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Engineering Services Report

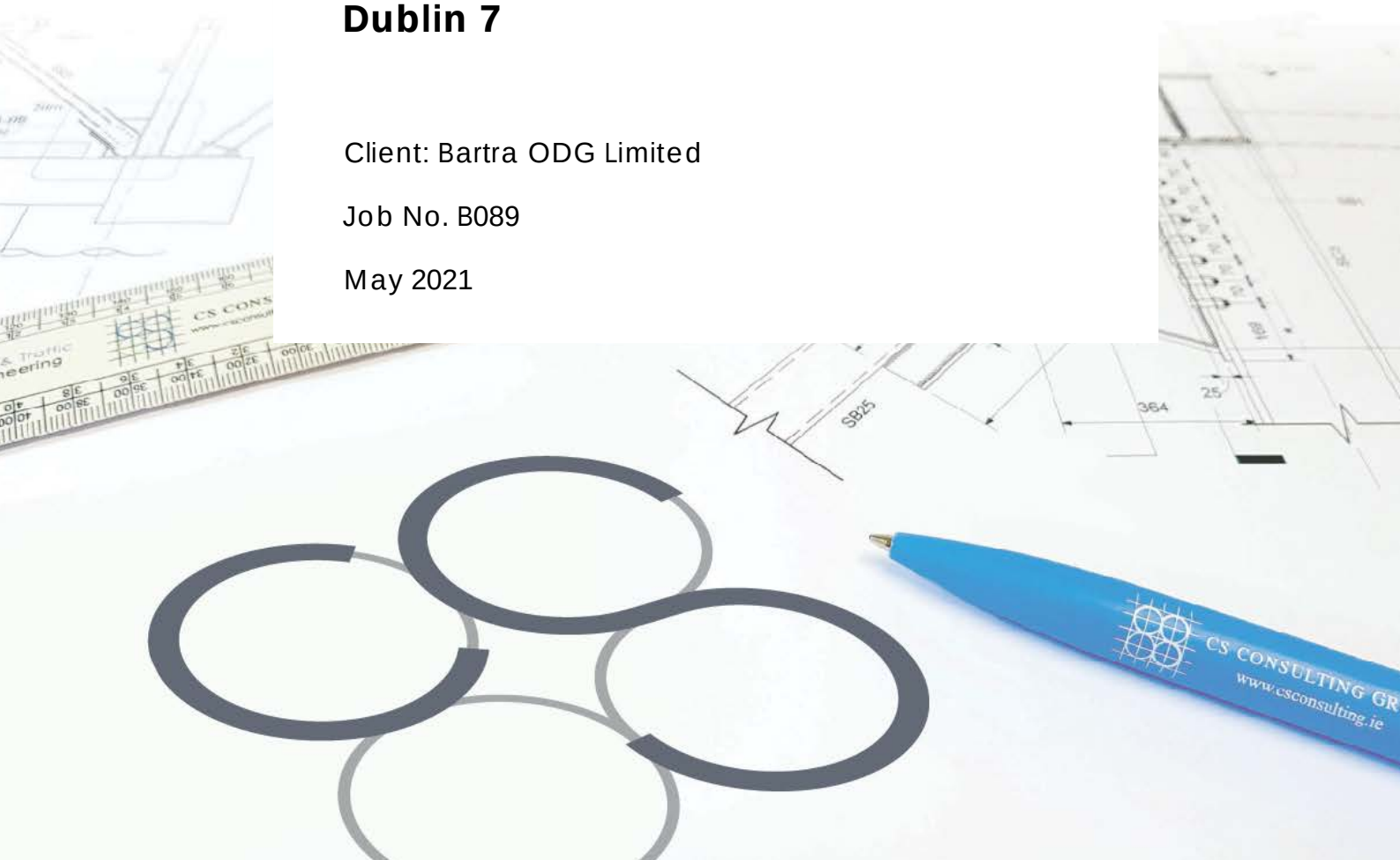
Strategic Housing Development

Former O'Devaney Gardens Site, Dublin 7

Client: Bartra ODG Limited

Job No. B089

May 2021



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ENGINEERING SERVICES REPORT

Strategic Housing Development, Former O'Devaney Gardens Site, Dublin 7

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1.0 INTRODUCTION

Cronin & Sutton Consulting Engineers (CS Consulting) have been commissioned by Bartra ODG Limited to prepare an Engineering Services Report to accompany a planning application for a residential development at O'Devaney Gardens, Stoneybatter, Dublin 7.

This report assesses the proposed development under the following headings:

- Foul Drainage Infrastructure;
- Stormwater Drainage Infrastructure;
- Potable Water Infrastructure; and

In preparing this report, CS Consulting has made reference to the following:

- Dublin City Development Plan 2016–2022;
- Dublin City Strategic Flood Risk Assessment 2016 – 2022;
- Regional Code of Practice For development works, Version 6;
- Irish Waters Code of Practice for Water Infrastructure;
- Irish Waters Code of Practice for Wastewater Infrastructure;
- Greater Dublin Strategic Development Study;

The Engineering Services Report is to be read in conjunction with the engineering drawings and documents submitted by CS Consulting and with the various additional information submitted by the other members of the design team.

2.0 SITE LOCATION AND PROPOSED DEVELOPMENT

2.1 Site Location

The proposed development site is located at O'Devaney Gardens, Stoneybatter, Dublin 7. The site is located in the administrative jurisdiction of DCC and has a total area of approximately 5.20 ha.

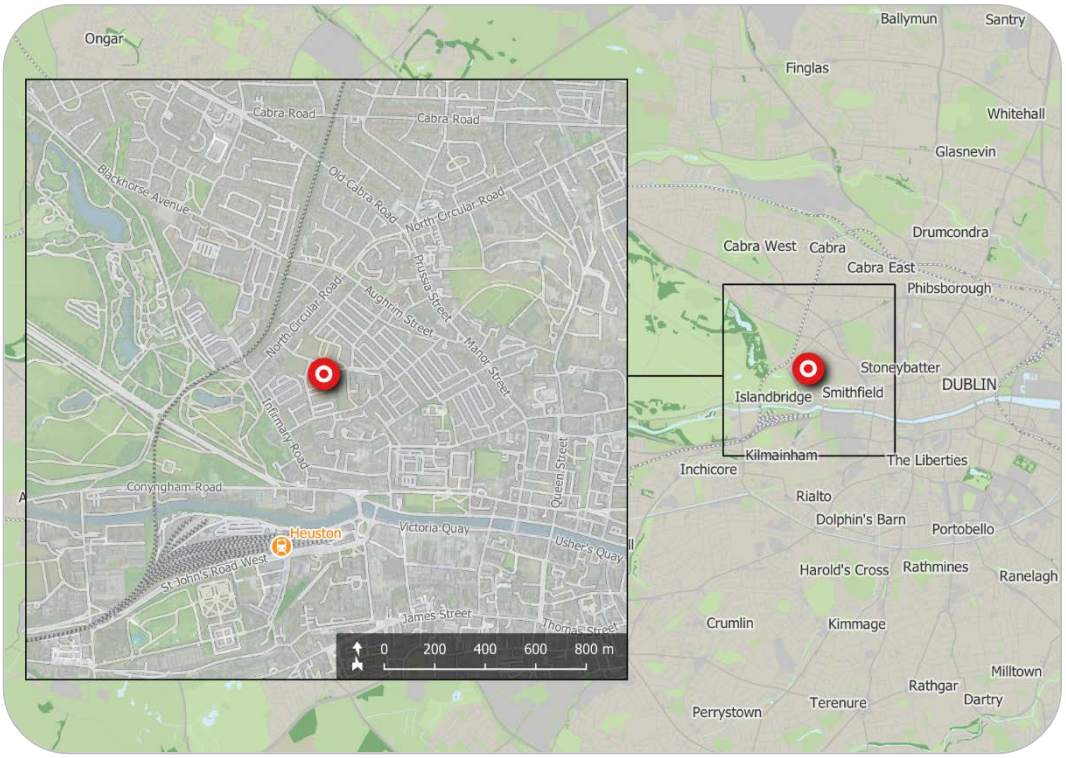


Figure 1 – Location of proposed development site
(*map data & imagery: EPA, OSi, OSM Contributors, Google*)

The location of the proposed development site is shown in Figure 01 above; the indicative extents of the development site, as well as relevant elements of the surrounding road network, are shown in more detail in Figure 02.

The site is bounded to the east by Saint Bricin's Military Hospital and residential properties, to the west by future development lands and residential properties and on all other sides by residential properties.

Figure 2 – Site extents and environs
(*map data & imagery: NTA, OSi, OSM Contributors, Microsoft*)

2.2 Existing Land Use

The subject site had previously been used for residential housing, in the form of a number of flat complexes. These have been removed from site. The subject lands are predominantly flat in nature with no water course or other physical features of note on the lands. To the north west of the lands a housing development is currently under construction. This estate and the services currently serving same will be required to be re-located into the proposed development.

2.3 Proposed Development

The proposed Strategic Housing Development comprises the following elements of relevance to the present Traffic and Transport Assessment:

- 43no. dwelling houses (including 20no. duplex units);
- 1,004no. apartments;
- crèche with gross floor area of 489m^2;
- community space with gross floor area of 157m^2;
- convenience retail units with total gross floor area of 1,393m^2; and
- café unit with gross floor area of 155m^2.

The subject development's internal road network shall tie into the existing surrounding road network at the existing O'Devaney Gardens / North Circular Road junction (north of the development site), the repositioned O'Devaney Gardens / Montpelier Gardens junction (south of the development site), and the existing connection between O'Devaney Gardens and Thor Park (east of the development site). Provision is also made for pedestrian and cyclist connectivity onto Ross Street and onto Ashford Cottages, at the development site's northern boundary. The development includes 273no. car parking spaces, 3no. crèche set-down spaces, 2,000no. bicycle parking spaces, and 11no. motorcycle parking spaces.

A detailed description of the proposed development is provided in the Site Notice.

For the purposes of the present assessment, it is assumed that the subject development shall be completed and occupied by the year 2023.

2.4 Proposed Services Alterations

The subject lands currently has both the remnants of drainage/watermain infrastructure from the sites previous land use and drainage/watermain infrastructure recently completed as part of the housing development to the north west of the subject lands. Subject to agreement with Irish Water and DCC these services will be diverted and re-located into the subject sties network. Without loss of service or capacity for the current user. The proposed diversions will include the re-routing of foul /storm water and potable water supplies. In addition, temporary attenuation storage for the housing development currently under development will be required to be incorporated into the proposed new storm water drainage systems and attenuation systems. Refer to CSC drawings for details of same:
- ***ODG-CSC-XX-XX-DR-C-0015 / 0039 & 0047***.

3.0 STORMWATER DRAINAGE

3.1 Existing Storm Water Arrangements

Following review of DCC's drainage records indicates that there are:

- A 225mm diameter concrete combined sewer on O'Devaney Gardens, flowing west to east;
- A 300-375mm diameter concrete combined sewer on O'Devaney Gardens, flowing north to south towards Montpelier Gardens;
- A 300mm diameter concrete combined sewer which connects the end of the 225mm diameter concrete combined sewer to 300mm diameter concrete combined sewer on O'Devaney Gardens, both mentioned previously. Note that this 300mm diameter concrete combined sewer has been indicated traversing the site;
- A 225mm diameter uPVC combined sewer on Montpelier Gardens, which flows towards Infirmary Gardens;
- A 225mm diameter vitrified clay combined sewer, which flows towards Infirmary Gardens;
- A 375mm diameter concrete combined sewer on Montpelier Gardens, which flows from O'Devaney Gardens to towards Infirmary Gardens and;
- A 225mm diameter stormwater sewer at east of Montpelier Gardens, which flows through Montpelier Park, Montpelier Drive and Montpelier Hill, and finally connected to a combined sewer on Infirmary Gardens.

Please refer to **Appendix A** for the DCC's drainage records.

3.2 Proposed Storm Water Alterations

The subject lands currently have both the remnants of stormwater infrastructure from the sites previous land use and stormwater infrastructure recently completed as part of the housing development to the north west of the subject lands. Subject to agreement with Irish Water and DCC these services will be diverted and re-located into the subject sties network. Without loss of service or capacity for the current user. The proposed diversions will include the re-routing of storm water and, in addition, temporary attenuation storage for the housing development currently under development will be required to be incorporated into the proposed new storm water drainage systems and attenuation systems.

3.3 Proposed Storm Water Arrangements

In accordance with DCC requirements, storm water shall be managed in two phases.

The **first** is to restrict storm water run-off from the proposed development to greenfield run-off rates. The **second** aspect to be included in new applications is to incorporate sustainable urban drainage systems ('SuDs') proposals into the scheme. The 'SuDs' concept requires that storm water quality is improved before disposal and, where applicable, storm water is discharged into the ground on site.

The proposed new storm water drainage arrangements will be designed and carried out in accordance with:

i) The Greater Dublin Strategic Drainage Study Volume 2,
ii) The Greater Dublin Regional Code of Practice for Drainage Works,
iii) BS EN – 752:2008, Drains & Sewer Systems Outside Buildings,
iv) Part H, Building Drainage of The Building Regulation.

The 'GDSDS' & the local authorities Regional Code of Practice for Drainage Works require that four main criteria to be provided by the developer.

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment of run-off within 'SUDS' features e.g. landscaping and green roof areas.
- Criterion 2: River Regime Protection - satisfied by attenuating run-off from the site.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the site being outside the 1000 year coastal and fluvial flood levels. Pluvial flood risk addressed by development designed to accommodate a 100-year extreme storm as noted in 'GDSDS'. Planned flood routing for storms greater that 100-year level considered in design and development run-off contained on site.
- Criterion 4: River Flood Protection – attenuation and/or long-term storage provided within the 'SuDs' features.

In accordance with the requirements of DCC all new developments are to incorporate the principles of 'SuDs'. The 'SuDs' principles require a two-fold approach to address storm water management on new developments.

The **first** aspect is to reduce any post development run-off to pre-development discharge rates. The development is to retain storm water volumes predicted to be experienced during extreme rainfall events. This is defined as the volume of storm water generated during a 1 in 100 year storm event increased by 20% for predicted climate change factors.

To ensure an accurate calculation of the required attenuation for the site Met Eireann was contacted to provide:

a) The SAAR (Standard Annual Average Rainfall) for the area: 727mm/year.

b) The sliding duration table for the site indicating the 1:100 year rainwater intensities to be used.

c) Soil type value obtained from the Flood Studies Report, (for the subject lands this has been established as soil type 4.

These parameters allow the Q-Bar, greenfield run-off rate, to be calculated. The Q-Bar value for the site is 5.00 l/sec/Ha. Therefore, the allowable discharge rate off site for any given storm even will be limited to 29l/sec. Note the proposed scheme will incorporate into the drainage system the existing housing developments attenuation area, this increases the sits overall area to 5.8Ha, giving a total discharge rate of 29.0l/sec for all storm event.

The proposed development is to retain storm water volumes predicted to be experienced during extreme rainfall events. This is defined as the volume of storm water generated during a 1 in 100 year storm event increased by 20% for predicted climate change factors. The attenuation volume requirement of 4042m^3 for the 1 in 100 year storm event. See **Appendix B** for the Met Eireann Data and Attenuation Calculation.

The proposed storm water network has been designed using the WinDes Micro Drainage Program, to check for suitable capacity in the network to ensure no on flooding takes place for the extreme storm events. See **Appendix C** for WinDes design, & simulation calculations for the proposed storm water system.

The outfall into the public system will be onto the 225mm diameter stormwater sewer on Montpelier Gardens. The last public manhole shall be constructed in accordance with Local Authority's requirements and the storm water flow will be restricted by the use of a flow control device to limit the flow to the public system.

Please refer to CS Consulting Drawing ***ODG-CSC-XX-XX-DR-C-0013 / 0014*** for drainage details.

3.4 Proposed Sustainable Urban Drainage System ('SuDs') Measures

The **second** aspect is the policy of the Local Authority is to include 'SuDs', for all new applications. The aim is to provide an effective system to mitigate the adverse effects of storm water run-off on the environments, through enhanced quality systems and on local infrastructure to aid in preventing downstream flooding. The features proposed shall reduce run-off volumes, pollution concentrations and enhance groundwater recharge and biodiversity.

The proposed 'SuDs' features shall consist of:

a) Green-roof – this allows the roof areas of the proposed apartments to use a Sedum type covering to absorb the first 'flush' from rainfall events. Typically, 5-10mm of rain can be retained on the sedum surface. As more intense rain is experienced the green roof can overflow from the roof through down pipes and into the schemes main drainage runs.

b) Water-'butts' – when the rain water from the green roofs and from the roofs of the housing units is drained to ground floor it will be directed into rainwater storage units, commonly referred to as water butts. The retained rainwater can then be stored and re-used for local landscaping and maintenance purposes. It would not be envisioned that the captured rainwater would be reused in the apartment units for public health reasons.

c) Permeable Paving – this system allows rainwater to be directed into carparking bays whereby the rainwater can filter through gaps in the paving blocks and percolate into the subsoil. The area which can be drainage is a subject to the infiltration characteristics of the subsoil,

which is established following ground investigation testing on site in accordance with BRE 365.

d) Land drains – it is also proposed to use land drains to the rear of individual dwellings to allow the percolation of rainwater locally, again subject to the infiltration rates of the subsoil, which has to be established. The land drains will be fitted with an overflow system to allow excess storm water to be directed into the main drainage runs.

e) Swales & Tree Pits – it is proposed to allow storm water to be directed locally into tree pits for prevent this storm water from entering the main drainage network. As the tree pits can only accommodate relatively small surface areas this proposal cannot be used to drain the site as a whole but can play an important part in contributing to the overall 'SuDs' strategy.

f) Main Attenuation Tank – As noted above the for extreme storm events, will require a dedicated system to contain the storm water flows generated during a 1-in-100 year storm, increased by 20%. It is proposed to use a proprietary underground storage tank for this purpose. The tank will be placed under open spaces, not roads so the open space above can be enjoyed while not preventing the schemes ability to retain the storm water.

g) Low Water Usage Appliances – It is also worth highlighting that low water usage appliances will also be utilised to aid in the reduction of water usage on the development.

h) Oil Separator – Prior to final disposal of storm water from the main drainage network into the public system the stormwater will pass through an oil separator to remove any hydrocarbons which may have entered the network from car parking areas.

The combination of the above noted elements will allow the proposed development to adhere to the principles of sustainable drainage practices while enhancing overall storm water quality.

4.0 FOUL DRAINAGE

4.1 Existing Foul Arrangements

Following review of DCC's drainage records indicates that there are:

- A 225mm diameter concrete combined sewer on O'Devaney Gardens, flowing west to east;
- A 300-375mm diameter concrete combined sewer on O'Devaney Gardens, flowing north to south towards Montpelier Gardens;
- A 300mm diameter concrete combined sewer which connects the end of the 225mm diameter concrete combined sewer to 300mm diameter concrete combined sewer on O'Devaney Gardens, both mentioned previously. Note that this 300mm diameter concrete combined sewer has been indicated traversing the site.
- A 225mm diameter uPVC combined sewer on Montpelier Gardens, which flows towards Infirmary Gardens;
- A 225mm diameter vitrified clay combined sewer, which flows towards Infirmary Gardens;
- A 375mm diameter concrete combined sewer on Montpelier Gardens, which flows from O'Devaney Gardens to towards Infirmary Gardens;
- A 225mm diameter foul sewer at east of Montpelier Gardens, which flows through Montpelier Park and Montpelier Drive and finally connected to a combined sewer on and Montpelier Hill.
-

Please refer to **Appendix A** for the DCC's drainage records.

4.2 Proposed Foul Drainage Arrangements

The proposed development will require a new separate drainage network to collect and convey the effluent generated by the proposed development. The drainage network for the proposed development has been designed in accordance with:

- The Regional Code of Practice Drainage Works; and
- The Greater Dublin Strategic Drainage Study; and
- Irish Water Code of Practice for Wastewater Infrastructure.

The drainage network for the development will be in accordance with Part H of the Building Regulations and to the requirements and specifications set out in the Irish Water Code of Practice for Wastewater.

4.3 Proposed Effluent Generation

The proposed development is to consist of 1047 and based on Irish Water guidelines, the foul effluent generated will be:

⇒ 446l/day per apartment (based on 2.7 persons per apartment x 150l/person/day, + a 10% increase factor).

⇒ 446 l/day/apt x 1047 units = 466,962 l/day = 466.96 m^3/day;

⇒ 5.40/sec Average flow (1 DWF);

⇒ 32.42l/sec Peak Flow (6 DWF).

4.4 Proposed Foul Drainage Arrangements

The drainage network for the development will be in accordance with Part H of the Building Regulations and to the requirements and specifications of Irish Water.

All foul effluent generated from the proposed development shall be collected in separate foul pipes and flow under gravity, to the 375mm diameter concrete combined sewer on Montpelier Gardens, which flows from O'Devaney Gardens to towards Infirmary Gardens. The proposed foul drainage infrastructure has been designed using the WinDes Micro Drainage Program and a copy of the sewer design is included in **Appendix D**.

The proposed drainage infrastructure and routing plan is shown on **ODG-CSC-XX-XX-DR-C-0013 & 0014** included with this submission.

4.5 Irish Water Confirmation of Feasibility

Irish Water have issued a pre-connection response. They note that investigation works are required by the applicant of the downstream network to guarantee that foul and stormwater are not interconnected. Irish Water has not indicated any restrictions with the local infrastructure network, and a such the proposed development can be accommodated.

Please refer to **Appendix E** for a copy of the confirmation of feasibility letter.

5.0 POTABLE WATER

5.1 Existing Potable Water System

Following review of DCC's watermain records indicates that there are:

- A 100mm diameter cast-iron located in O'Devaney Gardens. There are a several number of a 100mm diameter cast-iron which were located to supply the previous developments, currently demolished.
- A 100mm and 150mm diameter cast-iron on Montpelier Gardens;

Please refer to **Appendix A** for the DCC's watermain records.

5.2 Proposed Potable Water System

The proposed development is to consist of 1047 and based on Irish Water guidelines, the water demand will be:

⇒ 405 l/day per apartment (based on 2.7 persons per unit x 150l/person/day);

⇒ 405 l/day x 1047 units = 424035l/day = 424.035 m^3/day;

⇒ 4.90 l/sec Average water demand;

⇒ 24.53 l/sec Peak water demand (5 times average water demand).

The proposed watermain infrastructure and routing plan is shown on **ODG-CSC-XX-XX-DR-C-0015** included with this submission.

5.3 Proposed Watermain Alterations

The subject lands currently have a watermain infrastructure located at north side of the O'Devaney Gardens access road from Montpeller Gardens, northwest of the subject land. Subject to agreement with Irish

Water and DCC these services shall be decommissioned as part of Phase 1. The proposed house units shall have individual water connection from a proposed 160mm diameter watermain. Please refer to **ODG-CSC-XX-XX-DR-C-0015_Proposed Watermain** for details.

5.4 Irish Water Confirmation of Feasibility

Irish Water have issued a pre-connection response. They note that local connection works will be required to facilitate the development. As per Irish Water requirements these works will be carried out by Irish Water and form part of the post planning connection agreement requirements. Irish Water has not indicated any restrictions with the local infrastructure network, and a such the proposed development can be accommodated. The required upgrades shall be agreed with Irish Water at the connection application stage of the process.

Please refer to **Appendix E** for a copy of the confirmation of feasibility letter.

6.0 SITE EXCAVATIONS AND FOUNDATION CONSTRUCTION

6.1 Background

Historic Site Uses

The historic maps available on the Ordnance Survey Ireland (OSI) online data base provide evidence of the site uses in 1837-1842 and also 1888-1913.

Extracts of the maps are provided in **Figure 3** and Figure 4 below, and indicate that the site use historically was predominantly agricultural, with no evidence of any industry which would increase the risk of historic contamination.

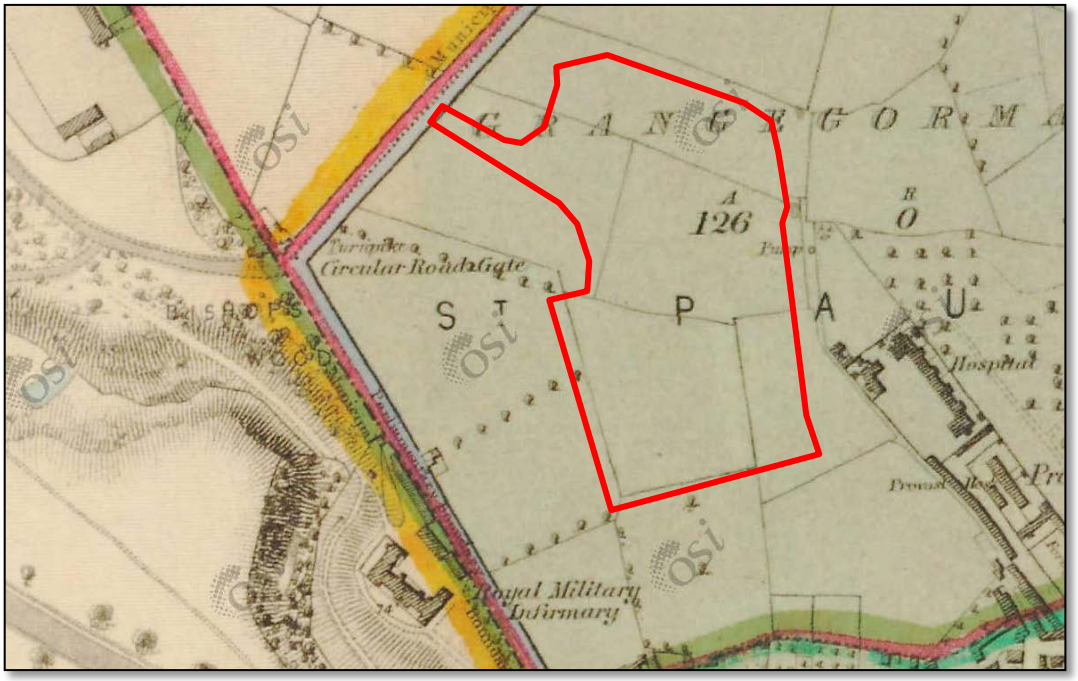


Figure 3 – Historic map (1837-1842)
(*source:* http://map.geohive.ie/mapviewer.html)

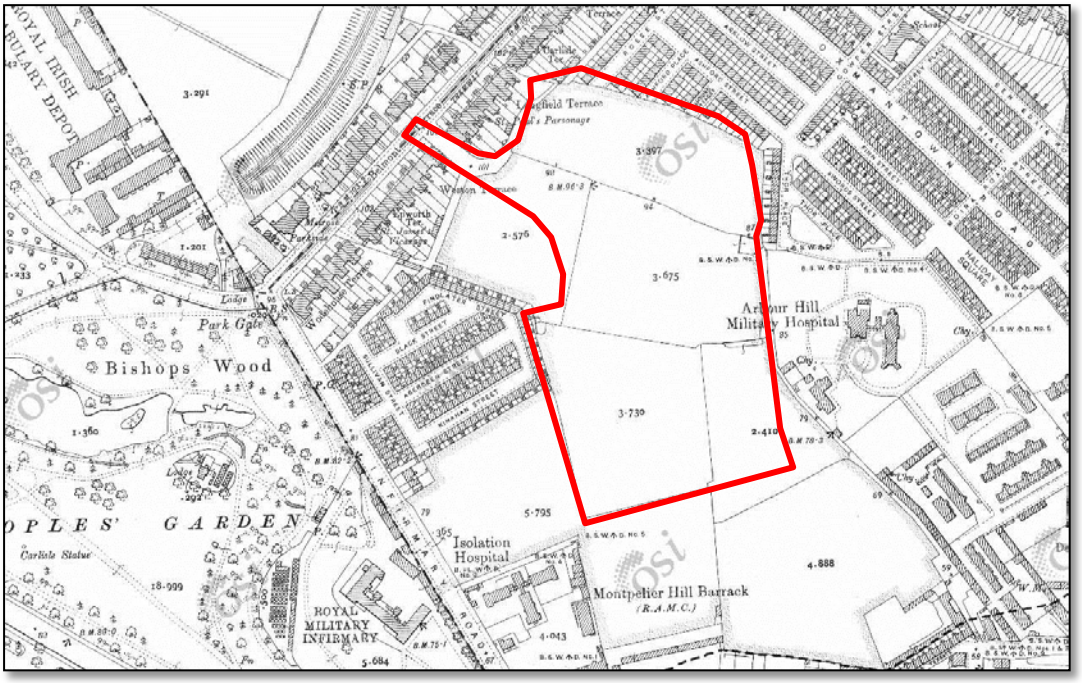


Figure 4 – Historic map (1888-1913)
(*source:* http://map.geohive.ie/mapviewer.html)

Modern Development

The recent residential buildings of O'Devaney Gardens were constructed in 1954 on undeveloped lands adjacent to St Bricin's Military Hospital. The original blocks consisted of 276no. apartments within thirteen blocks of four storeys in height (see **Figure 5**).

The north-western and northern blocks were demolished between 2008 and 2010. The four southern blocks were demolished in 2012-2014.

The site currently consists of some hard standing areas and heavy vegetation.

Figure 5 – Aerial photograph of original O'Devaney Gardens
(*source: OSi*)

6.2 Soils

A review of the Geological Survey of Irelands, 'GSI', database, (www.GSI.ie) gives
background data to the site's geology and hydrogeological properties. The site is underlain with Dark limestone and shale and forms part of the Lucan Formation. The GSI classifies the regional aquifer as locally important and moderately productive with a vulnerability classification as low.

6.3 Hydrology

The subject site is located c400m north of the River Liffey, refer to the extract below from the Environmental Protection Agency online database in **Figure**

6. The River Liffey rises at Kippure in the Wicklow Mountains, and flows approximately 100km to the Liffey Estuary.

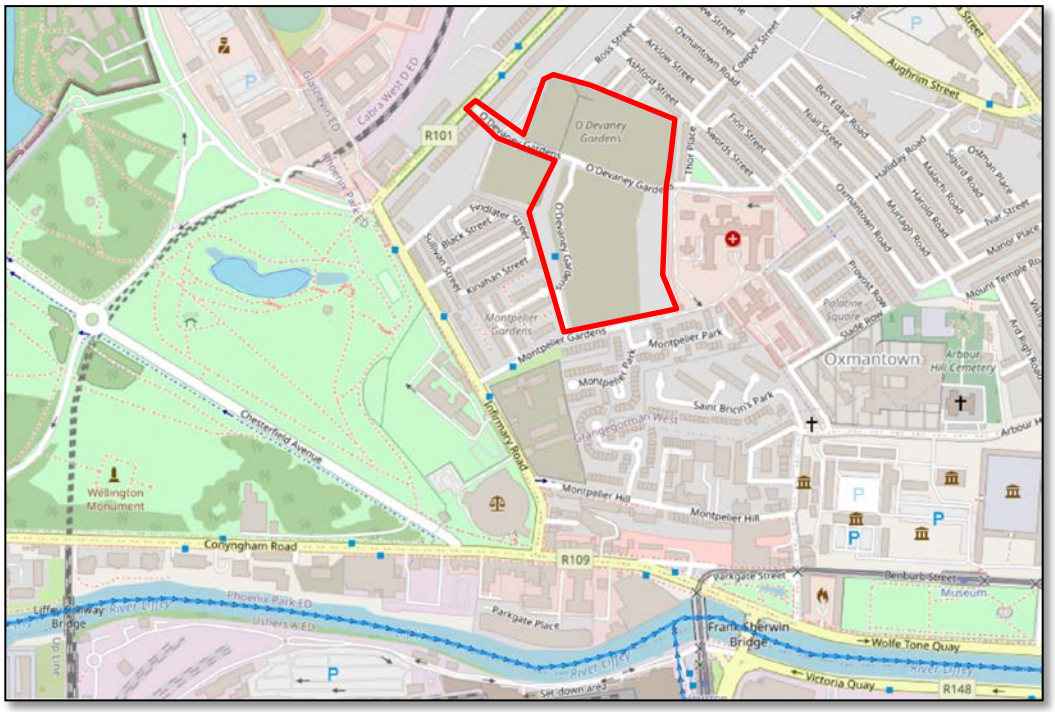


Figure 6 – Proximity of site to River Liffey
(*source:* https://gis.epa.ie/EPAMaps/)

The EPA online data base references the Latest River Q-Values upstream at the UCD Boat Club monitoring station at Island Bridge. The Q-Value score is noted at 3 and "Poor" Status. The EPA uses the Q-value system for assessing river water quality. This system describes the relationship between water quality and the macroinvertebrate community in numerical terms, with Q5 waters having high diversity of macroinvertebrate, and Q1 waters with little or none.

The subject development of the site will separate foul and storm water discharges. The foul generation will discharge to a combined public sewer, which ultimately discharges to the Ringsend Waste Water Treatment Plant.

The storm water from the site will discharge to a dedicated public storm water sewer. The storm water from the development will be managed in two phases. The first is to restrict storm water run-off from the proposed development to greenfield run-off rates via attenuation. The second aspect to be included in new applications is to incorporate sustainable urban drainage systems ('SuDs'), proposals into the scheme. The 'SuDs' concept requires that storm water quality is improved before disposal.

6.4 Hydrogeology

Hydrogeology is the study of groundwater, including its origin, occurrence, movement and quality. The hydrogeological of the Dublin Basin has been described by McConnell et al. (2001) as complex and variable and this is illustrated through the site conditions encountered in the vicinity of the site.

Aquifer Classification

The Geological Survey of Ireland has prepared Bedrock Aquifer Maps for the country based on the hydrogeological properties of the groundwater resource. The Bedrock Aquifer Map classifies the groundwater as a 'Locally Important' Aquifer which is moderately productive only in local zones (Ll). The bed rock aquifer is composed of Calp Limestone where dominate groundwater flows are through the upper weathered 20m of the rock typical through fissures & fractured zones.

Above the bed rock the two layers of clay, brown underlain with black, comprise low permeability clays, the variable thickness of fill material has limited ability for localized groundwater storage.

Groundwater Levels & Flow Paths

As noted above groundwater is expected to be encountered in the limestone bedrock and the gravels layers. At present there is no ongoing

long term groundwater monitoring regime in Dublin. Regional groundwater flow in Dublin City Centre is dominated by the major surface water body the River Liffey, and the close proximity to the coast. As a result the dominate groundwater flow direction is to the south, following the ground topography. The on-site groundwater observations are noted in the Site Investigation by IGSL carried out in 2019.

Ground Parameters

On site hydraulic conductivity testing was not carried out but regional experiences the permeability of Boulder Clay would be in the region of 10-8m/s to 10-6m/s. With Bedrock limestone having typical permeability in the range of 10-6m/s to 10-5m/s.

Recharge

The GSI groundwater recharge map indicates a typical average recharge rate of 67mm/year.

6.5 Site Investigation

A number of site investigations have been carried out on the site in recent years. Irish Geotechnical Services Limited, hereafter IGSL Ltd, carried out geotechnical site investigations in 2004 and Ground Investigations Ireland Ltd carried out updated environmental testing in June 2018.

IGSL were commissioned by Bartra ODG Limited to carry out a detailed geotechnical and environmental site investigation over the summer of 2020. The scope of works included 11no. cable percussive boreholes, 9no. rotary boreholes, 32no. trial puts and 74no. window samples. An Environmental Site Assessment and Waste Characterization Assessment Report was carried out by O'Callaghan Moran as part of the interpretive report.

Figure 7 – Extract from IGSL Site Investigation indicating sampling locations

In summary, the general soil stratigraphy consists of the following:

- **MADE GROUND** (general range of 1.5m to 2.5m in depth);
- Firm / stiff brown sandy gravelly **CLAY** (commonly known as "Brown Boulder Clay");
- Very stiff grey / black sandy gravelly **CLAY** (commonly known as "Black Boulder Clay");
- **LIMESTONE BEDROCK** (>12m below ground level).

6.6 Proposed Development

The proposed development consists of six Multi-storey apartment blocks, with terraced housing units around the site perimeter (Refer to the BMA Planning Report for a comprehensive development description). In general, it is not proposed to form basements within the development, with

the exception of a lower split level car park in Block 7, and also some localised subfloor plant areas in Blocks 9,7 and 5.

The current site topography falls from c27.3m (OD) along the northern boundary, to c21.1m (OD) along the southern boundary. It is proposed to maintain the current vehicular access points onto Montpelier Road (to the south), the North Circular Road (to the north-west) and Swords Street (to the east). As such, the proposed site levels will not deviate considerably from the existing ground profile. This will reduce the extent of any cut and fill across the site. The construction of the buildings will generate a surplus of excavated material which will have to be disposed of offsite at a suitable licensed facility.

Due to the depth of Made Ground across the site, and the relatively low bearing capacity of the underlying Brown Boulder Clay, it is proposed to utilize bored pile foundation systems for the construction of the apartment buildings. This is an accepted form of construction for mid-rise buildings within the Dublin City region. The utilisation of pile foundations will reduce the extent of excavations, and requirement to dispose of material off-site.

The bedrock in the area was generally encountered between 12 to 15m below ground level. At the north-eastern boundary of the site the rock was not encountered up to 22m of boring. As such, it is not envisaged that any rock breaking will take place as part of the construction works.

6.7 Proposed Excavations

As noted, the existing road levels through the site dictate the proposed building levels. The requirements of the Technical Guidance Documents – Part M will call for level access to buildings, and the necessary ground floor buildings for insulation etc will also determine the depth of excavation to formation level for each building.

The various blocks have been assessed, and the approximate excavation to formation level is summarized in **Table 6.1** below. In general, the depth to formation is c0.75m below Finished Floor Level to allow for the floor construction.

	Finished Floor Level	Average Depth to Formation	Distance to Adjoining Structures
Block 9	21.6m to 22.5m OD	1.2m to 3.5m	c23.4m
Block 10	21.5 to 22.5m OD	0.9 to 1.4m	c2.5m
Block 7	23.0 to 26m OD	<1m to 3.5m	c18.3m (29.2m at B'ment)
Block 6	24.5m OD	<1m to 1.1m	c9.7m (0.25m at Substation)
Block 4	Varies	<1m	c0.447m
Block 5	25.0m to 27.0m OD	<1m to 3.5m	c25.9m
Block 2	26.9m to 28.0m OD	0.55m to 1.1m	c8.3m
Block 3	27.2m OD	<1.0m	c1.2m (0.25m at Substation)
Housing	Varies	<1.0m	Varies. Min c1m

Table 6.1 - Approximate Excavation Depths at each Block

The extent of earthworks across the site is graphically shown in the indicative plan given in **Figure 8** below.

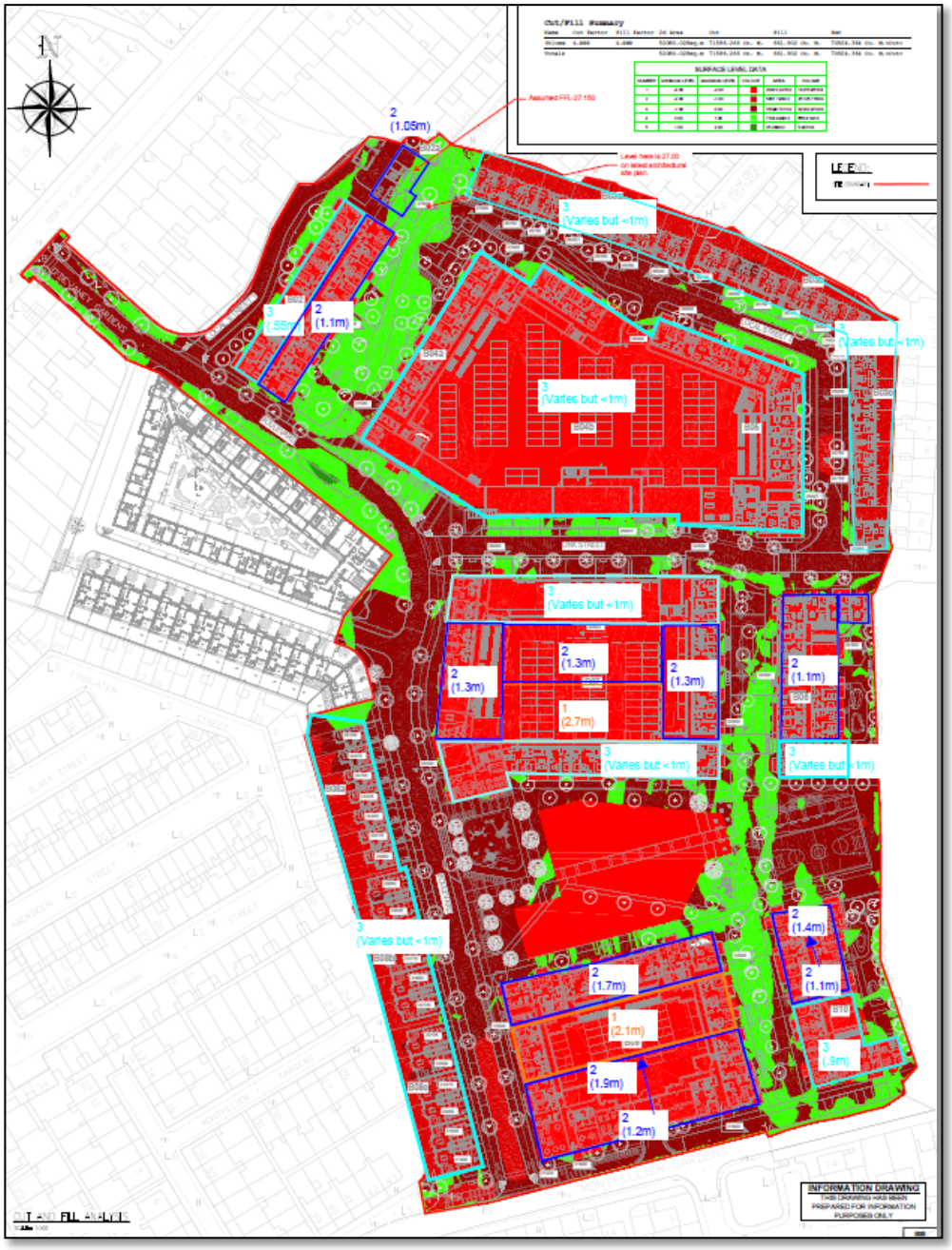


Figure 8 – Excavation depths at each block

6.8 Set -Back of Foundations from Site Boundaries

The extracts from the drawings below indicate the dimensions from the proposed Blocks and perimeter Housing to the site boundaries. Refer also

to the Architectural Ground Floor Site Plan; dwg 19045-OMP-00_SP-DR-A-1001.

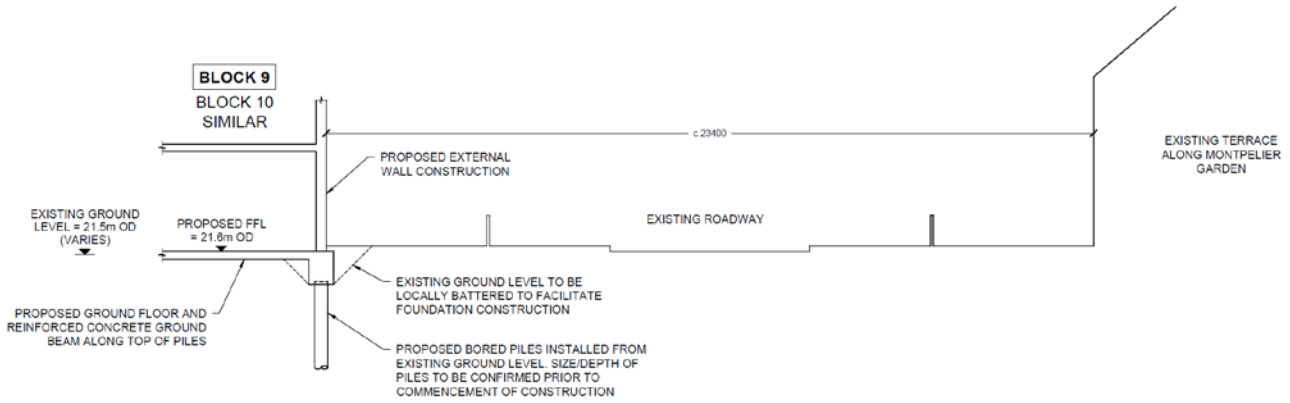


Figure 9 – Indicative section of Block 9: Montpelier Gardens

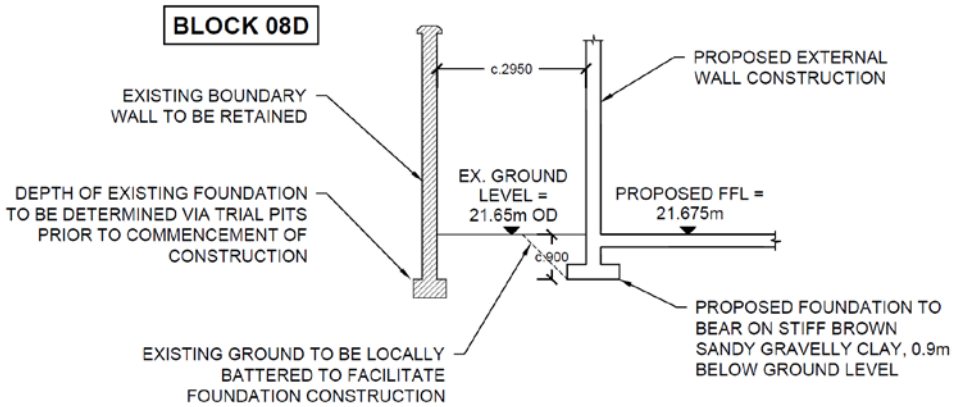


Figure 10 – Indicative section of Block 8D: Boundary

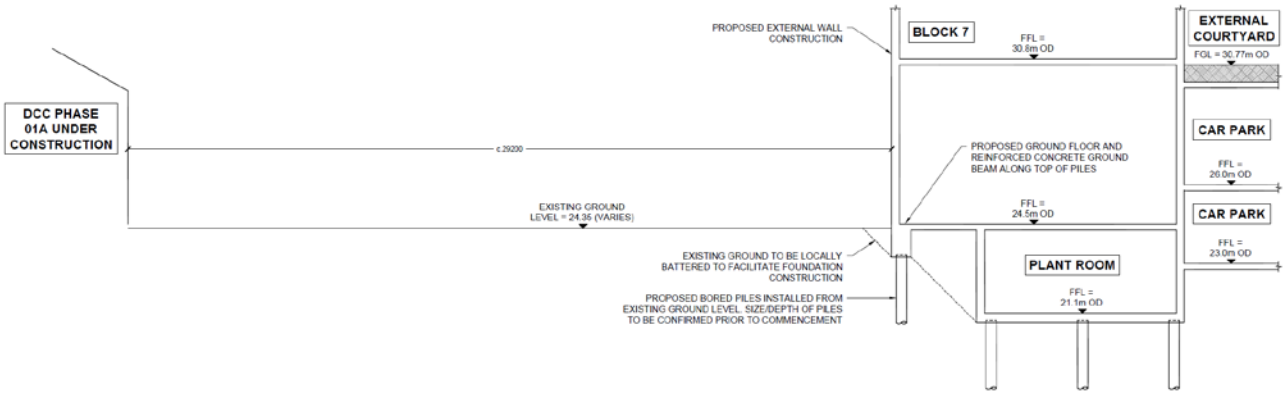


Figure 11 – Indicative section of Block 7: DCC Housing (under construction)

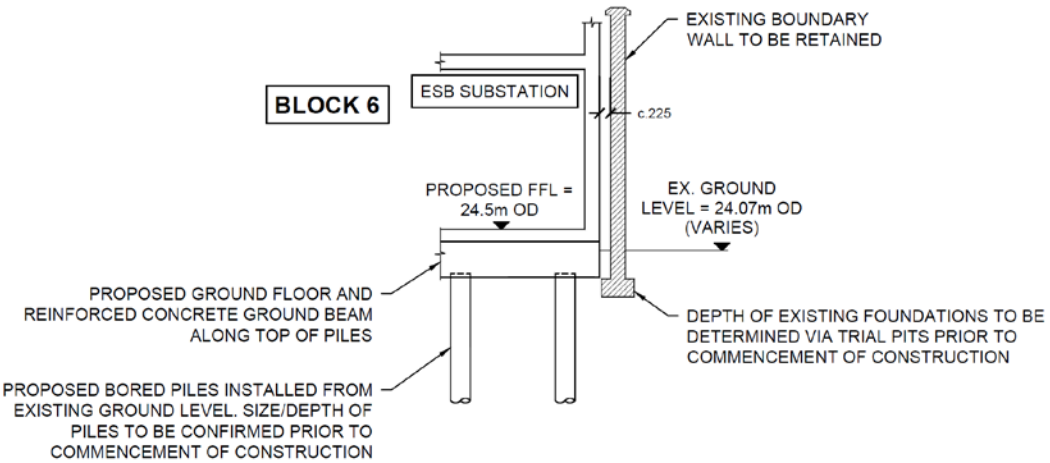


Figure 12 – Indicative section of Block 6: Boundary

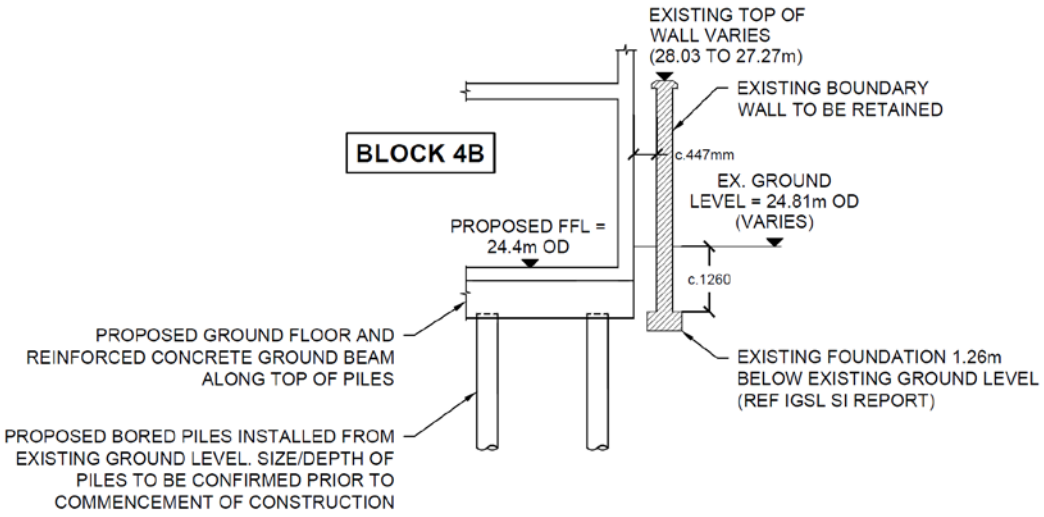


Figure 13 – Indicative section of Block 4: Boundary

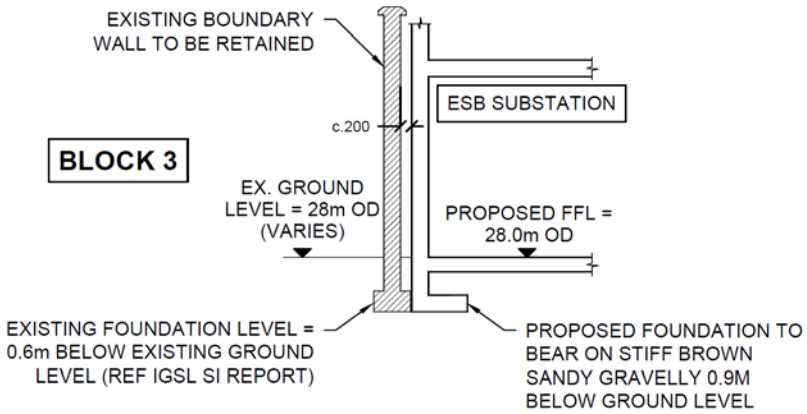


Figure 14 – Indicative section of Block 3: Boundary

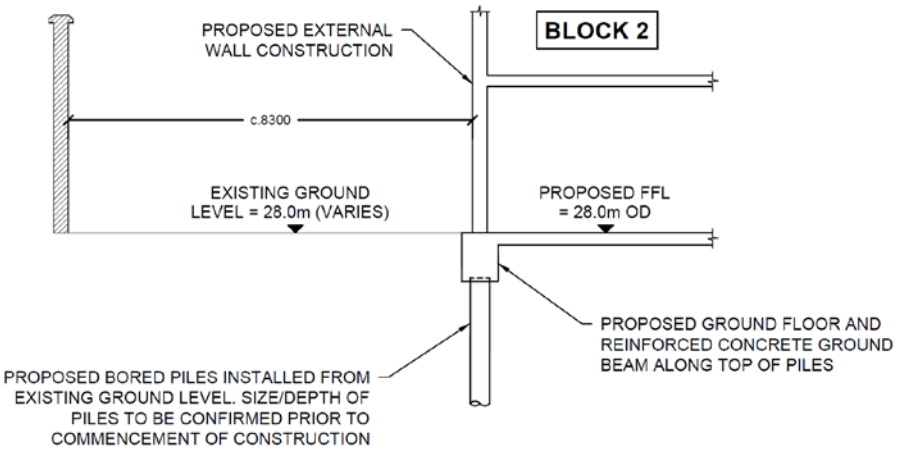


Figure 15 – Indicative section of Block 2: Boundary

6.9 Proposed Foundations

As noted, it is proposed to utilise bored piles as the foundation system for the apartment blocks. The 600-900mm diameter bored piles will be installed using a Llamada P-240TT piling rig (or similar) using a continuous flight auger. Following completion of the piles, at approximately 3-4m centres, a reinforced concrete ground beam will be constructed to allow the loads to be distributed from the super-structure to the pile foundations. See **Figure 16** and **Figure 17** below.

Figure 16 – Piling rig in operation

Figure 17 – Reinforced concrete ground beams cast between piles

For the perimeter housing, it is proposed to use more traditional reinforced concrete strip foundations. This system is used for domestic construction throughout the country. A standard JCB tracks machine (or similar) will excavate a 900-1200mm wide trench along the line of the load bearing walls to a suitable bearing level. Reinforced concrete strip foundations, approximately 400mm deep will be cast in advance of constructing the rising blockwork walls.

6.10 Conceptual Model

Based on the information available, a preliminary conceptual model is developed from ground information surrounding the site. The conceptual model will be revised and updated as more detailed site-specific information is to hand.

- The site currently consists areas of hardstanding and vegetation.

- From the desk top study, it can be inferred that the site is underlain by Made Ground, Brown/Black Boulder Clay and Limestone bedrock– this is verified by the site investigation works carried out in 2004, 2018 and 2020.
- Groundwater was encountered at 1.5m to 2.5m below ground level.
- Little groundwater is expected to be encountered in the Boulder Clay due to its low permeability, notwithstanding some seepage may be present.
- Regional groundwater flow in Dublin City is generally dominated by the River Liffey and the proximity of the coast. As such the flows pattern is to the south.
- The proposed excavations vary at each block, with an average excavation to formation of c1m, with a maximum excavation at Block 7 of 3.5m. The apartment buildings will be supported on pile foundations.
- The permeability values for the boulder clay in the region range between 10-8m/s to 10-6m/s. The presence of low permeability Boulder Clay beneath the Made Ground / Gravels ensures that the groundwater in the overburden and in the bedrock are hydraulically separated from each other.
- The GSI database of neighbouring sites indicates the bedrock level at >12m below ground level. As noted, the proposed buildings will be supported on pile foundations.

6.11 Summary Review of DCC Basement Policy Requirements

We confirm that we have reviewed the DCC Basement Development Policy Document and Guidance Document.

The proposed development does not incorporate full basement elements, with the exception of a lower split-level carpark at Block 7, and also some localised subfloor plant areas in Blocks 9,7 and 5. In order to carry out a thorough and comprehensive assessment, we have assessed the lower Plant Room area of Block 7 which will result in an excavation of c3.5m.

We note at Section 1.1 that "*DCC wish to acknowledge that the basement Policy and Guidance, contained herein, was developed with reference to existing policies and guidance documents already adopted by the London Borough of Camden"* in the UK.

It is therefore acknowledged that the document is based on a totally different soil type than that which is typical of Dublin which consists of gravels, brown and black boulder clays overlying rock. We note also that at Section 1.2 disclaimer that "*Owners, users and developers are advised to take all reasonable measures to assess potential issues (as outlined in this Policy document with reference also to the related guidance document) which may impact upon lands and buildings (including basements) in which they have an interest prior to making planning development decisions*".

6.12 Category of Basement

With reference to Section 7.2 of the DCC Basement Development Guidance Document the category of Basement for this development is Category A.

Summary of DCC Basement Development Policy Document

This section outlines the objectives and responses to the DCC Basement Policy document;

- *Protects and enhances where possible the groundwater quality, quantity and classification (groundwater environment).*

  The Lower Ground Floor and localised basement of Block 7 are set back c29.2m from the site boundary. Any dewatering required during the works is carried out by filtering the water prior to discharge under licence from DCC. Therefore, the groundwater is protected from contamination and the groundwater is enhanced by the removal of the contaminated soil which the groundwater was exposed to. Therefore, the proposed basement meets the requirement.

- *Provides evidence that the construction of basements shall not place the groundwater at undue risk.*

  The Lower Ground Floor and localised basement of Block 7 are set back c29.2m from the site boundary. The set-back, the relatively shallow nature of the excavation, and the absence of deep basements in the area will have a negligible impact on groundwater flow through the site.

- *Provides evidence that the structural stability of adjoining or neighbouring buildings are not put at risk. The Developer should also identify the risk to land stability of the site and adjacent areas and provides appropriate mitigation, as required.*

  The proposed Lower Ground Floor and basement of Block 7 , and the foundation construction of the perimeter housing are set back a considerable distance from the property boundary. In our opinion, the excavated sloped will be outside the zone of influence of neighbouring buildings. Monitoring wells shall be

provided to ensure that it is confirmed that there is no draw down of groundwater outside the site. As part of the monitoring works also, condition surveys of neighbouring buildings shall be carried out prior to commencement of the works and shall be monitored during the works.

- *Provides an in-depth management plan for any demolition works and for the construction of a basement. The Developer is required to adhere to this plan ("Construction Management Plan") if the application is deemed successful.*

  A full in-depth Construction Management Plan shall be submitted for agreement with DCC prior to commencement of the works to ensure all issues are covered during construction. An Outline Construction Management Plan is submitted with the planning application.

- *Is in accordance with the proper development of the area with a high quality design.*

  We confirm that the design is of high quality and in accordance with the proper development of the area.

- *Does not cause harm or undue nuisance to neighbourhoods and adjoining buildings where development is to occur, during and after construction.*

  Once the Lower Ground Floor and basement of Block 7 are complete, a reinforced watertight concrete basement walls and floors shall be constructed. Therefore, the development both during construction and after construction shall not cause harm or undue nuisance to neighbourhoods. The use of strict noise, vibration and dust monitoring during construction shall be implemented throughout the construction.

- *Ensures adequate consideration is given to traffic planning during construction and thereafter.*

  Traffic planning during construction shall be included in detail in the Construction Management Plan to be agreed with DCC prior to commencement of construction. Traffic Management is also set out in the Outline Construction Management Plan submitted with the planning application.

- *Does not have an adverse effect on existing patterns of surface water drainage, including infiltration into groundwater and is consistent with DCC's Policy on Sustainable Urban Drainage Systems ('SUDS').*

  The large extents of the site are currently unattenuated. It is proposed to attenuate the site in accordance with the Development Plan and also include 'SUDS' measures. Therefore, there is no increase in surface water being generated with the proposed development. A full Engineering Services Report has been provided indicating that the surface water drainage is designed to DCC's Policy on sustainable urban drainage systems.

- *Does not increase groundwater infiltration into existing sewers and drains beyond permitted restrictions.*

  Surface water drainage in the area is under ground water levels and the proposed development shall not affect the infiltration into existing systems.

- *Shall not significantly impact on groundwater or surface water flows to the extent that this is likely to increase the risk of flooding. This flood risk is to be evaluated, in accordance with the OPW 2009 Guidelines, during and post construction with appropriate mitigation provided.*

A full Site Specific Flood Risk Assessment report has been carried out and submitted with this Planning Application as part of the Engineering Services Report. The proposed development does not increase the risk of flooding. This risk has been evaluated for both during and post construction.

- *Does not include basement development for residential use, below the estimated flood levels in flood zone areas Zone A or Zone B (see DCC Development Plan for Zone locations).*

  A full Site Specific Flood Risk Assessment report has been carried out and submitted with this Planning Application as part of the Engineering Services Report.

- *Accounts for the impact of the future planting and mature development of trees on site. A thickness of at least 1m of soil on the "roof" of a basement is required to mitigate against and minimise surface water run-off, with various 'SUDS' measures incorporated.*

  This is not applicable to this project. Notwithstanding, a full landscape plan is provided to meet the requirements of the Development Plan and the drainage has been designed to DCC's 'SuDs' requirements.

- *Ensures that all basement developments shall account for and accommodate the existing groundwater contained within and flowing through their site. As a minimum standard there is to be at least 0.5m wide of clear space provided between the site/property boundary and the outer extent of a basement. This 0.5m wide space and shall extend over the full height and around the perimeter of the basement and shall be filled with suitable, highly permeable material (with appropriate wrapping).*

The Lower Ground Floor and localised basement of Block 7 are set back c29.2m from the site boundary.

- *Accounts for the characteristic of the site. In the case of a domestic basement development to the rear of a property (garden) generally should not exceed the footprint of the original building and be no deeper than one full storey below ground level. Domestic basement development should generally not extend to more than 50% of the amenity/garden space.*

  The Lower Ground Floor and localised basement of Block 7 are set back c29.2m from the site boundary. The excavations for the perimeter housing proposed will involve traditional shallow foundations.

- *Provide appropriate evidence for larger schemes, including those consisting of more than one storey in depth or extending beyond the footprint of the above ground building, to demonstrate to the Planning Authority`s satisfaction that the development does not harm the built and natural environment or local amenity.*

  Not applicable to this scheme.

- *Takes account of the content of the "Dublin City Development Plan 2016 – 2022" for construction and development related matters. This policy is to be read in conjunction with this document and all other current DCC policies.*

  As per the planning submission the development takes full account of the Dublin City Development Plan 2016 to 2022.

- *Conserves and where possible enhances the biodiversity value of the site.*

  The proposed development will provide enhanced landscaping to the local area.

- *Ensures appropriate handling and dealing with waste removal, including contaminated/hazardous ground arising during construction – details to be included in the "Construction Management Plan".*

  As per the submitted documents all local contaminated ground shall be dealt with in accordance with statutory legislation and shall be shipped to appropriately licensed landfills.

- *Ensures that the impact of the proposed construction methodologies and temporary works and ground anchors are fully assessed, and any necessary mitigation measures put in place.*

  The proposed Lower Ground Floor and basement of Block 7 will not require any temporary works which will extend beyond the site boundary.

- *Does not impact negatively on the surrounding areas, both private and public.*

  The proposed development as noted above does not impact negatively on the surrounding areas both private and public.

7.0 RESPONSE TO PLANNING BOARD'S OPINION

Following the stage two part of the SHD application process, the Board issued its opinion on the scheme. The opinion included an appendix from DCCs Drainage Division. Their commentary is noted below with CS Consultants response to same.

"DCC Drainage Division recommends seeking clarification on the proposed surface water and flood risk management strategy proposed for this development. The drainage proposal shall be developed further to address the requirements of the current DCC Development plan."

In particular, the following shall be addressed –

- *The development shall incorporate natural water retention measures in the management of surface water, with a minimum requirement of a 3-stage treatment approach, providing an integrated approach with the landscaping proposals. Soft landscaping should be considered before hard landscaping for surface water drainage and storage management.*

Response

This has been noted, refer to CS drawing **ODG-CSC-XX-XX-DR-C-0046** for a sustainable urban drainage drawing giving a clear break down of the areas in use providing the three stage treatment required by the Council.

- *Surface water storage and design calculations shall be submitted taking into account for 20% Climate Change as per the "Dublin City Development Plan 2016-2022 Strategic Flood Risk Assessment".*

Response

Noted refer to *section 3.3* for the storm water calculations indicating that 20% climate change factor has been used.

- *The proposal for the management of surface water as indicated on the drawings submitted is not acceptable. The developer shall submit a detailed site plan including location, size, and treatment train of proposed natural water retention measures.*

Response

This has been noted, refer to CS drawing **ODG-CSC-XX-XX-DR-C-0046** for a sustainable urban drainage drawing giving a clear break down of the areas in use providing 'SuDs' measures.

- *Detail of design analysis/strategy to locate attenuation storage to serve the entire development in the proposed public park.*

Response

The proposed scheme has to re-locate the existing attenuation tank from the housing development currently under construction. This volume of storm water has to be included within the provision for the total stormwater attenuation area for the scheme. While sustainable urban drainage systems will be used to cater for the 'first flush', (0 – 15mm) of rainfall the development must also provide a storage capacity for the 1-in-100 year extreme storm, increased by a factor of 20% for the predicated impacts of climate change. This volume of water, from the subject lands and from the housing estate currently under construction is too large to realistically be stored in an on-site detention pond or basin. The size required would greatly inhibit open space and recreational land use. For this and health and safety reasons it is proposed to store the volumes of storm water generated by the extreme storm events in an underground tank. This will allow for the required

volumes of storage to be stored underground while above the land can be used for alternative purposes.

• *Details of the proposed maintenance management strategy for the proposed attenuation storage shall be provided.*

Response

It is proposed to use a modular industry specific storage system to retain the storm water generated on site. See **Appendix F** for details from the propose supplier giving maintenance details for the system.

• *Details of interim solution for managing surface water run-off from existing residential development during construction of proposed new attenuation storage surface water sewers to facilitate the proposed diversions. This shall be addressed in the Site Specific Flood Risk Assessment.*

Response

The proposal is to construct a suitably sized attenuation storage area at the location for the permanent storm water attenuation tank. Then to divert the storm water from the existing housing scheme into this storage area. the storage area will be sized to ensure that storm water generate on site during an extreme rainfall event will be retained in a suitable location and drained via a restricted discharge rate. This will ensure that there is no chance of on site overland flooding during the reconstruction period from storm water generated on the existing housing estate site.

• *A longitudinal/cross section of the proposed surface sewer connection to Montpelier Gardens shall be provided indicating the size and depth of proposed sewer and adjacent utilities to ensure a route has been established.*

Response

Noted refer to drawing **ODG-CSC-XX-XX-DR-C-0014** for details of same.

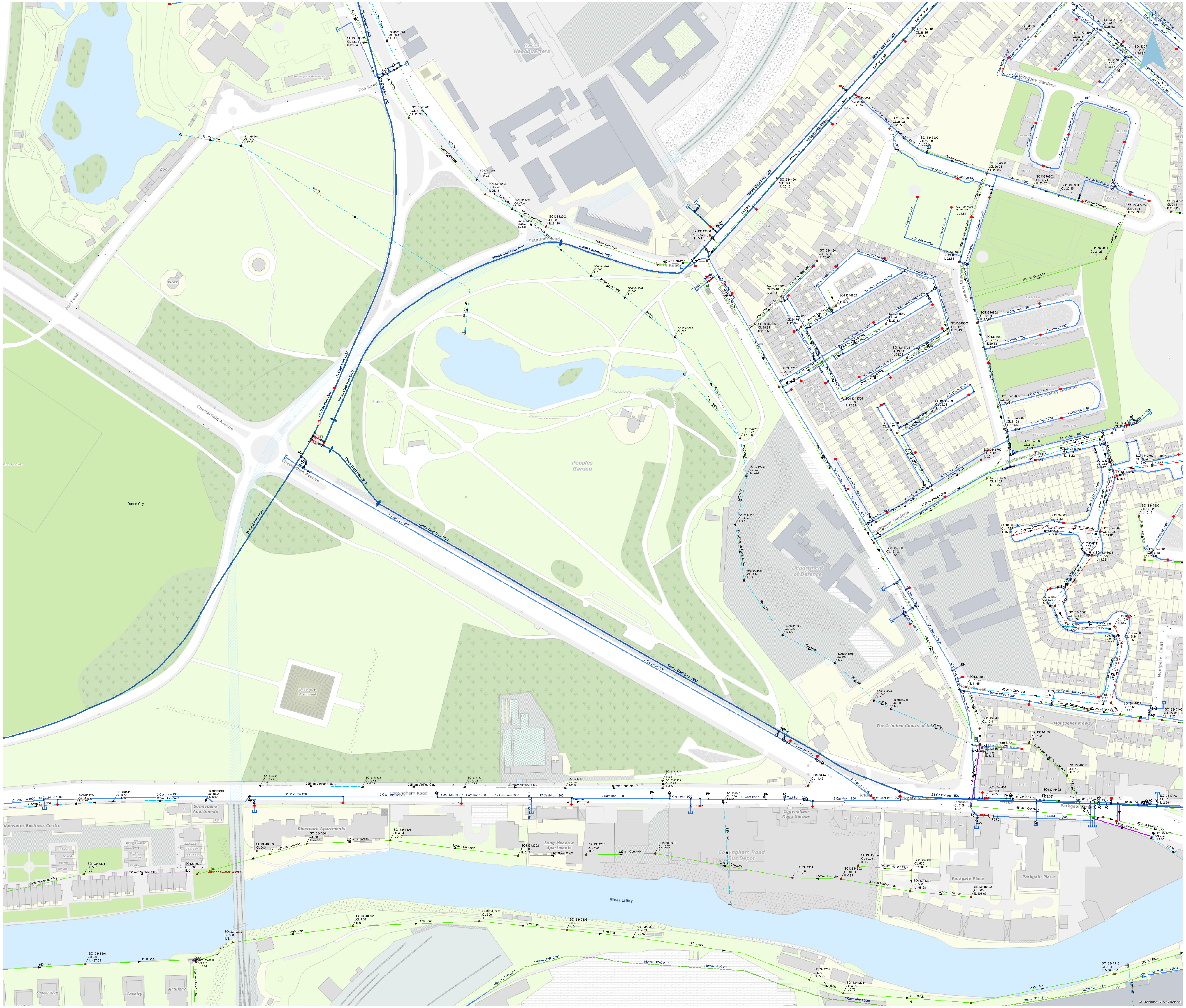
- *The location of the proposed petrol interceptor is not acceptable. Proposed location to be revised in accordance with the Greater Dublin Regional Code of Practice for Drainage Works.*

Response

Noted refer to drawing **ODG-CSC-XX-XX-DR-C-0013** for details of same.

Appendix A:

DCC's Records



UISCE ÉIREANN : IRISH WATER

Legend

Boundary Meter
Check Meter
Unknown Meter ; Other Meter
Sluice Valve Open
Sluice Valve Closed
Sluice Valve Open
Sluice Valve Closed
Double Air Control Valve

Water Hydrants

Hydrant Function

Fire Hydrant
Telemetry Kiosk
Cap
Other Fittings

Water Distribution Mains

Owned By

Irish Water
Private
Irish Water
Water Abandoned Lines

Sewer Manholes

Manhole Type

Standard
Other; Unknown

Sewer Discharge Points

Discharge Type

Other; Unknown
Pump Station

Sewer Inlets

Inlet Type

Catchpit
Gravity - Combined
Gravity - Foul
Gravity - Overflow

Storm Manholes

Manhole Type

Standard
Other; Unknown

Storm Discharge Points

Discharge Type

Outfall
Surface Gravity Mains

Storm Inlets

Inlet Type

Standard

Surface Fittings

Fitting Type

Other; Unknown

1:1,000 at A0

Last edited: 05/03/2018

Metres

0 25 50 100

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2. Whilst every care has been taken in its compilation, 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 to Irish Water.
Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions.This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out.
Service connection pipes are not generally shown but their presence should be anticipated.

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GROUP

Appendix B:

Met Eireann Data and Attenuation Calculation

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 313628, Northing: 234888,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.4,	3.5,	4.1,	5.0,	5.6,	6.1,	7.7,	9.5,	10.7,	12.4,	14.0,	15.2,	17.1,	18.6,	19.8,	N/A ,
10 mins	3.4,	4.9,	5.7,	7.0,	7.8,	8.5,	10.7,	13.2,	14.9,	17.3,	19.5,	21.2,	23.8,	25.9,	27.6,	N/A ,
15 mins	4.0,	5.8,	6.7,	8.2,	9.2,	10.0,	12.6,	15.6,	17.6,	20.4,	22.9,	24.9,	28.0,	30.4,	32.4,	N/A ,
30 mins	5.3,	7.5,	8.7,	10.6,	11.8,	12.8,	16.0,	19.6,	22.0,	25.4,	28.4,	30.8,	34.5,	37.3,	39.7,	N/A ,
1 hours	7.0,	9.8,	11.3,	13.6,	15.1,	16.3,	20.2,	24.6,	27.5,	31.6,	35.3,	38.1,	42.4,	45.8,	48.6,	N/A ,
2 hours	9.2,	12.8,	14.7,	17.5,	19.4,	20.9,	25.6,	31.0,	34.5,	39.4,	43.7,	47.1,	52.3,	56.2,	59.5,	N/A ,
3 hours	10.9,	14.9,	17.1,	20.3,	22.4,	24.1,	29.4,	35.4,	39.3,	44.8,	49.6,	53.3,	59.0,	63.4,	67.0,	N/A ,
4 hours	12.2,	16.7,	19.0,	22.5,	24.9,	26.7,	32.5,	39.0,	43.2,	49.1,	54.3,	58.2,	64.3,	69.0,	72.9,	N/A ,
6 hours	14.3,	19.5,	22.2,	26.1,	28.8,	30.8,	37.3,	44.6,	49.3,	55.8,	61.5,	65.9,	72.6,	77.8,	82.1,	N/A ,
9 hours	16.9,	22.7,	25.8,	30.3,	33.3,	35.5,	42.9,	51.0,	56.2,	63.4,	69.8,	74.6,	82.0,	87.7,	92.4,	N/A ,
12 hours	19.0,	25.4,	28.7,	33.6,	36.9,	39.4,	47.3,	56.0,	61.7,	69.5,	76.3,	81.5,	89.4,	95.5,	100.5,	N/A ,
18 hours	22.3,	29.7,	33.5,	39.0,	42.6,	45.4,	54.3,	64.1,	70.4,	79.0,	86.5,	92.3,	101.0,	107.7,	113.1,	N/A ,
24 hours	25.1,	33.1,	37.3,	43.3,	47.3,	50.3,	60.0,	70.5,	77.3,	86.5,	94.6,	100.8,	110.1,	117.2,	123.0,	143.0,
2 days	30.8,	39.9,	44.5,	51.2,	55.6,	58.9,	69.3,	80.6,	87.7,	97.5,	105.9,	112.3,	122.0,	129.3,	135.3,	155.6,
3 days	35.4,	45.4,	50.4,	57.6,	62.3,	65.8,	76.9,	88.8,	96.4,	106.6,	115.4,	122.1,	132.1,	139.6,	145.8,	166.7,
4 days	39.5,	50.1,	55.5,	63.2,	68.1,	71.9,	83.6,	96.1,	103.9,	114.6,	123.7,	130.6,	141.0,	148.8,	155.1,	176.5,
6 days	46.5,	58.5,	64.4,	72.8,	78.3,	82.3,	95.1,	108.6,	117.0,	128.4,	138.2,	145.5,	156.5,	164.7,	171.4,	193.9,
8 days	52.8,	65.8,	72.2,	81.3,	87.1,	91.5,	105.1,	119.5,	128.4,	140.5,	150.8,	158.5,	170.0,	178.6,	185.6,	209.0,
10 days	58.4,	72.4,	79.3,	89.0,	95.2,	99.8,	114.2,	129.3,	138.8,	151.4,	162.1,	170.2,	182.1,	191.1,	198.4,	222.7,
12 days	63.8,	78.6,	85.8,	96.1,	102.6,	107.5,	122.6,	138.4,	148.3,	161.4,	172.6,	181.0,	193.4,	202.7,	210.2,	235.3,
16 days	73.6,	90.0,	97.9,	109.1,	116.3,	121.6,	138.0,	155.1,	165.6,	179.7,	191.7,	200.6,	213.8,	223.7,	231.6,	258.2,
20 days	82.7,	100.4,	109.0,	121.1,	128.7,	134.4,	152.0,	170.2,	181.4,	196.3,	209.0,	218.4,	232.3,	242.7,	251.0,	278.8,
25 days	93.2,	112.6,	121.9,	134.9,	143.2,	149.3,	168.1,	187.5,	199.5,	215.4,	228.8,	238.8,	253.5,	264.4,	273.2,	302.5,

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

Annual Average Rainfall(mm)

313000	229000	743
313000	230000	729
313000	231000	714
313000	232000	713
313000	233000	718
313000	234000	727
313000	235000	740
313000	236000	752
313000	237000	765

Project:
Project No.: B089
Calculation: Attenuation 100-year
Calcs By: DD
Checked By: RFM
Date: 3/12/18

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DUBLIN - LONDON - LIMERICK

Site Location:	O'Devaney Gardens		
Design Storm Return Period:	100 years		
Climate Change Factor:	20 %		
Soil Type:	4		
Total Site Area:	5.80 ha		
Hardstand Area:	5.40 ha	.....@	100% Impervious
Softstand Area:	0.40 ha	.....@	20% Impervious
Effective Impermeable Area:	5.48 ha		

Allowable Outflow	**Calculate**	
IH124: QBAR = 0.00108 x AREA$^{0.89}$ x SAAR$^{1.17}$ x SOIL$^{2.17}$		
AREA:	0.0580 km^2	
SAAR:	732 mm	
SOIL:	0.47	
QBAR/ha	5.09 l/s/ha	
Allowable Outflow	**29.0 l/s**	Smallest Allowable Discharge Rate

Storage required =	**4042 m^3**	

Duration (min)	Rainfall 100-Year (mm)	Rainfall 100-Year with CCF (mm)	Intensity (mm/hr)	Discharge (Q = 2.78iA) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total Runoff (m^3)	Allowable Outflow (m^3)	Storage Required (m^3)
5	15.2	18.2	218.9	3251	975	0	975	9	966
10	21.2	25.4	152.6	2267	1360	0	1360	17	1343
15	24.9	29.9	119.5	1775	1597	0	1597	26	1571
30	30.8	37.0	73.9	1098	1976	0	1976	52	1924
60	38.1	45.7	45.7	679	2444	0	2444	104	2340
120	47.1	56.5	28.3	420	3022	0	3022	209	2813
180	53.3	64.0	21.3	317	3419	0	3419	313	3106
240	58.2	69.8	17.5	259	3734	0	3734	418	3316
360	65.9	79.1	13.2	196	4228	0	4228	626	3601
540	74.6	89.5	9.9	148	4786	0	4786	940	3846
720	81.5	97.8	8.2	121	5229	0	5229	1253	3976
1080	92.3	110.8	6.2	91	5922	0	5922	1879	4042
1440	100.8	121.0	5.0	75	6467	0	6467	2506	3961
2880	112.3	134.8	2.8	42	7205	0	7205	5011	2193
4320	122.0	146.4	2.0	30	7827	0	7827	7517	310
5760	130.6	156.7	1.6	24	8379	0	8379	10022	-1644
8640	145.5	174.6	1.2	18.0066	9335	0	9335	15034	-5699
11520	158.4	190.1	1.0	15	10162	0	10162	20045	-9883
14400	170.1	204.1	0.9	13	10913	0	10913	25056	-14143
17280	180.9	217.1	0.8	11	11606	0	11606	30067	-18461
23040	200.5	240.6	0.6	9	12863	0	12863	40090	-27226
28800	218.3	262.0	0.5	8	14005	0	14005	50112	-36107
36000	238.6	286.3	0.5	7	15307	0	15307	62640	-47333

CS CONSULTING
GROUP

Appendix C:

Stormwater WinDes Design

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500
PIMP (%)	100		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.230	4-8	3.164	8-12	0.101

Total Area Contributing (ha) = 4.495

Total Pipe Volume (m^3) = 167.239

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	29.544	0.148	199.6	0.036	4.00	0.0	0.600	o	225
1.001	17.748	0.089	200.0	0.068	0.00	0.0	0.600	o	225
2.000	19.626	0.098	200.3	0.072	4.00	0.0	0.600	o	225
2.001	23.531	0.118	200.0	0.052	0.00	0.0	0.600	o	225
2.002	28.881	0.144	200.0	0.056	0.00	0.0	0.600	o	225
1.002	37.381	0.187	200.0	0.139	0.00	0.0	0.600	o	300
3.000	88.854	0.444	200.1	0.452	4.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.53	26.000	0.036	0.0	0.0	0.0	0.92	36.7	4.8
1.001	50.00	4.86	25.852	0.103	0.0	0.0	0.0	0.92	36.6	14.0
2.000	50.00	4.36	26.000	0.072	0.0	0.0	0.0	0.92	36.6	9.8
2.001	50.00	4.78	25.902	0.124	0.0	0.0	0.0	0.92	36.6	16.8
2.002	50.00	5.30	25.784	0.179	0.0	0.0	0.0	0.92	36.6	24.3
1.002	50.00	5.87	25.565	0.422	0.0	0.0	0.0	1.11	78.3	57.1
3.000	50.00	5.34	24.000	0.452	0.0	0.0	0.0	1.11	78.3	61.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.003	40.953	0.205	200.0	0.216	0.00	0.0	0.600	o	450
1.004	14.057	0.070	200.0	0.080	0.00	0.0	0.600	o	450
4.000	51.226	0.512	100.1	0.326	4.00	0.0	0.600	o	450
4.001	60.882	0.609	100.0	0.177	0.00	0.0	0.600	o	525
4.002	17.367	0.174	100.0	0.018	0.00	0.0	0.600	o	525
4.003	6.561	0.066	100.0	0.000	0.00	0.0	0.600	o	525
5.000	65.447	0.327	200.1	0.403	4.00	0.0	0.600	o	375
4.004	17.620	0.088	200.0	0.037	0.00	0.0	0.600	o	525
4.005	80.823	0.404	200.0	0.463	0.00	0.0	0.600	o	525
1.005	52.000	0.260	200.0	0.497	0.00	0.0	0.600	o	600
1.006	36.317	0.182	200.0	0.378	0.00	0.0	0.600	o	600
1.007	14.870	0.074	200.0	0.000	0.00	0.0	0.600	o	600
1.008	25.105	0.126	200.0	0.072	0.00	0.0	0.600	o	600
6.000	70.401	0.704	100.0	0.356	4.00	0.0	0.600	o	375
6.001	79.597	0.531	150.0	0.358	0.00	0.0	0.600	o	375
1.009	9.188	0.037	250.0	0.000	0.00	0.0	0.600	o	675
1.010	76.735	0.307	250.0	0.000	0.00	0.0	0.600	o	675
1.011	17.297	0.069	250.0	0.237	0.00	0.0	0.600	o	675

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	48.59	6.34	23.406	1.091	0.0	0.0	0.0	1.43	228.1	143.5
1.004	48.07	6.51	23.201	1.171	0.0	0.0	0.0	1.43	228.1	152.4
4.000	50.00	4.42	22.000	0.326	0.0	0.0	0.0	2.03	323.3	44.2
4.001	50.00	4.87	21.413	0.504	0.0	0.0	0.0	2.24	485.0	68.2
4.002	50.00	5.00	20.804	0.521	0.0	0.0	0.0	2.24	484.9	70.6
4.003	50.00	5.05	20.630	0.521	0.0	0.0	0.0	2.24	484.9	70.6
5.000	50.00	4.85	22.000	0.403	0.0	0.0	0.0	1.28	141.0	54.6
4.004	50.00	5.24	20.565	0.962	0.0	0.0	0.0	1.58	342.1	130.3
4.005	49.42	6.09	20.477	1.425	0.0	0.0	0.0	1.58	342.1	190.8
1.005	46.55	7.01	19.998	3.094	0.0	0.0	0.0	1.72	485.8	390.0
1.006	45.56	7.36	19.738	3.471	0.0	0.0	0.0	1.72	485.8	428.3
1.007	45.17	7.51	19.556	3.471	0.0	0.0	0.0	1.72	485.8	428.3
1.008	44.53	7.75	19.482	3.544	0.0	0.0	0.0	1.72	485.8	428.3
6.000	50.00	4.65	21.000	0.356	0.0	0.0	0.0	1.81	200.1	48.3
6.001	50.00	5.55	20.296	0.714	0.0	0.0	0.0	1.48	163.1	96.7
1.009	44.29	7.84	19.281	4.258	0.0	0.0	0.0	1.65	591.5	510.7
1.010	42.41	8.62	19.150	4.258	0.0	0.0	0.0	1.65	591.5	510.7
1.011	42.01	8.79	18.843	4.495	0.0	0.0	0.0	1.65	591.5	511.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	28.720	2.720	Open Manhole	1200	1.000	26.000	225				
2	28.060	2.208	Open Manhole	1200	1.001	25.852	225	1.000	25.852	225	
3	28.100	2.100	Open Manhole	1200	2.000	26.000	225				
4	28.100	2.198	Open Manhole	1200	2.001	25.902	225	2.000	25.902	225	
5	27.810	2.026	Open Manhole	1200	2.002	25.784	225	2.001	25.784	225	
6	27.610	2.045	Open Manhole	1200	1.002	25.565	300	1.001	25.763	225	123
								2.002	25.640	225	
7	27.000	3.000	Open Manhole	1200	3.000	24.000	300				
8	26.680	3.274	Open Manhole	1200	1.003	23.406	450	1.002	25.378	300	1822
								3.000	23.556	300	
9	26.170	2.969	Open Manhole	1200	1.004	23.201	450	1.003	23.201	450	
10	26.090	4.090	Open Manhole	1200	4.000	22.000	450				
11	25.480	4.067	Open Manhole	1200	4.001	21.413	525	4.000	21.488	450	
12	24.370	3.566	Open Manhole	1200	4.002	20.804	525	4.001	20.804	525	
13	24.620	3.990	Open Manhole	1200	4.003	20.630	525	4.002	20.630	525	
14	24.500	2.500	Open Manhole	1200	5.000	22.000	375				
15	24.750	4.185	Open Manhole	1200	4.004	20.565	525	4.003	20.565	525	
								5.000	21.673	375	958
16	25.080	4.603	Open Manhole	1200	4.005	20.477	525	4.004	20.477	525	
17	26.030	6.032	Open Manhole	1200	1.005	19.998	600	1.004	23.131	450	2983
								4.005	20.073	525	
18	24.870	5.132	Open Manhole	1200	1.006	19.738	600	1.005	19.738	600	
19	24.500	4.944	Open Manhole	1200	1.007	19.556	600	1.006	19.556	600	
20	24.500	5.018	Open Manhole	1200	1.008	19.482	600	1.007	19.482	600	
21	22.000	1.000	Open Manhole	1200	6.000	21.000	375				
22	22.450	2.154	Open Manhole	1350	6.001	20.296	375	6.000	20.296	375	
23	22.450	3.169	Open Manhole	1200	1.009	19.281	675	1.008	19.356	600	
								6.001	19.765	375	184
24	23.500	4.350	Open Manhole	1200	1.010	19.150	675	1.009	19.244	675	94
25	23.000	4.157	Open Manhole	1200	1.011	18.843	675	1.010	18.843	675	
Mh-26	21.200	2.426	Open Manhole	0		OUTFALL		1.011	18.774	675	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	1	28.720	26.000	2.495	Open Manhole	1200
1.001	o	225	2	28.060	25.852	1.983	Open Manhole	1200
2.000	o	225	3	28.100	26.000	1.875	Open Manhole	1200
2.001	o	225	4	28.100	25.902	1.973	Open Manhole	1200
2.002	o	225	5	27.810	25.784	1.801	Open Manhole	1200
1.002	o	300	6	27.610	25.565	1.745	Open Manhole	1200
3.000	o	300	7	27.000	24.000	2.700	Open Manhole	1200
1.003	o	450	8	26.680	23.406	2.824	Open Manhole	1200
1.004	o	450	9	26.170	23.201	2.519	Open Manhole	1200
4.000	o	450	10	26.090	22.000	3.640	Open Manhole	1200
4.001	o	525	11	25.480	21.413	3.542	Open Manhole	1200
4.002	o	525	12	24.370	20.804	3.041	Open Manhole	1200
4.003	o	525	13	24.620	20.630	3.465	Open Manhole	1200
5.000	o	375	14	24.500	22.000	2.125	Open Manhole	1200
4.004	o	525	15	24.750	20.565	3.660	Open Manhole	1200
4.005	o	525	16	25.080	20.477	4.078	Open Manhole	1200
1.005	o	600	17	26.030	19.998	5.432	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	29.544	199.6	2	28.060	25.852	1.983	Open Manhole	1200
1.001	17.748	200.0	6	27.610	25.763	1.622	Open Manhole	1200
2.000	19.626	200.3	4	28.100	25.902	1.973	Open Manhole	1200
2.001	23.531	200.0	5	27.810	25.784	1.801	Open Manhole	1200
2.002	28.881	200.0	6	27.610	25.640	1.745	Open Manhole	1200
1.002	37.381	200.0	8	26.680	25.378	1.002	Open Manhole	1200
3.000	88.854	200.1	8	26.680	23.556	2.824	Open Manhole	1200
1.003	40.953	200.0	9	26.170	23.201	2.519	Open Manhole	1200
1.004	14.057	200.0	17	26.030	23.131	2.449	Open Manhole	1200
4.000	51.226	100.1	11	25.480	21.488	3.542	Open Manhole	1200
4.001	60.882	100.0	12	24.370	20.804	3.041	Open Manhole	1200
4.002	17.367	100.0	13	24.620	20.630	3.465	Open Manhole	1200
4.003	6.561	100.0	15	24.750	20.565	3.660	Open Manhole	1200
5.000	65.447	200.1	15	24.750	21.673	2.702	Open Manhole	1200
4.004	17.620	200.0	16	25.080	20.477	4.078	Open Manhole	1200
4.005	80.823	200.0	17	26.030	20.073	5.432	Open Manhole	1200
1.005	52.000	200.0	18	24.870	19.738	4.532	Open Manhole	1200

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	o	600	18	24.870	19.738	4.532	Open Manhole	1200
1.007	o	600	19	24.500	19.556	4.344	Open Manhole	1200
1.008	o	600	20	24.500	19.482	4.418	Open Manhole	1200
6.000	o	375	21	22.000	21.000	0.625	Open Manhole	1200
6.001	o	375	22	22.450	20.296	1.779	Open Manhole	1350
1.009	o	675	23	22.450	19.281	2.494	Open Manhole	1200
1.010	o	675	24	23.500	19.150	3.675	Open Manhole	1200
1.011	o	675	25	23.000	18.843	3.482	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	36.317	200.0	19	24.500	19.556	4.344	Open Manhole	1200
1.007	14.870	200.0	20	24.500	19.482	4.418	Open Manhole	1200
1.008	25.105	200.0	23	22.450	19.356	2.494	Open Manhole	1200
6.000	70.401	100.0	22	22.450	20.296	1.779	Open Manhole	1350
6.001	79.597	150.0	23	22.450	19.765	2.310	Open Manhole	1200
1.009	9.188	250.0	24	23.500	19.244	3.581	Open Manhole	1200
1.010	76.735	250.0	25	23.000	18.843	3.482	Open Manhole	1200
1.011	17.297	250.0	Mh-26	21.200	18.774	1.751	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.036	0.036	0.036
1.001	User	-	100	0.068	0.068	0.068
2.000	User	-	100	0.072	0.072	0.072
2.001	User	-	100	0.052	0.052	0.052
2.002	User	-	100	0.056	0.056	0.056
1.002	User	-	100	0.139	0.139	0.139
3.000	User	-	100	0.094	0.094	0.094
	User	-	100	0.358	0.358	0.452
1.003	User	-	100	0.216	0.216	0.216
1.004	User	-	100	0.080	0.080	0.080
4.000	User	-	100	0.326	0.326	0.326
4.001	User	-	100	0.177	0.177	0.177
4.002	User	-	100	0.018	0.018	0.018
4.003	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.403	0.403	0.403
4.004	User	-	100	0.037	0.037	0.037
4.005	User	-	100	0.463	0.463	0.463
1.005	User	-	100	0.497	0.497	0.497
1.006	User	-	100	0.378	0.378	0.378
1.007	-	-	100	0.000	0.000	0.000
1.008	User	-	100	0.072	0.072	0.072
6.000	User	-	100	0.356	0.356	0.356
6.001	User	-	100	0.358	0.358	0.358
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	User	-	100	0.237	0.237	0.237
				Total	Total	Total
				4.495	4.495	4.495

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011	Mh-26	21.200	18.774	18.750	0	0

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
1.000	29.544	0.148	199.6	0.036	4.00	0.600	o	225
1.001	17.748	0.089	200.0	0.068	0.00	0.600	o	225
2.000	19.626	0.098	200.3	0.072	4.00	0.600	o	225
2.001	23.531	0.118	200.0	0.052	0.00	0.600	o	225
2.002	28.881	0.144	200.0	0.056	0.00	0.600	o	225
1.002	37.381	0.187	200.0	0.139	0.00	0.600	o	300
3.000	88.854	0.444	200.1	0.452	4.00	0.600	o	300
1.003	40.953	0.205	200.0	0.216	0.00	0.600	o	450
1.004	14.057	0.070	200.0	0.080	0.00	0.600	o	450
4.000	51.226	0.512	100.1	0.326	4.00	0.600	o	450
4.001	60.882	0.609	100.0	0.177	0.00	0.600	o	525
4.002	17.367	0.174	100.0	0.018	0.00	0.600	o	525
4.003	6.561	0.066	100.0	0.000	0.00	0.600	o	525
5.000	65.447	0.327	200.1	0.403	4.00	0.600	o	375
4.004	17.620	0.088	200.0	0.037	0.00	0.600	o	525
4.005	80.823	0.404	200.0	0.463	0.00	0.600	o	525
1.005	52.000	0.260	200.0	0.497	0.00	0.600	o	600
1.006	36.317	0.182	200.0	0.378	0.00	0.600	o	600
1.007	14.870	0.074	200.0	0.000	0.00	0.600	o	600
1.008	25.105	0.126	200.0	0.072	0.00	0.600	o	600

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	1	28.720	26.000	2.495	28.060	25.852	1.983		1200
1.001	2	28.060	25.852	1.983	27.610	25.763	1.622		1200
2.000	3	28.100	26.000	1.875	28.100	25.902	1.973		1200
2.001	4	28.100	25.902	1.973	27.810	25.784	1.801		1200
2.002	5	27.810	25.784	1.801	27.610	25.640	1.745		1200
1.002	6	27.610	25.565	1.745	26.680	25.378	1.002		1200
3.000	7	27.000	24.000	2.700	26.680	23.556	2.824		1200
1.003	8	26.680	23.406	2.824	26.170	23.201	2.519		1200
1.004	9	26.170	23.201	2.519	26.030	23.131	2.449		1200
4.000	10	26.090	22.000	3.640	25.480	21.488	3.542		1200
4.001	11	25.480	21.413	3.542	24.370	20.804	3.041		1200
4.002	12	24.370	20.804	3.041	24.620	20.630	3.465		1200
4.003	13	24.620	20.630	3.465	24.750	20.565	3.660		1200
5.000	14	24.500	22.000	2.125	24.750	21.673	2.702		1200
4.004	15	24.750	20.565	3.660	25.080	20.477	4.078		1200
4.005	16	25.080	20.477	4.078	26.030	20.073	5.432		1200
1.005	17	26.030	19.998	5.432	24.870	19.738	4.532		1200
1.006	18	24.870	19.738	4.532	24.500	19.556	4.344		1200
1.007	19	24.500	19.556	4.344	24.500	19.482	4.418		1200
1.008	20	24.500	19.482	4.418	22.450	19.356	2.494		1200

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)
6.000	70.401	0.704	100.0	0.356	4.00	0.600	o	375
6.001	79.597	0.531	150.0	0.358	0.00	0.600	o	375
1.009	9.188	0.037	250.0	0.000	0.00	0.600	o	675
1.010	76.735	0.307	250.0	0.000	0.00	0.600	o	675
1.011	17.297	0.069	250.0	0.237	0.00	0.600	o	675

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
6.000	21	22.000	21.000	0.625	22.450	20.296	1.779		1200
6.001	22	22.450	20.296	1.779	22.450	19.765	2.310		1350
1.009	23	22.450	19.281	2.494	23.500	19.244	3.581	Depth/Flow Relationship	1200
1.010	24	23.500	19.150	3.675	23.000	18.843	3.482		1200
1.011	25	23.000	18.843	3.482	21.200	18.774	1.751	Depth/Flow Relationship	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011	Mh-26	21.200	18.774	18.750	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	20.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.000	Storm Duration (mins)	15
Ratio R	0.300		

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Online Controls for Storm

Depth/Flow Relationship Manhole: 23, DS/PN: 1.009, Volume (m³): 19.0

Invert Level (m) 19.281

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	29.0000	1.400	29.0000	2.600	29.0000	3.800	29.0000	5.000	29.0000
0.400	29.0000	1.600	29.0000	2.800	29.0000	4.000	29.0000	5.200	29.0000
0.600	29.0000	1.800	29.0000	3.000	29.0000	4.200	29.0000	5.400	29.0000
0.800	29.0000	2.000	29.0000	3.200	29.0000	4.400	29.0000	5.600	29.0000
1.000	29.0000	2.200	29.0000	3.400	29.0000	4.600	29.0000	5.800	29.0000
1.200	29.0000	2.400	29.0000	3.600	29.0000	4.800	29.0000	6.000	29.0000

Depth/Flow Relationship Manhole: 25, DS/PN: 1.011, Volume (m³): 31.7

Invert Level (m) 18.843

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	29.0000	1.400	29.0000	2.600	29.0000	3.800	29.0000	5.000	29.0000
0.400	29.0000	1.600	29.0000	2.800	29.0000	4.000	29.0000	5.200	29.0000
0.600	29.0000	1.800	29.0000	3.000	29.0000	4.200	29.0000	5.400	29.0000
0.800	29.0000	2.000	29.0000	3.200	29.0000	4.400	29.0000	5.600	29.0000
1.000	29.0000	2.200	29.0000	3.400	29.0000	4.600	29.0000	5.800	29.0000
1.200	29.0000	2.400	29.0000	3.600	29.0000	4.800	29.0000	6.000	29.0000

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Storage Structures for Storm

Tank or Pond Manhole: 23, DS/PN: 1.009

Invert Level (m) 19.756

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	1.200	2000.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	2000.0	1.400	2000.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	2000.0	1.600	2000.0	2.800	0.0	4.000	0.0		
0.600	2000.0	1.800	2000.0	3.000	0.0	4.200	0.0		
0.800	2000.0	2.000	2000.0	3.200	0.0	4.400	0.0		
1.000	2000.0	2.200	0.0	3.400	0.0	4.600	0.0		

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Summary of Results for 15 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.563	0.338	0.000	0.38	0.0	13.1	SURCHARGED
1.001	2	26.532	0.455	0.000	1.13	0.0	37.0	SURCHARGED
2.000	3	27.090	0.865	0.000	0.73	0.0	24.1	SURCHARGED
2.001	4	27.036	0.909	0.000	1.23	0.0	41.4	SURCHARGED
2.002	5	26.856	0.847	0.000	1.73	0.0	59.1	SURCHARGED
1.002	6	26.418	0.553	0.000	1.98	0.0	143.5	SURCHARGED
3.000	7	26.713	2.413	0.000	2.01	0.0	152.4	FLOOD RISK
1.003	8	24.726	0.870	0.000	1.78	0.0	361.7	SURCHARGED
1.004	9	24.043	0.392	0.000	2.28	0.0	385.4	SURCHARGED
4.000	10	24.290	1.840	0.000	0.45	0.0	133.2	SURCHARGED
4.001	11	24.245	2.307	0.000	0.33	0.0	146.3	SURCHARGED
4.002	12	24.195	2.866	0.000	0.56	0.0	179.9	FLOOD RISK
4.003	13	24.162	3.007	0.000	0.78	0.0	192.9	SURCHARGED
5.000	14	24.318	1.943	0.000	1.10	0.0	146.7	FLOOD RISK
4.004	15	24.145	3.055	0.000	0.98	0.0	244.3	SURCHARGED
4.005	16	24.073	3.071	0.000	1.08	0.0	343.8	SURCHARGED
1.005	17	23.567	2.970	0.000	1.94	0.0	830.8	SURCHARGED
1.006	18	22.565	2.227	0.000	2.23	0.0	911.3	SURCHARGED
1.007	19	21.628	1.472	0.000	2.67	0.0	912.8	SURCHARGED
1.008	20	20.790	0.708	0.000	2.61	0.0	926.4	SURCHARGED
6.000	21	21.827	0.452	0.000	0.66	0.0	125.6	FLOOD RISK
6.001	22	21.512	0.841	0.000	1.57	0.0	243.3	SURCHARGED
1.009	23	20.136	0.180	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.626	0.801	0.000	0.05	0.0	29.0	SURCHARGED
1.011	25	20.645	1.127	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 30 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.339	0.114	0.000	0.32	0.0	10.9	SURCHARGED
1.001	2	26.312	0.235	0.000	0.96	0.0	31.6	SURCHARGED
2.000	3	26.763	0.538	0.000	0.64	0.0	21.3	SURCHARGED
2.001	4	26.719	0.592	0.000	1.09	0.0	36.7	SURCHARGED
2.002	5	26.578	0.569	0.000	1.55	0.0	52.8	SURCHARGED
1.002	6	26.230	0.365	0.000	1.73	0.0	125.3	SURCHARGED
3.000	7	25.930	1.630	0.000	1.78	0.0	134.8	SURCHARGED
1.003	8	24.462	0.606	0.000	1.58	0.0	321.2	SURCHARGED
1.004	9	23.937	0.286	0.000	2.03	0.0	343.5	SURCHARGED
4.000	10	23.913	1.463	0.000	0.36	0.0	105.0	SURCHARGED
4.001	11	23.869	1.931	0.000	0.31	0.0	135.7	SURCHARGED
4.002	12	23.821	2.492	0.000	0.45	0.0	144.9	SURCHARGED
4.003	13	23.790	2.634	0.000	0.60	0.0	149.5	SURCHARGED
5.000	14	23.942	1.567	0.000	0.95	0.0	125.6	SURCHARGED
4.004	15	23.773	2.684	0.000	0.94	0.0	234.8	SURCHARGED
4.005	16	23.709	2.708	0.000	1.05	0.0	332.4	SURCHARGED
1.005	17	23.257	2.659	0.000	1.83	0.0	782.3	SURCHARGED
1.006	18	22.379	2.041	0.000	2.13	0.0	870.9	SURCHARGED
1.007	19	21.543	1.387	0.000	2.55	0.0	871.5	SURCHARGED
1.008	20	20.796	0.715	0.000	2.50	0.0	887.1	SURCHARGED
6.000	21	21.402	0.027	0.000	0.59	0.0	111.8	SURCHARGED
6.001	22	21.168	0.497	0.000	1.39	0.0	215.2	SURCHARGED
1.009	23	20.277	0.321	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	21.221	1.396	0.000	0.05	0.0	29.0	SURCHARGED
1.011	25	21.238	1.720	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 45 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.143	-0.082	0.000	0.27	0.0	9.4	OK
1.001	2	26.120	0.043	0.000	0.79	0.0	26.0	SURCHARGED
2.000	3	26.461	0.236	0.000	0.54	0.0	17.9	SURCHARGED
2.001	4	26.423	0.296	0.000	0.92	0.0	30.8	SURCHARGED
2.002	5	26.321	0.311	0.000	1.31	0.0	44.7	SURCHARGED
1.002	6	26.066	0.201	0.000	1.45	0.0	104.7	SURCHARGED
3.000	7	25.248	0.948	0.000	1.50	0.0	113.7	SURCHARGED
1.003	8	24.192	0.336	0.000	1.33	0.0	270.2	SURCHARGED
1.004	9	23.823	0.171	0.000	1.71	0.0	288.8	SURCHARGED
4.000	10	23.126	0.676	0.000	0.29	0.0	86.2	SURCHARGED
4.001	11	23.088	1.150	0.000	0.26	0.0	113.9	SURCHARGED
4.002	12	23.046	1.717	0.000	0.39	0.0	125.6	SURCHARGED
4.003	13	23.018	1.863	0.000	0.54	0.0	134.1	SURCHARGED
5.000	14	23.137	0.762	0.000	0.79	0.0	105.4	SURCHARGED
4.004	15	23.004	1.914	0.000	0.85	0.0	211.9	SURCHARGED
4.005	16	22.953	1.951	0.000	0.93	0.0	295.8	SURCHARGED
1.005	17	22.598	2.000	0.000	1.60	0.0	682.0	SURCHARGED
1.006	18	21.915	1.578	0.000	1.86	0.0	759.6	SURCHARGED
1.007	19	21.262	1.106	0.000	2.22	0.0	756.8	SURCHARGED
1.008	20	20.681	0.599	0.000	2.18	0.0	773.6	SURCHARGED
6.000	21	21.192	-0.183	0.000	0.51	0.0	96.2	OK
6.001	22	20.897	0.226	0.000	1.19	0.0	184.2	SURCHARGED
1.009	23	20.356	0.400	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.817	0.992	0.000	0.05	0.0	28.9	SURCHARGED
1.011	25	20.834	1.316	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 60 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.075	-0.150	0.000	0.24	0.0	8.1	OK
1.001	2	26.005	-0.072	0.000	0.71	0.0	23.3	OK
2.000	3	26.256	0.031	0.000	0.47	0.0	15.6	SURCHARGED
2.001	4	26.223	0.096	0.000	0.79	0.0	26.5	SURCHARGED
2.002	5	26.148	0.139	0.000	1.12	0.0	38.3	SURCHARGED
1.002	6	25.961	0.096	0.000	1.25	0.0	90.5	SURCHARGED
3.000	7	24.803	0.503	0.000	1.30	0.0	98.6	SURCHARGED
1.003	8	24.034	0.178	0.000	1.15	0.0	234.4	SURCHARGED
1.004	9	23.758	0.107	0.000	1.48	0.0	250.8	SURCHARGED
4.000	10	22.464	0.014	0.000	0.25	0.0	74.7	SURCHARGED
4.001	11	22.430	0.492	0.000	0.24	0.0	103.9	SURCHARGED
4.002	12	22.393	1.064	0.000	0.36	0.0	116.4	SURCHARGED
4.003	13	22.368	1.213	0.000	0.48	0.0	120.3	SURCHARGED
5.000	14	22.461	0.086	0.000	0.69	0.0	91.6	SURCHARGED
4.004	15	22.355	1.266	0.000	0.78	0.0	195.0	SURCHARGED
4.005	16	22.311	1.310	0.000	0.82	0.0	261.6	SURCHARGED
1.005	17	22.039	1.442	0.000	1.40	0.0	596.9	SURCHARGED
1.006	18	21.519	1.182	0.000	1.64	0.0	668.9	SURCHARGED
1.007	19	21.022	0.866	0.000	1.95	0.0	667.5	SURCHARGED
1.008	20	20.595	0.513	0.000	1.92	0.0	679.9	SURCHARGED
6.000	21	21.173	-0.202	0.000	0.43	0.0	81.0	OK
6.001	22	20.679	0.008	0.000	1.01	0.0	157.0	SURCHARGED
1.009	23	20.412	0.456	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.327	0.502	0.000	0.05	0.0	28.9	SURCHARGED
1.011	25	20.343	0.825	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 90 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.065	-0.160	0.000	0.18	0.0	6.2	OK
1.001	2	25.972	-0.105	0.000	0.55	0.0	18.0	OK
2.000	3	26.096	-0.129	0.000	0.38	0.0	12.7	OK
2.001	4	26.034	-0.093	0.000	0.64	0.0	21.6	OK
2.002	5	25.954	-0.055	0.000	0.91	0.0	31.2	OK
1.002	6	25.828	-0.037	0.000	1.00	0.0	72.4	OK
3.000	7	24.345	0.045	0.000	1.02	0.0	77.4	SURCHARGED
1.003	8	23.860	0.004	0.000	0.92	0.0	186.7	SURCHARGED
1.004	9	23.685	0.034	0.000	1.18	0.0	200.3	SURCHARGED
4.000	10	22.134	-0.316	0.000	0.19	0.0	57.2	OK
4.001	11	21.759	-0.179	0.000	0.20	0.0	86.7	OK
4.002	12	21.728	0.399	0.000	0.28	0.0	88.2	SURCHARGED
4.003	13	21.709	0.554	0.000	0.36	0.0	89.4	SURCHARGED
5.000	14	22.195	-0.180	0.000	0.53	0.0	70.5	OK
4.004	15	21.699	0.609	0.000	0.60	0.0	149.6	SURCHARGED
4.005	16	21.662	0.660	0.000	0.69	0.0	218.6	SURCHARGED
1.005	17	21.469	0.871	0.000	1.16	0.0	494.5	SURCHARGED
1.006	18	21.116	0.778	0.000	1.36	0.0	554.5	SURCHARGED
1.007	19	20.790	0.634	0.000	1.62	0.0	552.7	SURCHARGED
1.008	20	20.509	0.427	0.000	1.58	0.0	562.7	SURCHARGED
6.000	21	21.148	-0.227	0.000	0.33	0.0	62.3	OK
6.001	22	20.553	-0.118	0.000	0.80	0.0	123.9	OK
1.009	23	20.489	0.533	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.320	0.495	0.000	0.05	0.0	28.9	SURCHARGED
1.011	25	20.317	0.799	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 180 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.050	-0.175	0.000	0.11	0.0	3.9	OK
1.001	2	25.943	-0.134	0.000	0.35	0.0	11.3	OK
2.000	3	26.074	-0.151	0.000	0.24	0.0	7.9	OK
2.001	4	26.001	-0.126	0.000	0.40	0.0	13.6	OK
2.002	5	25.907	-0.102	0.000	0.58	0.0	19.6	OK
1.002	6	25.740	-0.125	0.000	0.64	0.0	46.2	OK
3.000	7	24.178	-0.122	0.000	0.65	0.0	49.5	OK
1.003	8	23.654	-0.202	0.000	0.59	0.0	119.1	OK
1.004	9	23.496	-0.156	0.000	0.76	0.0	127.8	OK
4.000	10	22.104	-0.346	0.000	0.12	0.0	35.8	OK
4.001	11	21.536	-0.402	0.000	0.13	0.0	55.2	OK
4.002	12	20.953	-0.376	0.000	0.18	0.0	57.1	OK
4.003	13	20.896	-0.259	0.000	0.23	0.0	56.4	OK
5.000	14	22.149	-0.226	0.000	0.33	0.0	44.2	OK
4.004	15	20.889	-0.201	0.000	0.42	0.0	104.3	OK
4.005	16	20.864	-0.138	0.000	0.48	0.0	152.7	OK
1.005	17	20.782	0.184	0.000	0.75	0.0	321.7	SURCHARGED
1.006	18	20.646	0.309	0.000	0.88	0.0	360.6	SURCHARGED
1.007	19	20.627	0.471	0.000	1.06	0.0	360.7	SURCHARGED
1.008	20	20.618	0.537	0.000	1.04	0.0	368.3	SURCHARGED
6.000	21	21.115	-0.260	0.000	0.21	0.0	39.1	OK
6.001	22	20.617	-0.054	0.000	0.50	0.0	78.1	OK
1.009	23	20.611	0.655	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.450	0.625	0.000	0.05	0.0	28.9	SURCHARGED
1.011	25	20.444	0.926	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 360 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.039	-0.186	0.000	0.07	0.0	2.4	OK
1.001	2	25.922	-0.155	0.000	0.21	0.0	6.9	OK
2.000	3	26.057	-0.168	0.000	0.15	0.0	4.8	OK
2.001	4	25.977	-0.150	0.000	0.25	0.0	8.3	OK
2.002	5	25.876	-0.133	0.000	0.35	0.0	12.0	OK
1.002	6	25.695	-0.170	0.000	0.39	0.0	28.3	OK
3.000	7	24.132	-0.168	0.000	0.40	0.0	30.3	OK
1.003	8	23.592	-0.264	0.000	0.36	0.0	73.0	OK
1.004	9	23.416	-0.235	0.000	0.46	0.0	78.4	OK
4.000	10	22.081	-0.369	0.000	0.07	0.0	21.9	OK
4.001	11	21.509	-0.429	0.000	0.08	0.0	33.7	OK
4.002	12	20.919	-0.410	0.000	0.11	0.0	34.9	OK
4.003	13	20.765	-0.391	0.000	0.14	0.0	34.9	OK
5.000	14	22.114	-0.261	0.000	0.20	0.0	27.0	OK
4.004	15	20.745	-0.344	0.000	0.26	0.0	64.4	OK
4.005	16	20.725	-0.276	0.000	0.30	0.0	95.5	OK
1.005	17	20.719	0.121	0.000	0.48	0.0	203.1	SURCHARGED
1.006	18	20.710	0.373	0.000	0.55	0.0	225.4	SURCHARGED
1.007	19	20.702	0.546	0.000	0.66	0.0	224.9	SURCHARGED
1.008	20	20.697	0.615	0.000	0.65	0.0	229.5	SURCHARGED
6.000	21	21.088	-0.287	0.000	0.13	0.0	23.9	OK
6.001	22	20.697	0.026	0.000	0.31	0.0	47.8	SURCHARGED
1.009	23	20.692	0.736	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.519	0.694	0.000	0.05	0.0	29.0	SURCHARGED
1.011	25	20.513	0.995	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 720 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.030	-0.195	0.000	0.04	0.0	1.4	OK
1.001	2	25.905	-0.172	0.000	0.13	0.0	4.2	OK
2.000	3	26.045	-0.180	0.000	0.09	0.0	2.9	OK
2.001	4	25.960	-0.167	0.000	0.15	0.0	5.0	OK
2.002	5	25.854	-0.155	0.000	0.21	0.0	7.3	OK
1.002	6	25.663	-0.202	0.000	0.24	0.0	17.1	OK
3.000	7	24.100	-0.200	0.000	0.24	0.0	18.4	OK
1.003	8	23.548	-0.308	0.000	0.22	0.0	44.2	OK
1.004	9	23.363	-0.288	0.000	0.28	0.0	47.5	OK
4.000	10	22.061	-0.389	0.000	0.04	0.0	13.2	OK
4.001	11	21.485	-0.453	0.000	0.05	0.0	20.4	OK
4.002	12	20.892	-0.437	0.000	0.07	0.0	21.2	OK
4.003	13	20.733	-0.423	0.000	0.09	0.0	21.2	OK
5.000	14	22.087	-0.288	0.000	0.12	0.0	16.4	OK
4.004	15	20.704	-0.386	0.000	0.16	0.0	39.0	OK
4.005	16	20.702	-0.299	0.000	0.18	0.0	57.8	OK
1.005	17	20.698	0.100	0.000	0.29	0.0	123.8	SURCHARGED
1.006	18	20.692	0.355	0.000	0.34	0.0	137.1	SURCHARGED
1.007	19	20.686	0.531	0.000	0.40	0.0	136.7	SURCHARGED
1.008	20	20.682	0.601	0.000	0.39	0.0	139.5	SURCHARGED
6.000	21	21.068	-0.307	0.000	0.08	0.0	14.5	OK
6.001	22	20.683	0.012	0.000	0.19	0.0	29.0	SURCHARGED
1.009	23	20.678	0.721	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.498	0.673	0.000	0.05	0.0	29.0	SURCHARGED
1.011	25	20.492	0.974	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 1440 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.024	-0.201	0.000	0.03	0.0	0.9	OK
1.001	2	25.893	-0.184	0.000	0.08	0.0	2.5	OK
2.000	3	26.033	-0.192	0.000	0.05	0.0	1.8	OK
2.001	4	25.947	-0.180	0.000	0.09	0.0	3.0	OK
2.002	5	25.838	-0.172	0.000	0.13	0.0	4.4	OK
1.002	6	25.640	-0.225	0.000	0.14	0.0	10.3	OK
3.000	7	24.076	-0.224	0.000	0.15	0.0	11.1	OK
1.003	8	23.514	-0.342	0.000	0.13	0.0	26.7	OK
1.004	9	23.325	-0.326	0.000	0.17	0.0	28.7	OK
4.000	10	22.049	-0.401	0.000	0.03	0.0	8.0	OK
4.001	11	21.471	-0.467	0.000	0.03	0.0	12.3	OK
4.002	12	20.871	-0.458	0.000	0.04	0.0	12.8	OK
4.003	13	20.706	-0.449	0.000	0.05	0.0	12.8	OK
5.000	14	22.067	-0.308	0.000	0.07	0.0	9.9	OK
4.004	15	20.673	-0.417	0.000	0.09	0.0	23.6	OK
4.005	16	20.615	-0.387	0.000	0.11	0.0	34.9	OK
1.005	17	20.608	0.010	0.000	0.18	0.0	75.4	SURCHARGED
1.006	18	20.602	0.264	0.000	0.20	0.0	83.4	SURCHARGED
1.007	19	20.596	0.440	0.000	0.24	0.0	83.0	SURCHARGED
1.008	20	20.591	0.510	0.000	0.24	0.0	84.7	SURCHARGED
6.000	21	21.051	-0.324	0.000	0.05	0.0	8.7	OK
6.001	22	20.592	-0.079	0.000	0.11	0.0	17.5	OK
1.009	23	20.587	0.631	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.419	0.594	0.000	0.05	0.0	29.0	SURCHARGED
1.011	25	20.413	0.895	0.000	0.07	0.0	29.0	SURCHARGED

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Summary of Results for 2880 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	26.017	-0.208	0.000	0.02	0.0	0.5	OK
1.001	2	25.883	-0.194	0.000	0.05	0.0	1.5	OK
2.000	3	26.026	-0.199	0.000	0.03	0.0	1.1	OK
2.001	4	25.936	-0.191	0.000	0.05	0.0	1.8	OK
2.002	5	25.826	-0.183	0.000	0.08	0.0	2.7	OK
1.002	6	25.624	-0.241	0.000	0.09	0.0	6.3	OK
3.000	7	24.060	-0.240	0.000	0.09	0.0	6.7	OK
1.003	8	23.490	-0.366	0.000	0.08	0.0	16.2	OK
1.004	9	23.297	-0.354	0.000	0.10	0.0	17.4	OK
4.000	10	22.035	-0.415	0.000	0.02	0.0	4.8	OK
4.001	11	21.455	-0.483	0.000	0.02	0.0	7.5	OK
4.002	12	20.859	-0.470	0.000	0.02	0.0	7.7	OK
4.003	13	20.691	-0.465	0.000	0.03	0.0	7.7	OK
5.000	14	22.051	-0.324	0.000	0.05	0.0	6.0	OK
4.004	15	20.646	-0.444	0.000	0.06	0.0	14.3	OK
4.005	16	20.565	-0.437	0.000	0.07	0.0	21.2	OK
1.005	17	20.385	-0.212	0.000	0.11	0.0	45.9	OK
1.006	18	20.380	0.042	0.000	0.13	0.0	51.1	SURCHARGED
1.007	19	20.374	0.219	0.000	0.15	0.0	50.9	SURCHARGED
1.008	20	20.370	0.289	0.000	0.15	0.0	51.8	SURCHARGED
6.000	21	21.041	-0.334	0.000	0.03	0.0	5.3	OK
6.001	22	20.375	-0.296	0.000	0.07	0.0	10.6	OK
1.009	23	20.365	0.409	0.000	0.08	0.0	28.9	SURCHARGED
1.010	24	20.198	0.373	0.000	0.05	0.0	28.9	SURCHARGED
1.011	25	20.192	0.674	0.000	0.07	0.0	29.0	SURCHARGED

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Appendix D:

Foul Water WinDes Design

FOUL SEWERAGE DESIGN

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	0.000
Persons per House	3.00	Min Design Depth for Optimisation (m)	0.000
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	90.299	0.451	200.0	0.000	0	0.0	1.500	o	225
1.001	23.581	0.118	200.0	0.000	0	0.0	1.500	o	225
1.002	23.581	0.118	200.0	0.000	0	0.0	1.500	o	225
2.000	42.699	0.213	200.0	0.000	0	0.0	1.500	o	225
2.001	50.000	0.250	200.0	0.000	0	0.0	1.500	o	225
2.002	6.550	0.033	200.0	0.000	0	0.0	1.500	o	225
2.003	26.183	0.131	200.0	0.000	0	0.0	1.500	o	225
2.004	37.811	0.189	200.0	0.000	0	0.0	1.500	o	225
2.005	22.247	0.111	200.0	0.000	0	0.0	1.500	o	225
3.000	46.153	0.231	200.0	0.000	0	0.0	1.500	o	225
2.006	23.262	0.116	200.0	0.000	0	0.0	1.500	o	225
2.007	9.763	0.049	200.0	0.000	0	0.0	1.500	o	225
2.008	72.510	0.363	200.0	0.000	0	0.0	1.500	o	225
1.003	31.911	0.160	200.0	0.000	0	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	24.500	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.001	24.049	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.002	23.931	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.000	23.700	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.001	23.487	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.002	23.237	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.003	23.204	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.004	23.073	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.005	22.884	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
3.000	22.900	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.006	22.669	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.007	22.553	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
2.008	22.504	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.003	22.142	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
4.000	14.205	0.071	200.0	0.000	0	0.0	1.500	o	225
1.004	20.988	0.105	200.0	0.000	0	0.0	1.500	o	225
1.005	32.000	0.160	200.0	0.000	0	0.0	1.500	o	225
5.000	64.101	0.321	200.0	0.000	0	0.0	1.500	o	225
5.001	30.000	0.150	200.0	0.000	0	0.0	1.500	o	225
1.006	47.074	0.235	200.0	0.000	0	0.0	1.500	o	225
6.000	59.957	0.300	200.0	0.000	0	0.0	1.500	o	225
6.001	45.272	0.226	200.0	0.000	0	0.0	1.500	o	225
6.002	41.250	0.206	200.0	0.000	0	0.0	1.500	o	225
1.007	62.223	0.311	200.0	0.000	0	0.0	1.500	o	225
1.008	15.196	0.076	200.0	0.000	0	0.0	1.500	o	225

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.000	23.950	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.004	21.982	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.005	21.877	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
5.000	23.000	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
5.001	22.679	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.006	21.717	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
6.000	20.500	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
6.001	20.200	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
6.002	19.974	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.007	19.768	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0
1.008	19.456	0.000	0.0	0	0.0	0	0.00	0.81	32.2	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	27.000	2.500	Open Manhole	1200	1.000	24.500	225				
2	26.600	2.551	Open Manhole	1200	1.001	24.049	225	1.000	24.049	225	
Ex.MN	26.500	2.569	Open Manhole	1200	1.002	23.931	225	1.001	23.931	225	
3	26.700	3.000	Open Manhole	1200	2.000	23.700	225				
4	26.090	2.603	Open Manhole	1200	2.001	23.487	225	2.000	23.487	225	
5	25.670	2.433	Open Manhole	1200	2.002	23.237	225	2.001	23.237	225	
6	25.480	2.276	Open Manhole	1200	2.003	23.204	225	2.002	23.204	225	
7	24.950	1.877	Open Manhole	1200	2.004	23.073	225	2.003	23.073	225	
8	24.370	1.486	Open Manhole	1200	2.005	22.884	225	2.004	22.884	225	
9	24.500	1.600	Open Manhole	1200	3.000	22.900	225				
10	24.630	1.961	Open Manhole	1200	2.006	22.669	225	2.005	22.773	225	103
								3.000	22.669	225	
11	25.080	2.527	Open Manhole	1200	2.007	22.553	225	2.006	22.553	225	
12	25.100	2.596	Open Manhole	1200	2.008	22.504	225	2.007	22.504	225	
13	26.030	3.888	Open Manhole	1200	1.003	22.142	225	1.002	23.813	225	1671
								2.008	22.142	225	
14	25.500	1.550	Open Manhole	1200	4.000	23.950	225				
15	25.550	3.568	Open Manhole	1200	1.004	21.982	225	1.003	21.982	225	
								4.000	23.879	225	1897
16	25.170	3.293	Open Manhole	1200	1.005	21.877	225	1.004	21.877	225	
17	24.500	1.500	Open Manhole	1200	5.000	23.000	225				
18	25.400	2.721	Open Manhole	1200	5.001	22.679	225	5.000	22.679	225	
19	24.200	2.483	Open Manhole	1200	1.006	21.717	225	1.005	21.717	225	
								5.001	22.529	225	812
20	22.000	1.500	Open Manhole	1200	6.000	20.500	225				
21	22.450	2.250	Open Manhole	1200	6.001	20.200	225	6.000	20.200	225	
22	22.400	2.426	Open Manhole	1200	6.002	19.974	225	6.001	19.974	225	
23	22.700	2.932	Open Manhole	1200	1.007	19.768	225	1.006	21.482	225	1714
								6.002	19.768	225	
24	21.500	2.044	Open Manhole	1200	1.008	19.456	225	1.007	19.456	225	
Ex. MH	21.220	1.839	Open Manhole	0		OUTFALL		1.008	19.381	225	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	1	27.000	24.500	2.275	Open Manhole	1200
1.001	o	225	2	26.600	24.049	2.326	Open Manhole	1200
1.002	o	225	Ex.MN	26.500	23.931	2.344	Open Manhole	1200
2.000	o	225	3	26.700	23.700	2.775	Open Manhole	1200
2.001	o	225	4	26.090	23.487	2.378	Open Manhole	1200
2.002	o	225	5	25.670	23.237	2.208	Open Manhole	1200
2.003	o	225	6	25.480	23.204	2.051	Open Manhole	1200
2.004	o	225	7	24.950	23.073	1.652	Open Manhole	1200
2.005	o	225	8	24.370	22.884	1.261	Open Manhole	1200
3.000	o	225	9	24.500	22.900	1.375	Open Manhole	1200
2.006	o	225	10	24.630	22.669	1.736	Open Manhole	1200
2.007	o	225	11	25.080	22.553	2.302	Open Manhole	1200
2.008	o	225	12	25.100	22.504	2.371	Open Manhole	1200
1.003	o	225	13	26.030	22.142	3.663	Open Manhole	1200
4.000	o	225	14	25.500	23.950	1.325	Open Manhole	1200
1.004	o	225	15	25.550	21.982	3.343	Open Manhole	1200
1.005	o	225	16	25.170	21.877	3.068	Open Manhole	1200
5.000	o	225	17	24.500	23.000	1.275	Open Manhole	1200
5.001	o	225	18	25.400	22.679	2.496	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	90.299	200.0	2	26.600	24.049	2.326	Open Manhole	1200
1.001	23.581	200.0	Ex.MN	26.500	23.931	2.344	Open Manhole	1200
1.002	23.581	200.0	13	26.030	23.813	1.992	Open Manhole	1200
2.000	42.699	200.0	4	26.090	23.487	2.378	Open Manhole	1200
2.001	50.000	200.0	5	25.670	23.237	2.208	Open Manhole	1200
2.002	6.550	200.0	6	25.480	23.204	2.051	Open Manhole	1200
2.003	26.183	200.0	7	24.950	23.073	1.652	Open Manhole	1200
2.004	37.811	200.0	8	24.370	22.884	1.261	Open Manhole	1200
2.005	22.247	200.0	10	24.630	22.773	1.632	Open Manhole	1200
3.000	46.153	200.0	10	24.630	22.669	1.736	Open Manhole	1200
2.006	23.262	200.0	11	25.080	22.553	2.302	Open Manhole	1200
2.007	9.763	200.0	12	25.100	22.504	2.371	Open Manhole	1200
2.008	72.510	200.0	13	26.030	22.142	3.663	Open Manhole	1200
1.003	31.911	200.0	15	25.550	21.982	3.343	Open Manhole	1200
4.000	14.205	200.0	15	25.550	23.879	1.446	Open Manhole	1200
1.004	20.988	200.0	16	25.170	21.877	3.068	Open Manhole	1200
1.005	32.000	200.0	19	24.200	21.717	2.258	Open Manhole	1200
5.000	64.101	200.0	18	25.400	22.679	2.496	Open Manhole	1200
5.001	30.000	200.0	19	24.200	22.529	1.446	Open Manhole	1200

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	o	225	19	24.200	21.717	2.258	Open Manhole	1200
6.000	o	225	20	22.000	20.500	1.275	Open Manhole	1200
6.001	o	225	21	22.450	20.200	2.025	Open Manhole	1200
6.002	o	225	22	22.400	19.974	2.201	Open Manhole	1200
1.007	o	225	23	22.700	19.768	2.707	Open Manhole	1200
1.008	o	225	24	21.500	19.456	1.819	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.006	47.074	200.0	23	22.700	21.482	0.993	Open Manhole	1200
6.000	59.957	200.0	21	22.450	20.200	2.025	Open Manhole	1200
6.001	45.272	200.0	22	22.400	19.974	2.201	Open Manhole	1200
6.002	41.250	200.0	23	22.700	19.768	2.707	Open Manhole	1200
1.007	62.223	200.0	24	21.500	19.456	1.819	Open Manhole	1200
1.008	15.196	200.0	Ex. MH	21.220	19.381	1.614	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	Ex. MH	21.220	19.381	19.500	0	0

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CS CONSULTING
GROUP

Appendix E:

Irish Water Confirmation of Feasibility Letter

Gessica Silva
CS Consulting
19-22 Dame Street
Dublin 2
Dublin, Ireland D02E267

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

28 May 2020

Dear Gessica Silva,

Re: Connection Reference No CDS19008657 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 900 unit(s) at O'Devaney Gardens, Dublin 7, County Dublin.

Irish Water has reviewed your pre-connection enquiry in relation to a water connection at O'Devaney Gardens, Dublin 7, County Dublin.

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

Water

In order to accommodate the proposed connection to Irish Water network at the Premises, upgrade works are required to the network as follows:

- Connection main - (Approx.) 35m of new 200mm ID pipe main to be laid to connect the site development to the newly laid 200mm ID main and connect up to the existing 150mm DI, as shown below, see red line on attached figure. Bulk meter to be installed on connection main with capability to link up to the online telemetry system. Connection between the new 200mm ID main and 150mm DI main will replace the existing 4" CI.
- Secondary connection main – (Approx.) 20m of new 200mm ID pipe to be laid to connect the site development to the existing 12" CI, as shown below, see dark red line on attached figure. Operational valve to be installed on the connection main, to be set closed for normal operation.
- Pipe Upgrades – (Approx.) 140m of new 200mm ID pipe to replace the existing 6" and 4" CI, as shown below, see orange line on attached figure.

Irish Water currently does not have any plans to extend its network in this area. Should you wish to progress with the connection you will be required to fund this network extension.

Wastewater

Irish Water is currently undertaking a hydraulic modelling assessment of the downstream network to confirm the available capacity. The outcome of investigative surveys on the downstream network to confirm connectivity will allow the hydraulic model to be updated to confirm the available capacity and any potential upgrades.

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
IW-HP-MD
REV012

Irish Water does not have any plans, in the current Capital Investment Programme (CIP), to undertake upgrades to facilitate this connection. Should upgrades be identified Irish Water may require you to provide a contribution of a relevant portion of the costs for the required upgrades.

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 Pleanala 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 Marko Komso from the design team on 022 54611 or email mkomso@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Required upgrades to the water infrastructure:

Robert Fitzmaurice
19 22 Dame Street
Dublin 2
D02 E267, Ireland

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

12 May 2021

Re: Design Submission for O'Devaney Gardens, Dublin 7, County Dublin (the "Development")
(the "Design Submission") / Connection Reference No: CDS19008657

Dear Robert Fitzmaurice,

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

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

IW-HP-MD

REV012

Appendix A

Document Title & Revision

ODG-CSC-XX-XX-DR-C-0013_Proposed Drainage Layout
ODG-CSC-XX-XX-DR-C-0015_Proposed Watermain
ODG-CSC-XX-XX-DR-C-0021_Surface Water Profiles_Sheet_1
ODG-CSC-XX-XX-DR-C-0022_Surface Water Profiles_Sheet_2
ODG-CSC-XX-XX-DR-C-0023_Foul Sewer Profiles_Sheet_1
ODG-CSC-XX-XX-DR-C-0024_Foul Sewer Profiles_Sheet 2

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

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

Appendix F:

Stormtech Attenuation Brochure

ADVANCED DRAINAGE SYSTEMS, INC.

SiteASSIST™ by StormTech

FOR STORMTECH INSTRUCTIONS, DOWNLOAD THE INSTALLATION APP

ODG

Dublin City

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-4500 OR APPROVED EQUAL.
2. CHAMBERS SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. 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.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES 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 AASHTO FOR THERMOPLASTIC PIPE.
   b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
   c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

©2015 ADS, INC.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-4500 CHAMBER SYSTEM

1. STORMTECH MC-4500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTITIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-4500 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 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 SUBGRADE.
   - 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 - 9" (230 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 3/4-2" (20-50 mm) MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS SO AS NOT TO DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-4500 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 CONSRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

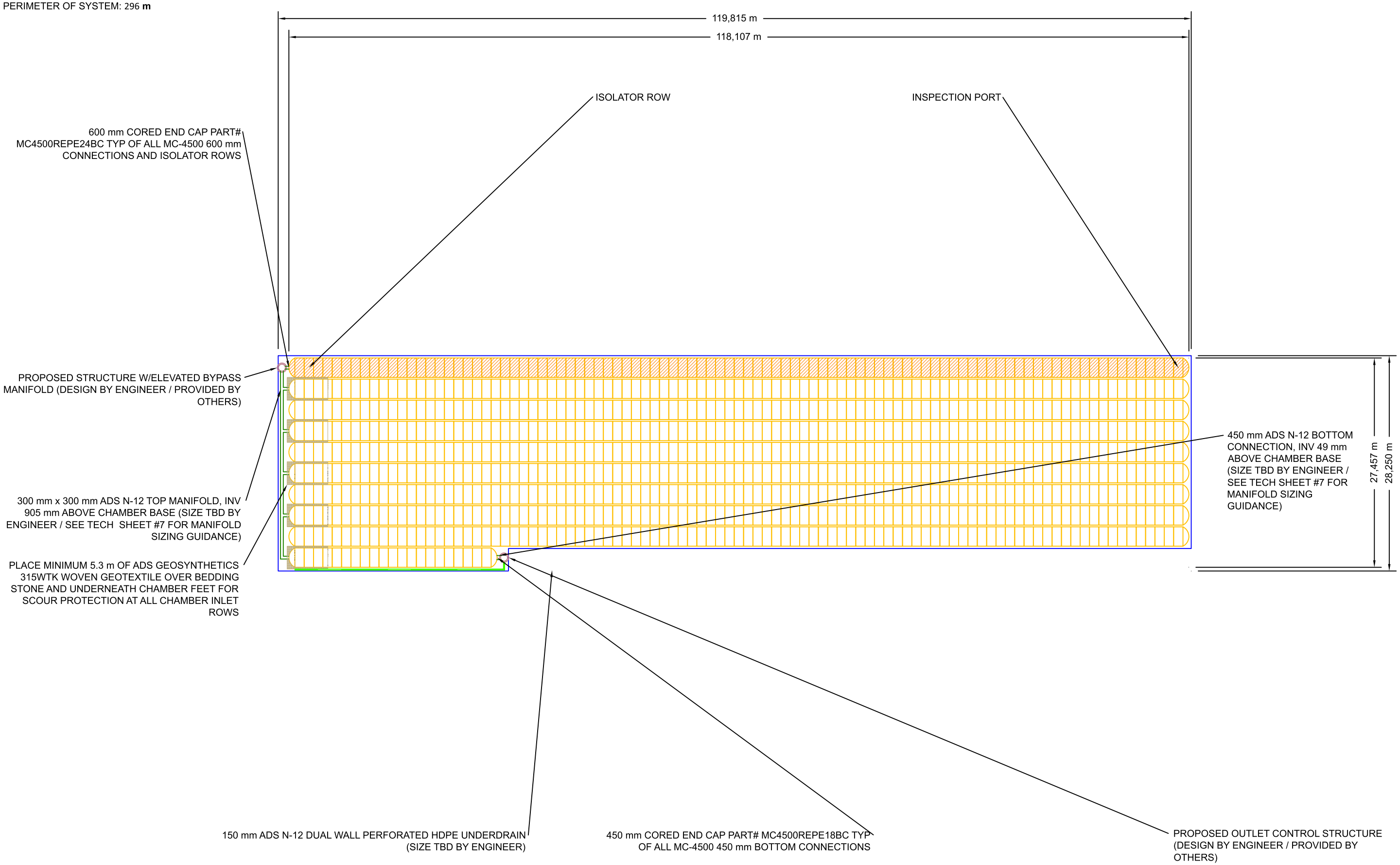
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

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

CONCEPTUAL LAYOUT

(876) STORMTECH MC-4500 CHAMBERS
(20) STORMTECH MC-4500 END CAPS
INSTALLED WITH 305 mm COVER STONE, 229 mm BASE STONE, 40% STONE VOID
INSTALLED SYSTEM VOLUME: 4166 m³
AREA OF SYSTEM: 3120 **m²**
PERIMETER OF SYSTEM: 296 **m**

COMPUTER GENERATED CONCEPTUAL LAYOUT - NOT FOR CONSTRUCTION



ODG
Dublin City

DATE: 06/26/2020 | DRAWN: DD | CHECKED: ---
PROJECT #: Tool

REV	DRW	CHK	DESCRIPTION

StormTech®
Detention · Retention · Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

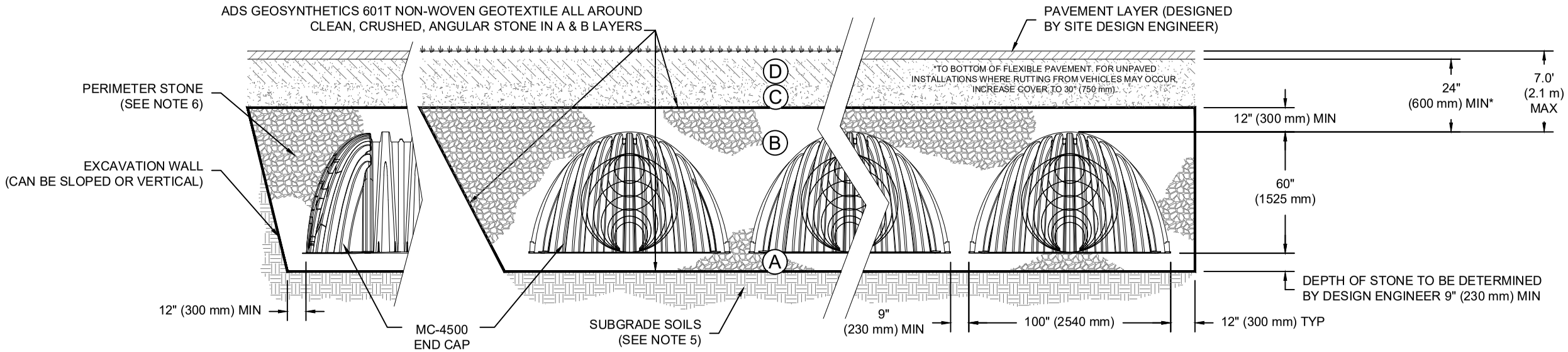
NOT TO SCALE

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. [2] [3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.



NOTES:

1. MC-4500 CHAMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-4500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION REQUIREMENTS FOR FOUNDATION, EMBEDMENT, AND FILL MATERIALS.
4. THE "SITE DESIGN ENGINEER" REFERS TO THE ENGINEER RESPONSIBLE FOR THE DESIGN AND LAYOUT OF THE STORMTECH CHAMBERS FOR THIS PROJECT.
5. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
6. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
7. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.

ODG
Dublin City
DATE: 06/26/2020
DRAWN: DD
PROJECT #: Tool
CHECKED: ---

REV | DRW | CHK | DESCRIPTION

StormTech
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

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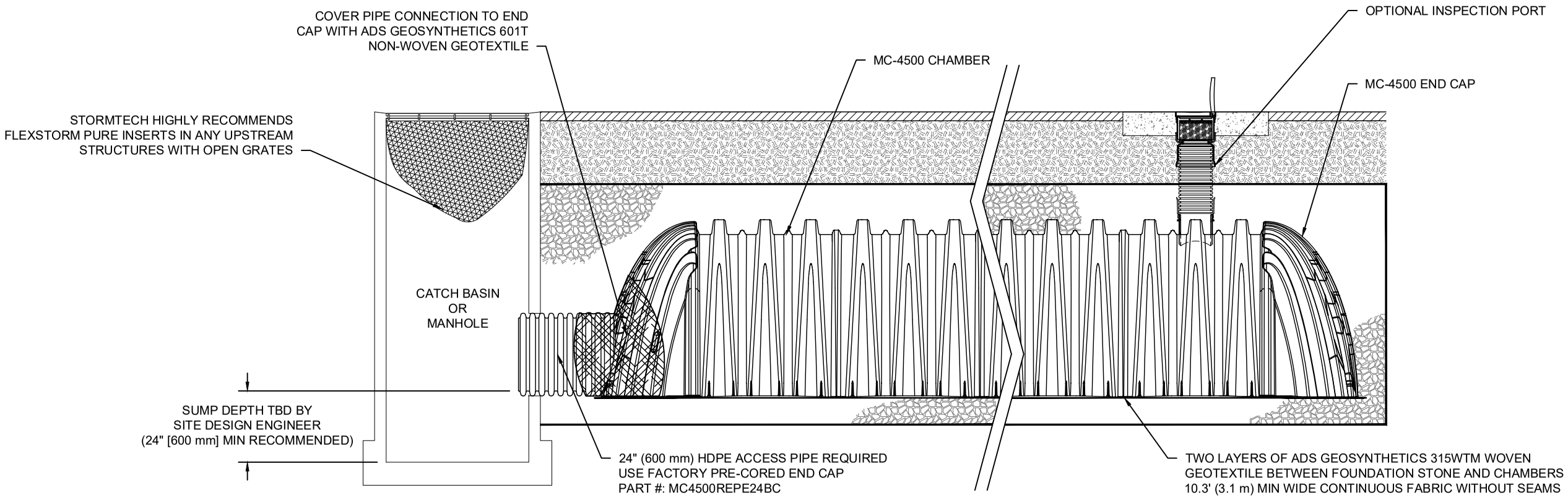


MC-4500 ISOLATOR ROW DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

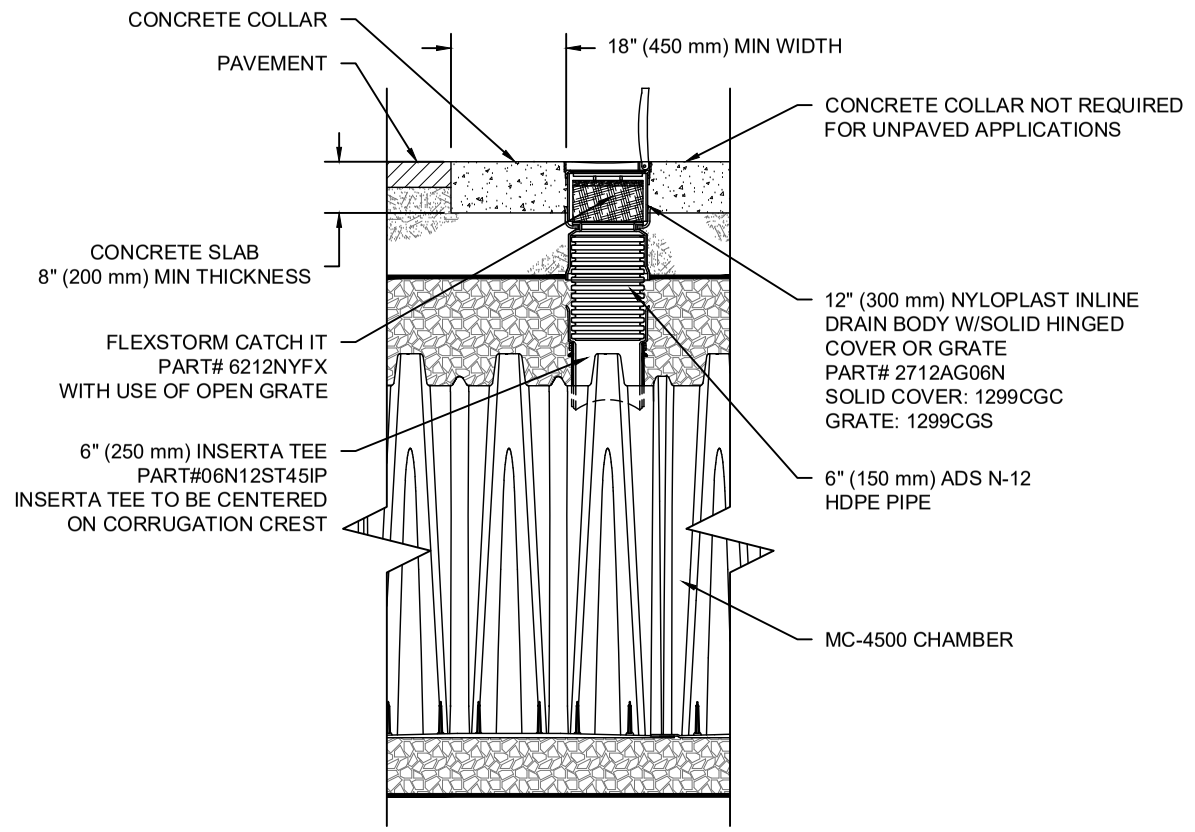
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-4500 6" INSPECTION PORT DETAIL
NTS

ODG
Dublin City

DATE: 06/26/2020 | DRAWN: DD | PROJECT #: Tool | CHECKED: ---

REV	DRW	CHK	DESCRIPTION

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UNDERDRAIN DETAIL

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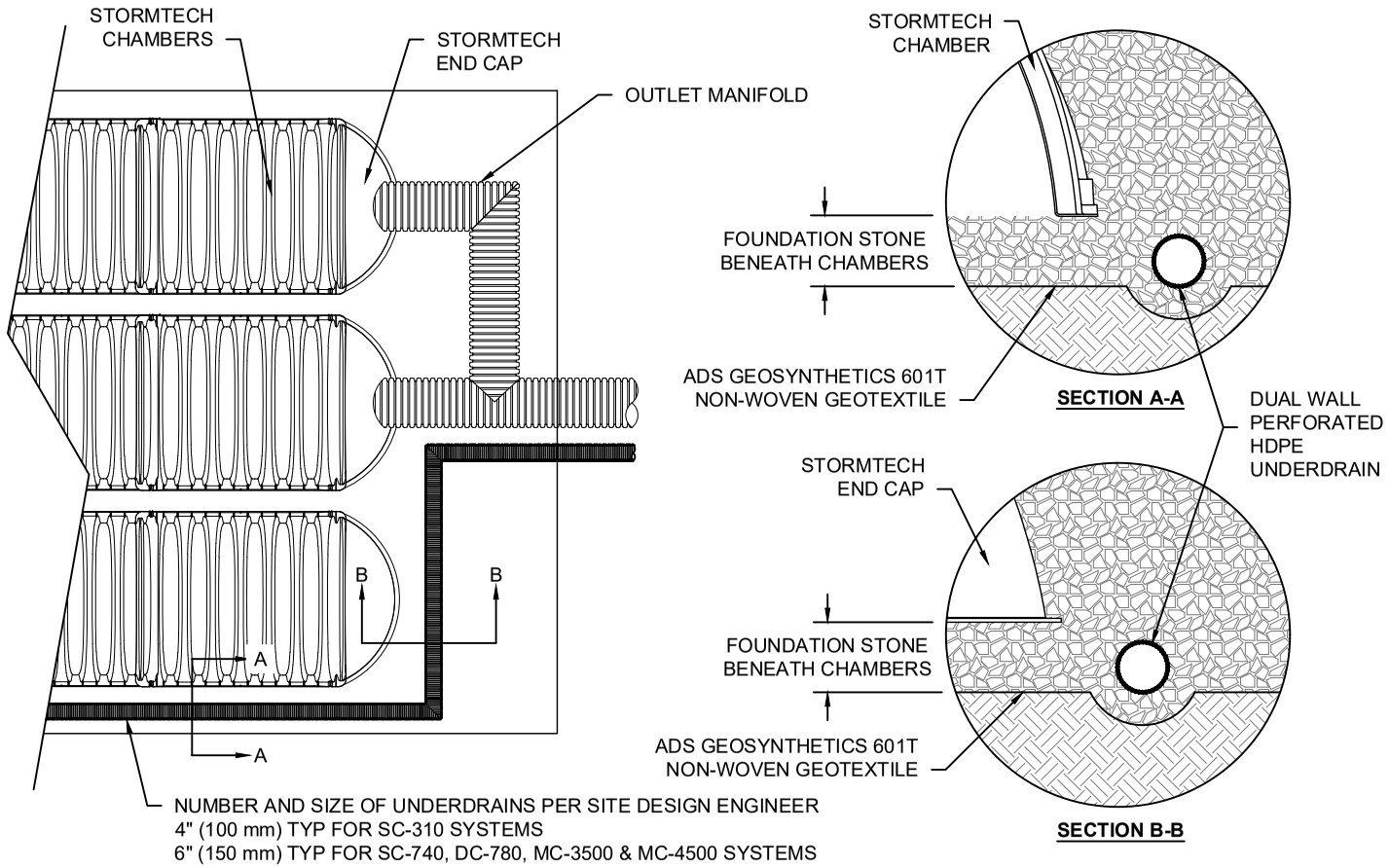
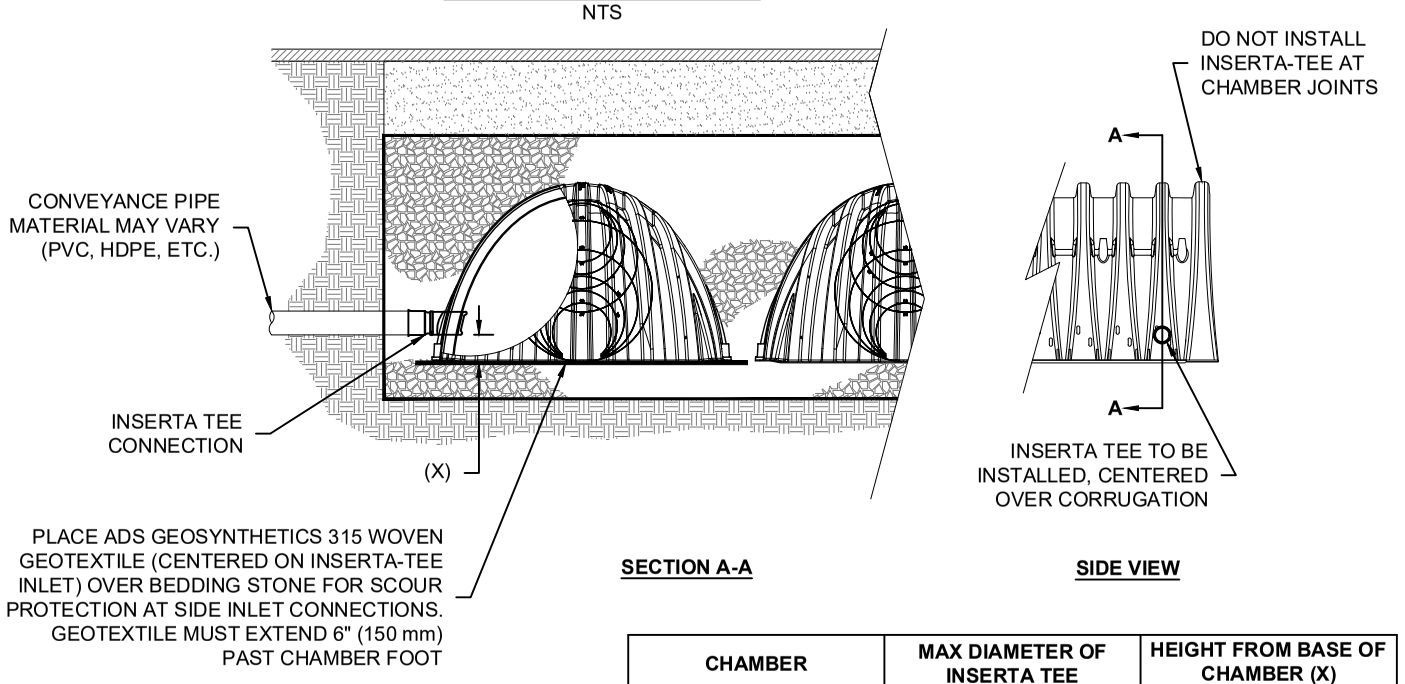


INSERTA TEE DETAIL

NTS

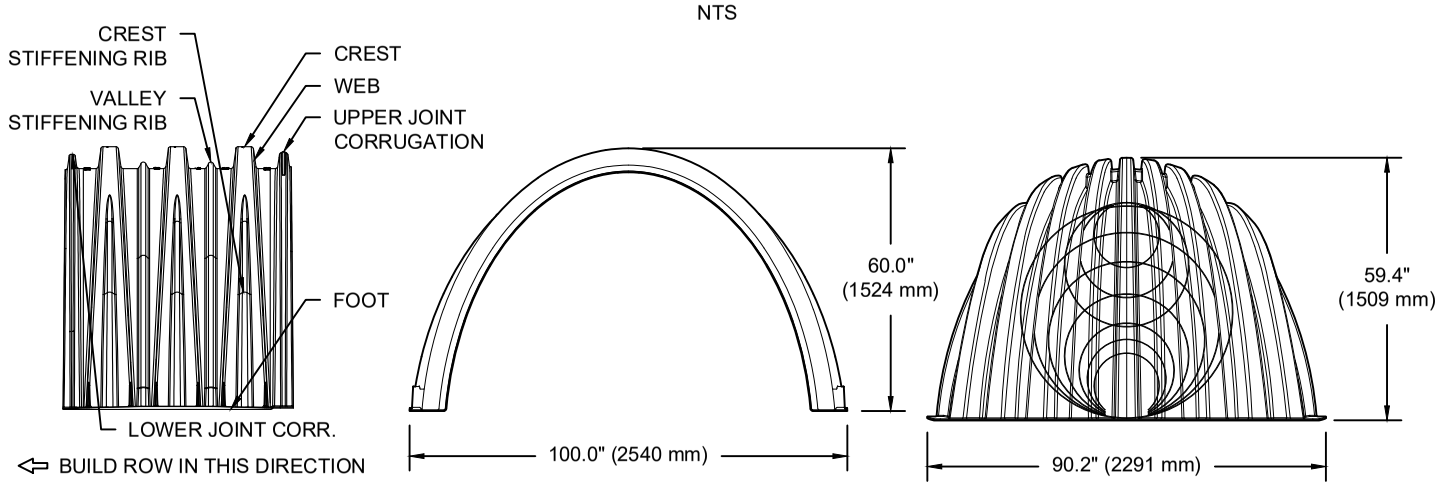


NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS.
CONTACT STORMTECH FOR MORE INFORMATION.

CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

MC-4500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 48.3"	(2540 mm X 1524 mm X 1227 mm)
CHAMBER STORAGE	106.5 CUBIC FEET	(3.01 m³)
MINIMUM INSTALLED STORAGE*	162.6 CUBIC FEET	(4.60 m³)
WEIGHT	130.0 lbs.	(59.0 kg)

NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	90.2" X 59.4" X 30.7"	(2291 mm X 1509 mm X 781 mm)
END CAP STORAGE	35.7 CUBIC FEET	(1.01 m³)
MINIMUM INSTALLED STORAGE*	108.7 CUBIC FEET	(3.08 m³)
WEIGHT	135.0 lbs.	(61.2 kg)

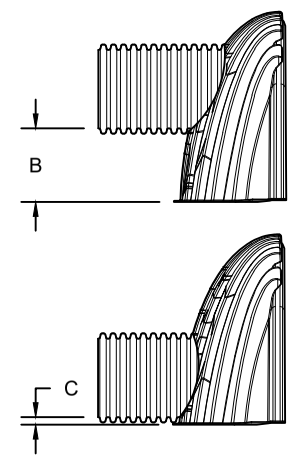
*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	B	C
MC4500REPE06T	6" (150 mm)	42.54" (1.081 m)	---
MC4500REPE06B		---	0.86" (22 mm)
MC4500REPE08T	8" (200 mm)	40.50" (1.029 m)	---
MC4500REPE08B		---	1.01" (26 mm)
MC4500REPE10T	10" (250 mm)	38.37" (975 mm)	---
MC4500REPE10B		---	1.33" (34 mm)
MC4500REPE12T	12" (300 mm)	35.69" (907 mm)	---
MC4500REPE12B		---	1.55" (39 mm)
MC4500REPE15T	15" (375 mm)	32.72" (831 mm)	---
MC4500REPE15B		---	1.70" (43 mm)
MC4500REPE18TC	18" (450 mm)	29.36" (746 mm)	---
MC4500REPE18BC		---	1.97" (50 mm)
MC4500REPE24TC	24" (600 mm)	23.05" (585 mm)	---
MC4500REPE24BC		---	2.26" (57 mm)
MC4500REPE30BC	30" (750 mm)	---	2.95" (75 mm)
MC4500REPE36BC	36" (900 mm)	---	3.25" (83 mm)
MC4500REPE42BC	42" (1050 mm)	---	3.55" (90 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS.
CUSTOM INVERT LOCATIONS ON THE MC-4500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm)
THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHTEST POSSIBLE FOR THE PIPE SIZE.



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MC-SERIES END CAP INSERTION DETAIL

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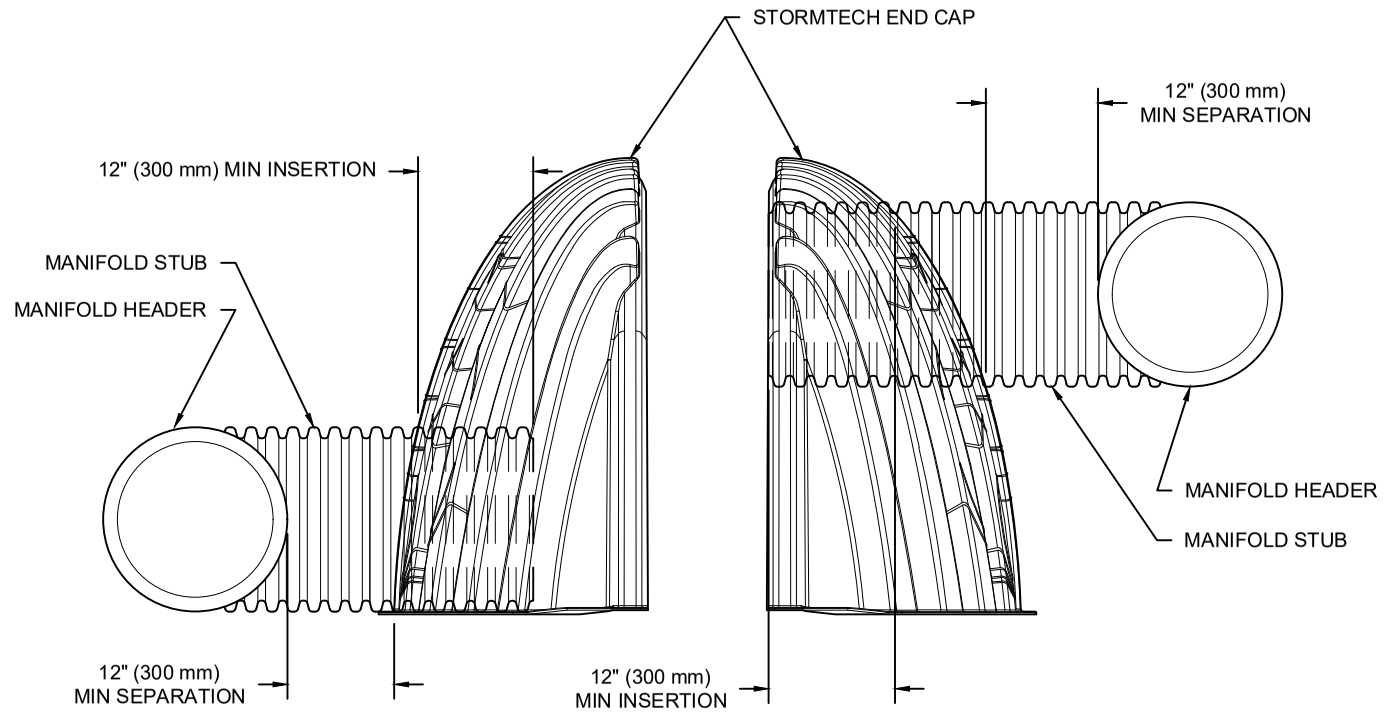

NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL
FOR A PROPER FIT IN END CAP OPENING.

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