Sample Type	Sample Depth

Groundwater	Y/N	Depth
	N	

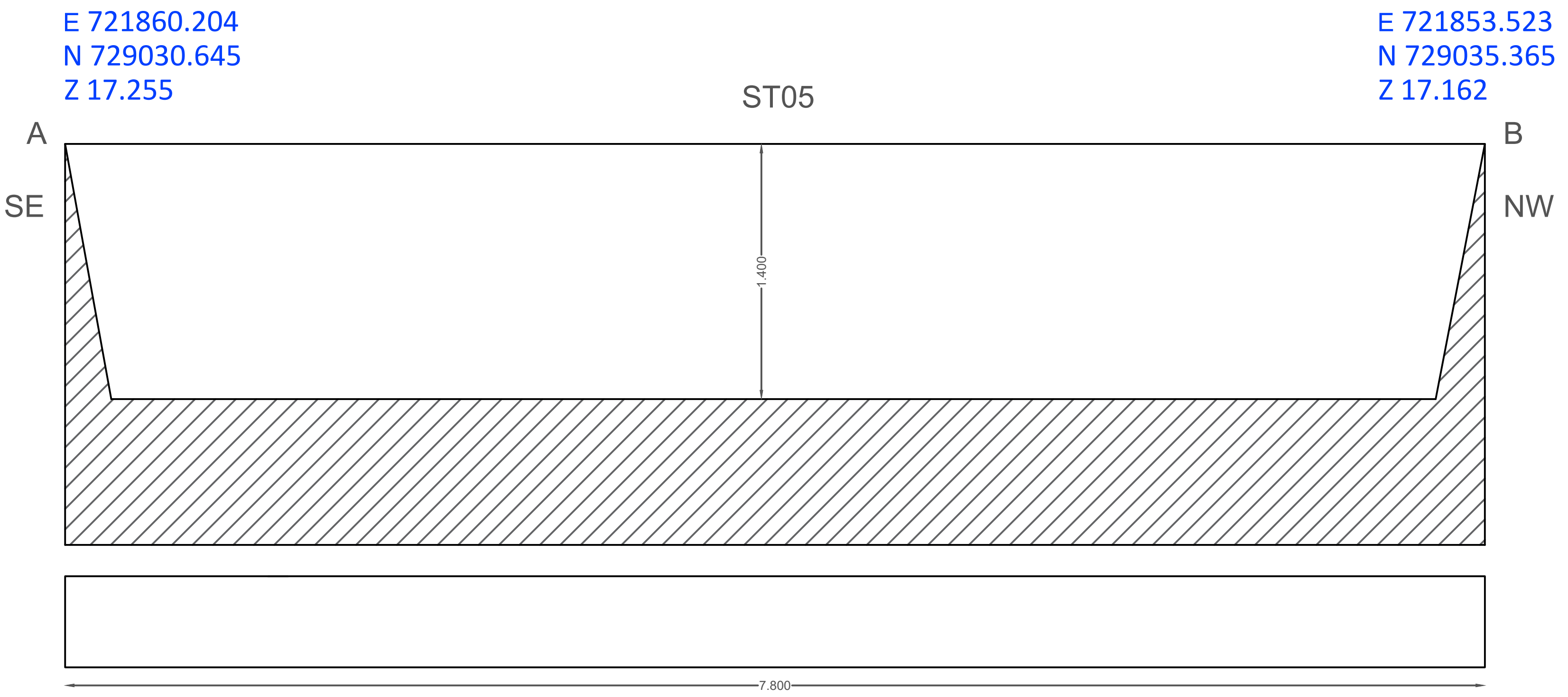
Surface from/to		Surface type
0.00	3.30	Grass

DATE OF EXCAVATION : 06/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

PROJECT: St. Teresa's, Temple Hill
DRAWING No.: 10069-10-20 ST 04
DATE: November 2020
CLIENT: JJ Campbell & Associates
SCALE: NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK



From (m)	To (m)	Description
0.00	0.30	Brown slightly sandy slightly gravelly TOPSOIL with some grass rootlets
0.30	0.70	MADE GROUND: Grey/brown slightly sandy gravelly Clay with occasional rebar
0.70	1.40	Stiff reddish brown slightly sandy gravelly CLAY with occasional subangular to subrounded cobbles

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation

Sample Type	Sample Depth

Groundwater	Y/N	Depth
	N	

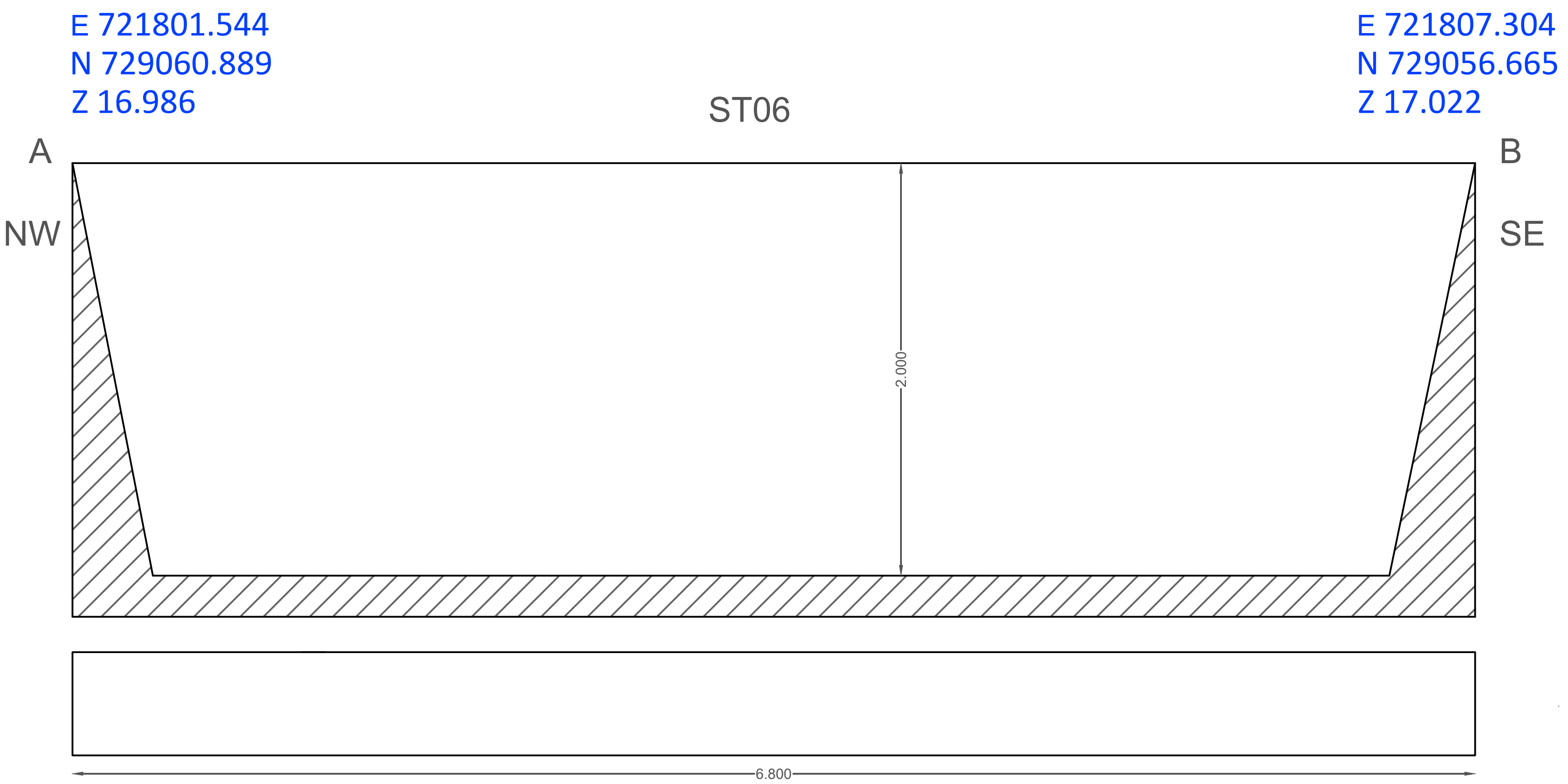
Surface from/to		Surface type
0.00	7.80	Grass

DATE OF EXCAVATION : 09/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

PROJECT:	St. Teresa's, Temple Hill
DRAWING No.:	10069-10-20 ST 05
DATE:	November 2020
CLIENT:	JJ Campbell & Associates
SCALE:	NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK



From (m)	To (m)	Description
0.00	0.30	Brown slightly sandy slightly gravelly TOPSOIL with some grass rootlets
0.30	0.90	MADE GROUND: Brown slightly sandy slightly gravelly Clay with occasional plastic fragments
0.90	1.40	Firm brown slightly sany gravelly CLAY
1.40	2.00	grey/brown clayey very sandy fine to coarse angular to subrounded GRAVEL

Service No	ø (m)	Colour- Material	Utility	Angle to trench	Co-ordinates	Elevation
n/a						

Sample Type	Sample Depth

Groundwater	Y/N	Depth
	N	

Surface from/to		Surface type
0.00	6.80	Grass

DATE OF EXCAVATION : 09/11/2020

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

PROJECT:	St. Teresa's, Temple Hill
DRAWING No.:	10069-10-20 ST 06
DATE:	November 2020
CLIENT:	JJ Campbell & Associates
SCALE:	NTS @ A4

Version:	Date:	Drawn By:	Checked:
No.	Initials	Initials	Initials
	13/11/2020	EB	SK

St. Teresa's Temple Hill Blackrock Slit Trench Photographs

ST01

ST01

ST01

ST01

ST01

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ST06

APPENDIX 5 – Laboratory Testing

National Materials Testing Laboratory Ltd.

SUMMARY OF TEST RESULTS

				Particle			Index Properties		Bulk	Cell	Undrained Triaxial Tests		Lab	
BH/TP	Depth	Sample	Moisture	Density	<425um	LL	PL	PI	Density	Presssure	Compressive	Strain at	Vane	Remarks
No	m	No.	%	Mg/m3	%	%	%	%	Mg/m3	kPa	Stress kPa	Failure %	kPa	
TP01	2.00	B	9.9		9.7	37	26	11						
TP04	2.00	B	9.9		35.9	34	19	15						

NMTL

Notes :

1. All BS tests carried out using preferred (definitive) method unless otherwise stated.

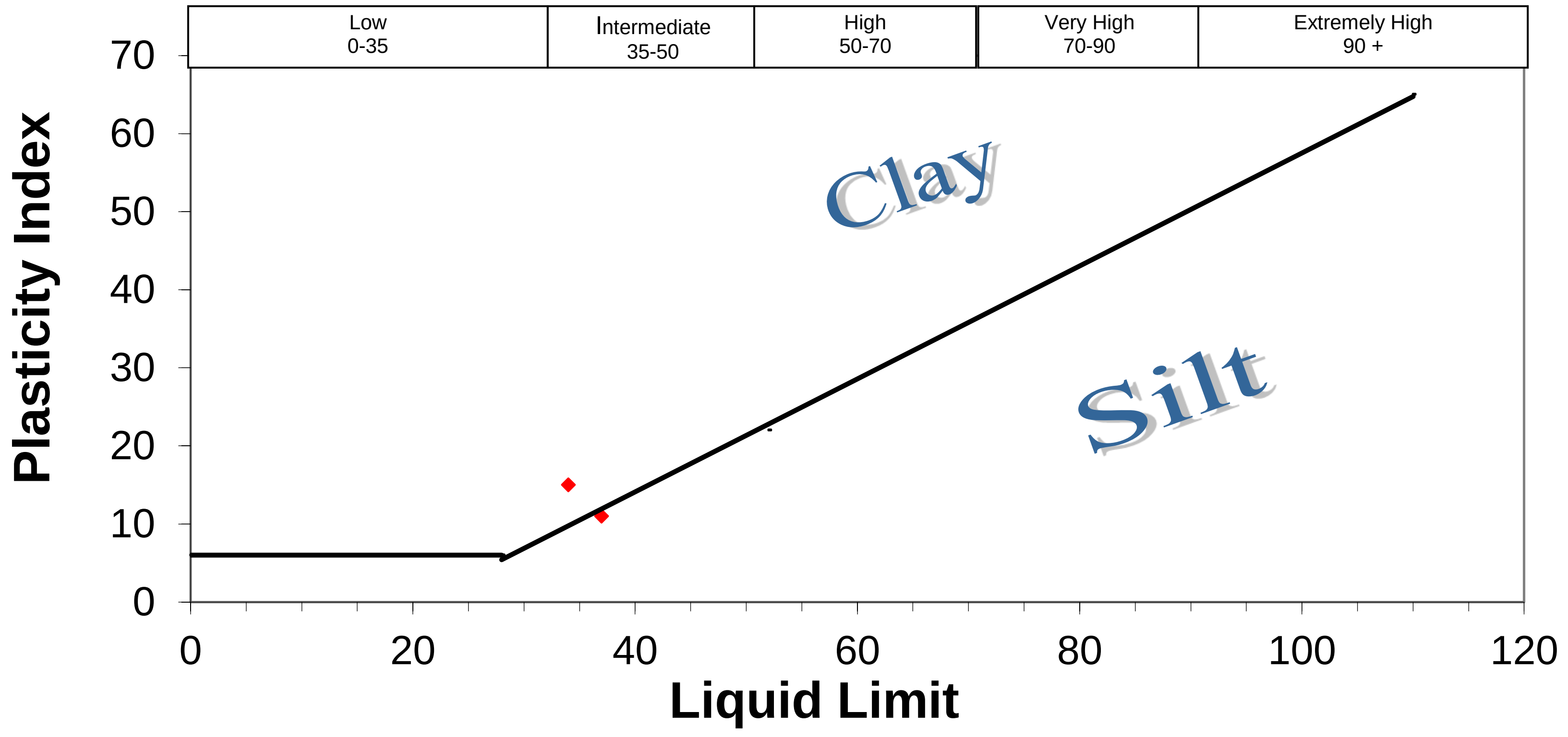
Job ref No. NMTL 3328 GII Project ID: 10069-10-20

Location St Teresa's

Revision-02

NMTL LTD
Unit 18c, Tullow Industrial Estate
Tullow
County Carlow
Tel: 00353 59 9180822
Mob: 00353 872575508
billa@nmtl.ie

Contract: St Teresa's
Client: Ground Investigations Ireland Ltd
Engineer: Eoin Byrne
GII Project ID 10069-10-20
Date: 04/12/2020
Tested By: Sb/Tch/Ms **Checked:** Bc
Job ref No. NMTL 3328



NMTL Ltd

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	97.8
50.000	93.1
37.500	87.6
28.000	78.0
20.000	67.6
14.000	56.7
10.000	48.0
6.300	38.8
5.000	35.5
3.350	30.9
2.000	23.9
1.180	18.1
0.600	11.8
0.425	9.7
0.300	8.4
0.212	7.6
0.150	7.0
0.063	5.5

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
	Silt			Sand			Gravel				
	5.5			18.4			73.9			2.2	0.0

Sample Description Dark brown silty sandy GRAVEL, with occsaional cobbles.

Project No. NMTL 3328

BH/TP No. TP01

Project St Terea's

GII PROJECT ID:10069-10-20

Sample No. B

NMTL Ltd

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	02/12/2020	Depth	2.0m

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	91.0
63.000	80.4
50.000	76.2
37.500	70.3
28.000	66.4
20.000	62.6
14.000	59.1
10.000	55.8
6.300	52.1
5.000	50.9
3.350	49.4
2.000	46.0
1.180	42.3
0.600	37.9
0.425	35.9
0.300	33.9
0.212	32.0
0.150	30.1
0.063	25.8

Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	25.8	20.2	34.4	19.6	0.0

Sample Description	Dark brown slightly sandy gravelly silty CLAY	Project No.	NMTL 3328
		BH/TP No.	TP04
Project	St Terea's GII PROJECT ID:10069-10-20	Sample No.	B

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	02/12/2020	Depth	2.0m

NM
TL
Ltd

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781

W: www.element.com

Ground Investigations Ireland
Catherinestown House
Hazelhatch Road
Newcastle
Co. Dublin
Ireland

4225

Attention :	Conor Finnerty
Date :	26th November, 2020
Your reference :	10069-10-20
Our reference :	Test Report 20/15944 Batch 1
Location :	St Teresas, Temple Hill, Blackrock
Date samples received :	13th November, 2020
Status :	Final report
Issue :	1

One sample was received for analysis on 13th November, 2020 of which one was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Bruce Leslie
Project Manager

Client Name:	Ground Investigations Ireland	**Report :**	**Solid**
Reference:	10069-10-20		
Location:	St Teresas, Temple Hill, Blackrock	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Conor Finnerty		
EMT Job No:	20/15944		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1												
Sample ID	TP01												
Depth	2.00												
COC No / misc													
Containers	T												
Sample Date	09/11/2020												
Sample Type	Soil												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	13/11/2020												
Sulphate as SO4 (2:1 Ext) #	0.0081										<0.0015	g/l	TM38/PM20
pH #	8.51										<0.01	pH units	TM73/PM11

Notification of Deviating Samples

Client Name: Ground Investigations Ireland
Reference: 10069-10-20
Location: St Teresas, Temple Hill, Blackrock
Contact: Conor Finnerty

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 20/15944						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/15944

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 20/15944

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993 (comparabl	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

James Fisher Testing Services
Materials Laboratory, Unit D
Zone 5, Clonminam Business Park
Portlaoise, Co. Laois

Laboratory Test Report
Point Load Strength Index

Project : St. Teresa's Lands, Temple Hill
Client : Ground Investigations Ireland
Catherinestown House, Hazelhatch Road
Newcastle, Co. Dublin
Originator Conor Finnerty

Job Number 10069-10-20
Lab Ref No ST 98624
Date Received 08/12/2020
Date Tested 09/12/2020
Date Reported 10/12/2020

Point Load Strength Index

Sample No:-	Depth (m)	Description	Type	Orientation	W (mm)	D (mm)	P (kN)	De^2 (mm^2)	De (mm)	I_s	F	$I_{s(50)}$MN/m²
BH03	2.59-2.68	1	D	⊥	100.0	63.5	7.00	4032	63.5	1.736	1.11	1.93
BH03	2.79-2.86	1	D	⊥	135.0	63.5	6.00	4032	63.5	1.488	1.11	1.66

Description 1 : Brown Rock
Description 2 :
Description 3 :

$I_{s(50)}$MN/m² for	Description 1	Description 2	Description 3
Min	1.66		
Mean	1.80		
Max	1.93		

Test
A = axial
D = diametrical

Relationship to planes of weakness
IL = irregular lump
II = parallel
⊥ = perpendicular

	$I_{s(50)}$MN/m²	U.C.S. MN/m²
Extremely Weak	<0.05	0.6-1.0
Very Weak	0.05-0.20	1.0-5.0
Weak	0.20-0.50	5.0-25.0
Medium Strong	0.50-2.00	25-50
Strong	2.00-4.50	50-100
Very Strong	4.50-9.00	100-250
Extremely Strong	9.00 +	>250

The stated result only relates to the item/location tested, this report shall not be reproduced except in full.

Approved Signature
James Fisher Testing Services Ireland

☐ **James Ward, Operations Manager**

Appendix N – Civil Infrastructure Report

JJ CAMPBELL & ASSOCIATES
CONSULTING CIVIL & STRUCTURAL ENGINEERS
F1 Nutgrove Office Park, Dublin 14
tel: 01 2980538, fax: 01 2963956, e-mail info@jjc.ie, www.jjc.ie

CIVIL INFRASTRCUTURE REPORT

DOCUMENT CONTROL SHEET

Client	Oval Target Ltd.					
Project Title	St Teres’a Lands Temple Hill, Monkstown, Blackrock, County Dublin.					
Document Title	Infrastructure Report					
Document No.	2011-07 - Infrastructure Report					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	8	-	-	0

Rev.	**Status**	**Author(s)**	**Reviewed By**	**Approved By**	**Office of Origin**	**Issue Date**
P1	Planning	MW	JJC	JJC	Dublin	February 2021
P2	Planning	MW	JJC	JJC	Dublin	December 2021

1 TABLE OF CONTENTS

1 INTRODUCTION

J.J. Campbell & Associates were instructed by Oval Target Ltd. to design the necessary drainage systems, water distribution, road build-up and surface carparking for a planning application for a proposed residential Development at St. Teresa's Lands Temple Hill, Monkstown, Blackrock, County Dublin.

2 CIVIL WORKS.

2.1 GENERAL.

This section covers the Civil works associated with the following areas: drainage systems, water Distribution, footpaths, and all underground work associated with the distribution of site services.

Details of existing utilities were obtained from Irish Water record drawings. A topographical survey and survey of underground utilities was carried out by Murphy Surveys ltd. The exact position of all sewers and culverts is subject to verification at construction stages.

2.2 STORMWATER.

Site stormwater drains have been designed using the modified rational method and taking account of the Greater Dublin Strategic Drainage Study, the Greater Dublin Regional Code of Practice for Drainage Works, Irish Water publication "Code of Practice for Wastewater Infrastructure, Connections and Developer Services, Design and Construction requirements for self-lay Developments" and CIRIA C753, The SUDS Manual. Causeway Storm Water Analysis software has been used to design the storm network.

Pipes will be precast concrete, flexibly jointed, or unplasticised polyvinyl chloride (uPVC), flexibly jointed, and laid in granular bed and surround. For design purposes, a Colebrook-White friction factor K=0.6mm will be used. Manholes shall be cast insitu or precast concrete. Gully chambers shall be precast concrete. Manhole covers and gully gratings shall be cast-iron, designed for heavy traffic use. The principles of Sustainable Urban Drainage Systems, local authority and Irish Water requirements will be incorporated into the drainage design.

Stormwater drainage attenuation calculations have been provided in annex D in the main drainage planning report.

A petrol interceptor will be provided for underground carparks.

Storm-water attenuation calculations have been carried out in accordance with the Greater Dublin Strategic Drainage Policy. The calculated volume of attenuation is 1600m^3, including a 20% allowance for climate change. The maximum allowable discharge from the site is 8.17 litres/sec.

Surface water drainage calculations are included in Annex E and Annex F in the main drainage planning report.

The site drainage will connect to the existing public sewer in Temple Road. The final manhole, local to each building, will be trapped as required by GDSDS before discharge to the system.

A Flood Risk Assessment has been carried out by JBA Consulting Engineers; the report is included in Annex H in the main drainage planning report.

2.3 FOUL DRAINAGE.

Domestic effluent will discharge to the existing foul drainage system in Temple Road. Pipelines will be designed to provide self cleansing velocities. Pipe will be pre-cast concrete, flexibly jointed, or unplasticised polyvinyl chloride (uPVC), flexibly jointed, and laid in granular bed and surround. For design purposes, a Colebrook-White friction factor K=1.5mm will be used. Manholes shall be cast insitu or pre-cast concrete. Manhole covers shall be cast-iron, designed for heavy traffic use.

Foul water drainage calculations have been included in section 3.0 in the main drainage planning report. Calculations are based on a flow rates given in Irish Water Code of Practice for Waste Water, and a peaking factor of 6. Occupancy is based on number of bed units provided. Foul water will be discharge to the existing 1200mm diameter combined sewer in Temple Road via an existing 300mm connection. The layout is described in drawings C2-0 to C2-6.

All existing drains will be surveyed prior to construction of the on-site drainage system to confirm the above invert level.

2.4 WATER DISTRIBUTION.

A new distribution 200Ø (Inside diameter) watermain is proposed for the development, which will to be connected to the existing IW 400Ø watermain on Temple Hill Road.

The existing watermain supplying the adjacent St. Catherine’s lands will be replaced along the length of the St. Teresa’s avenue as this main was laid in 1943 and is approaching the end of its useful life. All works will comply with Irish Water publication “Water Infrastructure Standard Details, Connections and Developer Services, Construction Requirements for Self-Lay Developments”.

2.5 ROADS, FOOTPATHS AND CARPARKS.

All roads within the development shall be designed in accordance with RT 181 – Geometric Design Guidelines for Roads and local authority requirements. Pavement construction will typically be designed to DOE specification for road works standard, based upon California Bearing Ratio tests (BS 1377, Part 4: Section 7), carried out on typical soil samples obtained from the site.