LUTRA CONSULTANCY

Drainage Strategy Report (DSR) For:

Cardonnel Court Nursing Home,
Cardonnel Road,
Neath,
SA10 6BS

Prepared for: QUORUM Consulting Engineering

October 2025



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Prepared By: J Wall (MEng) **Signed:** 

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1 LIMITATIONS

The DSR is prepared in support of a planning application and is for exclusive benefit of The Client. It may not be assigned to or relied upon by third party without agreement in writing.

All comments and proposals contained in this report, including any conclusions, are based on information available during investigations. The conclusions drawn below, could therefore differ if the information is found to be inaccurate or misleading. Lutra Consultancy accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Except as otherwise requested by the client, Lutra Consultancy is not obliged to and disclaims any obligation to update the report for events taking place after: -

The date on which this assessment was undertaken, and the date on which the final report is delivered.

All the Natural Resources Wales (NRW) mapping data used is under special license. Data is current as of the issue date of this report and is subject to change.

The information presented and conclusions drawn are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

1.1 Purpose of the Report

The purpose of this report is to derive a drainage strategy in line with the current Sustainable Drainage System (SuDS) guidance to support a planning application with a drainage condition.

1.2 Relevant Documents

The DSR has been informed by the following documents:

- Welsh Government – Sustainable Drainage (SuDS) Statutory Guidance. (*ISBN: 978-1-78964-618-4*)
- Welsh Government Advice Note – SAB applications for single dwellings, extensions, and parking and access areas (July 2022). (*ISBN: 978-1-80364-492-9*)
- CIRIA Report C753 – The SuDS Manual 2015
- BRE Digest 365 – Soakaway Design
- Sewers for Adoption – A Design and Construction Guide for Developers – Eight edition – August 2018

2 INTRODUCTION

Lutra Consultancy has been instructed by Joel Saunder from Quorum Consulting Engineers "The Client", to undertake a DSR in support of a SAB application for the proposed redevelopment of Cardonnel Court Nursing Home, Cardonnel Road, Neath, SA10 6BS.

Previously a Full SAB approval for the development was agree on the 21st of November 2023. Application No: S2023/0036. The following report is guided by this approval and design approach.

Easting: 272781 Northings: 196775

The existing Brownfield site was a 2 storey nursing home with parking and gardens. Refer to Existing Site Plan, Appendix A.

2.1 Site Location

The site is located off Cardonnel Road with a railway line along the southeast boundary. 150m south-east of the site is the Tennant Canal and another 100m past this is the River Neath. The development is situated in the greater residential area of Neath. Refer to Figure 1 & 2.



Figure 1: Data Maps Wales Topographical Survey Site Maps

2.2 Proposed Development

The proposed development is a new nursing home, built over the footprint of the old nursing home. The arrangement of the building and car park will remain with a small reducing in the overall footprint of the building from 1030m^2 down to 680m^2 (34% decrease). This will result in an increase in external space on site.

As a result of this the reduced building footprint allows for a large car park and a new landscaping layout, external balconies and storage space for the site. Levels on site will seek to retain the existing arrangement and will not alter or impact the existing land drainage.

Refer to Figure 2 below for the site boundary comparing the old and new building footprints. Additionally refer to Appendix A for the proposed building arrangement and sections.

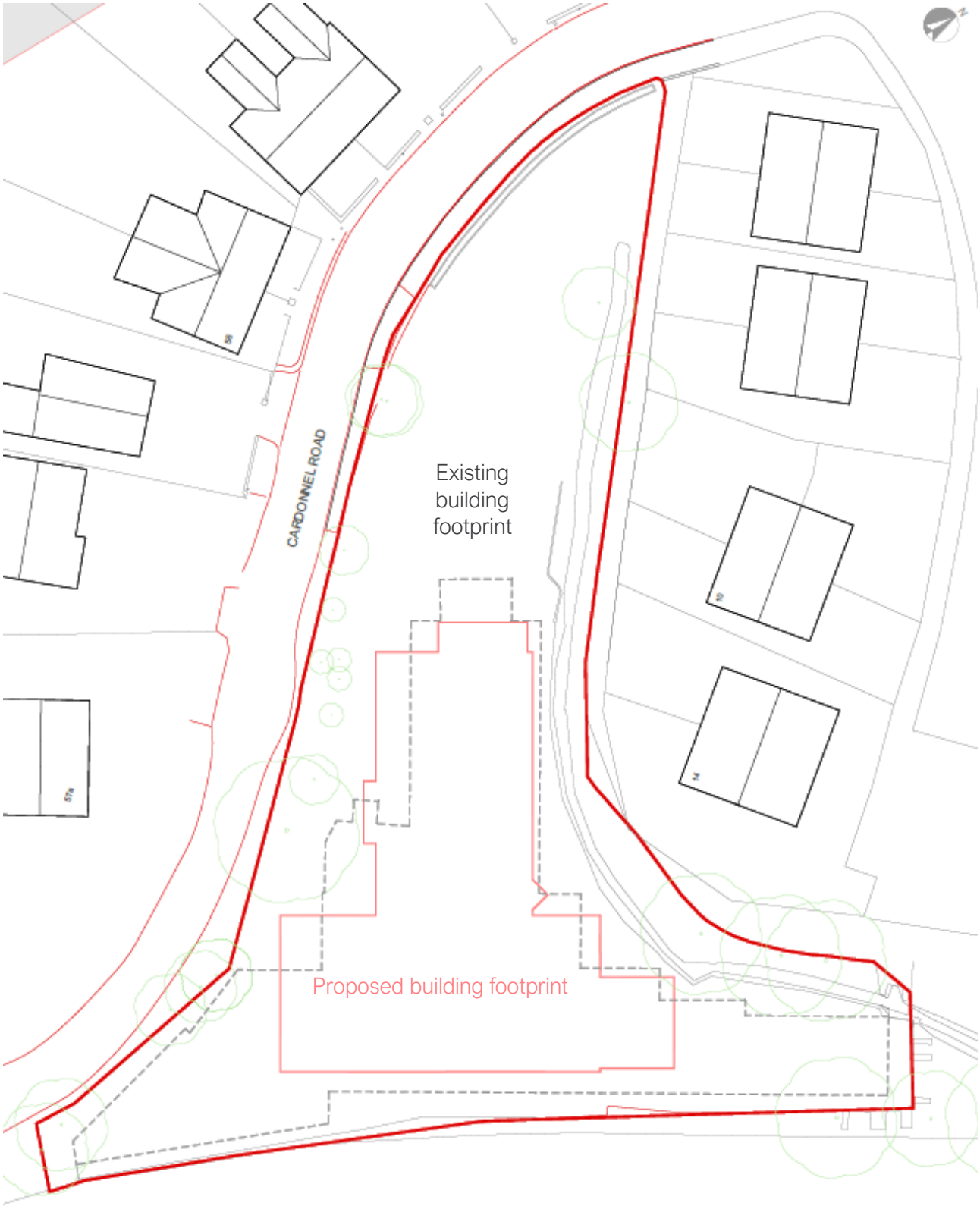


Figure 2: Site Plan Comparing Existing and Proposed building footprints

Refer to Appendix A & B.

2.3 Existing Topography

A topographical survey has been completed for the site which has accurately located a small land drain that runs along the northern boundary of the site. This is seen to following the local topography which naturals falls from northwest to southeast. Refer to Figure 3 below.

Level change from 25m AOD down to 18m AOD over a length of approximately 80m which gives a typical gradient of 1 in 11.

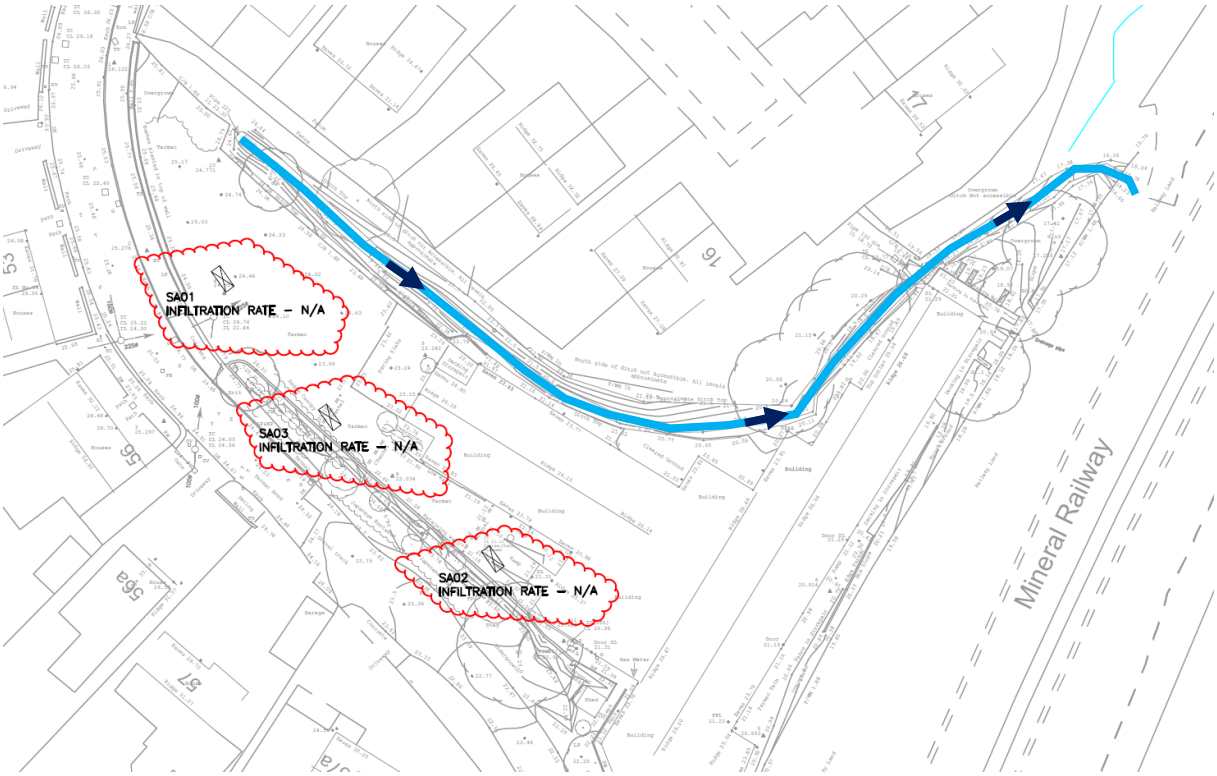


Figure 2: Topographical survey with direction of land drainage.

Cardonnel Road is raised above the site and at the lower end of the property is in line with the first floor of the existing building. Trees and hedges separate the property from the highway via an embankment. To the north of the site a new residential development is also set slightly higher than the site.

2.4 Existing Geology

From review of the British Geological Survey Online Geology Viewer maps the existing soils are classified as:

Existing Geology	
Substrate	**Type**
Superficial Soil	Till, Devensian – Diamicton.
Bedrock	Hughes Member - Sandstone

Infiltration testing performed on site as part pervious SAB application, refer to figure 3 above for test location and results. **The testing found insufficient movement to determine a rate of filtration.**

2.5 Existing Site Drainage

Dwr Cymru Welsh Water (DCWW) local records show combined sewer passing through the parking area of the site north of the building.

Planning consultation from DCWW on the 15th of June 2023 ref No: PPA0007880, recognises this sewer as a public asset and confirms capacity for the foul drainage only. This sewer has been surveyed as part of the topographical survey and accurately plotted. Refer to Appendix B drawing 25074-500-P01-Cardonnel Court-Existing Drainage Plan for more information.

2.6 Flood Risk

The site was found to be at risk of surface water and small watercourse flooding. National Resources Wales (NRW) flood risk maps for planning shows a flood zone 2 & 3 for most of the site.

As such a Flood Consequence Assessment (FCA) report was produced by Lutra Consultancy to review this. Refer to FCA-25074-01-Cardonnel Court Nursing Home for more information.

The report summarises a betterment in flooding due to the reduction of the building footprint and suggestion for finished floor levels as well as other flood resilient features to ensure a quick return to operations in the event of a flood.

3 SUSTAINABLE DRAINAGE SYSTEMS (SuDS)

In line with Welsh Government SuDS Statutory Guidance the following section will address how the proposed site incorporates SuDS practises and features.

3.1 Compliance with Standard Principles

The principles listed below underpin the design of surface water management schemes to meet the Statutory National Standards for SuDS for Wales.

The proposed development seeks to replace the existing nursing home with a more functional design that reduces the impermeable areas on site. It is intended that the new arrangement improves water quantity, amenity and biodiversity through the use of SuDS systems, while being sensitive to the elderly residential use.

Infiltration was found to be unsuitable on site and as such an existing discharge to the local land drainage will be re-used. This discharge will be limited to 6l/s with attenuation on site provided through permeable paving and geocellular tanks.

SuDSPod's will be added to rainwater pipes on site to improve the aesthetics and biodiversity. Safey of the residents is the key priority on the site and as such a lot of softer drainage systems have been considered unsafe or a possible risk, such as swale and filter drains.

A causeway flow model has been used to ensure that the system can accommodate up to 1 in 100 years plus 40% climate change plus 10% urban creep. Should storm water exceed this event or the system become neglected then exceedance flows will run towards the existing land drainage and away from walkways.

The private drainage will be cost considerate and robust to reduce the likelihood of flooding on site. All systems will be given clear access points for easy access. Maintenance will be managed by the site team who will be responsible for the upkeep of the drainage systems.

3.2 Standard S1 – Surface water runoff destination

The following receptors have been considered for surface water runoff on site, in order of SuDS preference.

1. Priority Level 1: Collection for reuse.
2. Priority Level 2: Infiltration into ground
3. Priority Level 3: Discharge into open surface water body
4. Priority Level 4: Discharge into surface water sewer, highway drain, or another drainage system
5. Priority Level 5: Discharge to a combined sewer.

3.2.1 Priority Level 1 - Surface water collected for use:

Rainfall from the roofs will be used to water planting within the SuDSPod set at the base of some of the rainwater pipes (RWP). This system will also function as water butts for the property.

Rainwater harvesting for the proposed property have been considered unsuitable due to the extent of double plumbing which would be required through the building. As such the benefit of this re-use is likely to be outweighed by the initial construction cost.

Additionally, the risk of a leak is doubled and given the vulnerability of the residents reducing this risk is a priority.

Move to next priority level.

3.2.2 Priority Level 2 – Discharge via infiltration:

Initial testing of 3 No. pits to the BRE 365 digest standards found insufficient movement in water levels to calculate a rate of discharge. This has previously been reviewed and agreed as part of the last SAB application in 2023.

Move to next priority level.

3.2.3 Priority Level 3 – Discharge into open surface water body:

The existing land drain to the northeastern boundary of the site is the preferred means of discharge, with a proposed connection to the southeast at the lower end of the development.

3.3 Standard S2 – Surface water runoff hydraulic Control

3.3.1 Greenfield runoff:

Greenfield run off rates using the FEH method for the site have been determined by use of the HR Wallingford online tools for an area of 0.2465ha, which determine:

Q_{Med} = 2.6 l/s.

Q_{bar} = 2.8 l/s.

Refer to Appendix C Greenfield Run off Calculation.

3.3.2 Discharge rate:

An existing discharge rate for the current site can be determined for a regular event of 5 mins storms through the use of the Building Regulation Part H Diagram 1 Rainfall intensities for design of gutting and rainfall pipes. This simple assessment for an area of 1618m^2 with a rate of 0.016 litter/second/m^2 find an average discharge of 25.9 l/s

Firstly, the site should seek to mimic green field run off rates where possible or an improvement on the existing discharge with a minimum better of 30%. The greenfield run off rate is less than 5l/s and most flow controls have an increased risk of a blockage for discharges of this magnitude. This would also result in considerable attenuation on site. Due to the vulnerability of the residents and need for maximising available space to support this vital public service, it is not considered appropriate to attenuate storm events for rates of 2l/s.

As such the site will seek to re-use the previously agreed discharge from the SAB application dated 2023 which proposed a discharge rate of 6.6l/s, joining the existing land drain in the southeast corner of the site.

The proposed development will be restricted to 6l/s for a design head of 1.4m using a Hydro-international vortex flow control, Hydro brake units. Ref No. SHE-0109-6000-1400-6000

3.3.3 Attenuation systems:

Flows in exceedance of the discharge rate will be attenuated on site within the geocellular attenuation tank or within permeable paving in the car park.

The site gradients present a complication to attenuation on site with limited space available at the lower end and a larger area for attenuation available at the higher end. As such a second flow control will be installed to control water at the northern half of the site reducing the peak storage requirements at the lower end. A Turtle Enviro orifice plate chamber with Siltblok has been proposed. This flow control will be set to 10l/s with a design head of 2.4m and an overflow.

Additionally, the SuDSPod's at the bottom of RWP's will also aid in reducing peak flow events. These have not however been included within the surface water model.

By reducing the runoff rate to the lower geocellular attenuation tank, it was possible to safely create sufficient storage to allow for a lower discharge rate. This tank will be wrapped in an impermeable membrane and set 0.6m below ground level and will not be subject to anything greater than garden loadings. As such Wavin Aquacell ECO units were proposed for a depth of 1.2m.

A Causeway Flow model for the site has been created to ensure the site can infiltrate safely all storm events, with no surcharging in any SuDS features for a 1 in 2 year storm event, no flood risk for a 1 in 30 year storm and no flooding for a 1 in 100 year storm. All simulation have 40% climate change and an additional 10% Urban Creep applied to them. Results from the modelling can be seen in Appendix C.

A 1 in 200 year storm event plus climate change was also modelled and found flooding of 3.78m^3 above the attenuation tank. This water would be spread over an aread of approximately 400m^2 causing 9mm of flooding in the patio which would then run off towards the land drain.

3.3.4 Interception:

The existing brownfield site does not meet interception and joins the land drainage at an uncontrolled rate. Due to the size of the building and poor infiltration rates causing the SuDS system to require an impermeable lining, meeting interception standards for the whole site is not considered viable. However, **the reduction in impermeable areas (218m²) as well as the introduction of flow controls, there is considerable betterment made to small 5 minutes storm events.**

Additionally, the new development will improve this further through the introduction of permeable paving and raingardens set to the bottom of the rainwater pipes. This has been reviewed using the criteria set out in the Statutory Standards for SuDS section G2.11-2.16 and Table G2.1. Refer to table 2 below.

INTERCEPTION SYSTEMS REVIEW							
Provided					Required		
System	Area (m²)	Lining	Factor	Area provided (m²)	System	Area (m²)	
Permeable paving	173	Lined	2	346	Parking	427	Insufficient
Rain gardens	2	Lined	5	10	Roof	720	Insufficient
			Total	356	Total	1,147	Insufficient

Table 1: Interception Systems Review table.

Despite not meeting the current SAB criteria for interception the following assessment should be considered an improvement and be considerate of the building purpose.

3.3.5 Factor of Safety:

Factor of safety has been applied to the SuDS systems as per the Statutory Standards for SuDS Table G1.1 where the consequences for failure are considered a '*No damage or inconvenience'* as water will pool within the garden space, soft landscaping or flow directly into the land drainage on site.

3.3.6 Exceedance flows:

Should the system fall into neglect, become blocked or experience more extreme storm events than it is necessary to design for, water will pool within the permeable paving or swales before running southeast into the garden.

3.4 Standard S3 – Water Quality

The development will ensure water quality via the permeable paving, and proprietary treatment systems in line with CIRIA 753 guidance set out in Chapter 26, using tables 26.2, 26.3 & 26.4

As set out in the Welsh Government Statutory Standards for Sustainable Drainage Systems Standards (SSDS) for Wales, Table G3.1 the residential roof will have a very low pollution hazard

which does not need to meet the simple index approach but must have solids removed. The driveway and parking will have a low risk which does need meet the simple index approach.

SuDSPod raingardens units will be installed at the base of some RWP's to manage solids and sediment from the site. A sump chamber will be installed upstream of the attenuation tank to collect any silt of litter from the remaining RWP's and patio areas.

Refer to Table 1 below.

SIMPLE INDEX APPROACH									
Hazard Indices					Mitigation Indices				
Land Use	Risk	TSS	Metals	Hydro carbons	System (Table 26.3)	TSS	Metal	Hydro carbons	
Roof	Very Low	0.2	0.2	0.05	SuDSPod	0.8	0.8	0.8	Okay
Parking	Low	0.5	0.4	0.4	Permeable Paving	0.7	0.6	0.7	Okay

Table 1: Water Quality Indices comparison.

3.5 Standard S4 – Amenity

Amenity space will be a key priority for the residents of the nursing home and ensuring that area are safe and easily accessible for elderly residents is paramount. Because of this drainage has been kept below ground level or raised out of the way. Permeable paving and raised rain gardens will ensure water is controlled safely in location that still accessible.

Channel drainage has been chosen over filter drains to prevent water from pooling which could freeze over and reduce slip hazards. For similar reasons swales have also been considered inappropriate for the development.

Rain gardens have been kept to a minimum on site to allow for a maximisation of communal areas ensuring clear wheelchair access as well as sitting space. Planting has however been added to the SuDSPod.

3.6 Standard S5 – Biodiversity

Biodiversity on the site will be increased through the reduction in impermeable areas and management of planting and trees on site.

The existing land drain is a rich location for biodiversity which will be retained on site. Chances at this location have been limited and protected.

A wider landscaping plan will be developed for the surrounding area which are not part of the drainage scheme and with the site located so close to the woodland and watercourses the site is considered to be in a rich biodiverse area. Improvement on site will seek to be added through the rain gardens which will be planted with pollinator friendly species.

3.7 Standard S6 – Design of drainage for Construction and Maintenance and Structural Integrity

The proposed development will be maintained and managed by the freeholders of the land, who will be responsible for the upkeep and ensuring all drainage systems are functional. To ensure maintenance is kept as simple as possible, shallow systems with regular access have been placed in an area where repair works can be safely undertaken and quickly inspected.

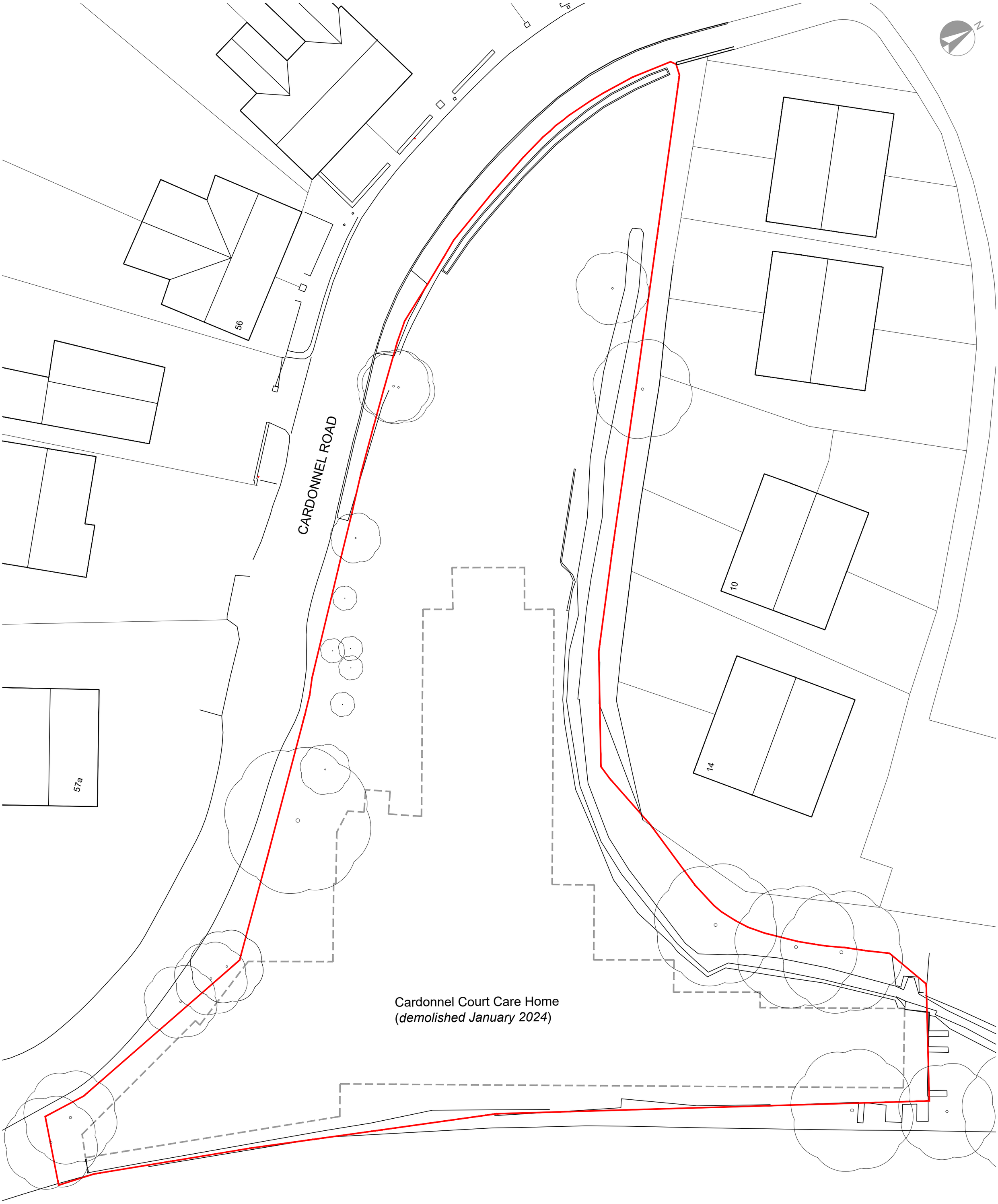
Access to the parking area will allow for safe storage. Access to the whole site is limited due to the confined space. As such repairs to the lower level drainage will need to be preformed by hand following installation. It is advised that these systems are put in place pre-construction to provide a safe control for water during works and the tank is then washed out and cleaned before the site is operational.

Guidance for maintenance of the drainage design will follow the CIRIA 753 Chapter 32 and any other manufactures recommendations.

All SuDS systems will be as per the proposed drainage plans and details, refer to Appendix B.

Further information is provided on the Construction, Operation, Maintenance and Structural Integrity report by Lutra Consultancy: Ref COMSI-25074-01-Cardonnel Court.

APPENDIX A: Existing Site Plan and Proposed Development Plans



Cardonnel Court Care Home
(*demolished January 2024*)

0 1 5 10 20 30

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Tel : +44 (0)2920 223123 E-Mail : enquiries@cw-arch.co.uk Web : www.cw-arch.co.uk

Project Name :	Cardonnel Court, Skewen		
Project Ref :	SP803		
Drawing Title :	Existing Site Plan	Scale :	
Drawing Number :	SP803 - P01	1:100 @ A2	
Revision:	PAC	Drawn by: ce	Date: Sept 2025

Up

Path

Lower retaining wall

Terrace

ASHP Enclosure

Deck

Wildflower mix

N

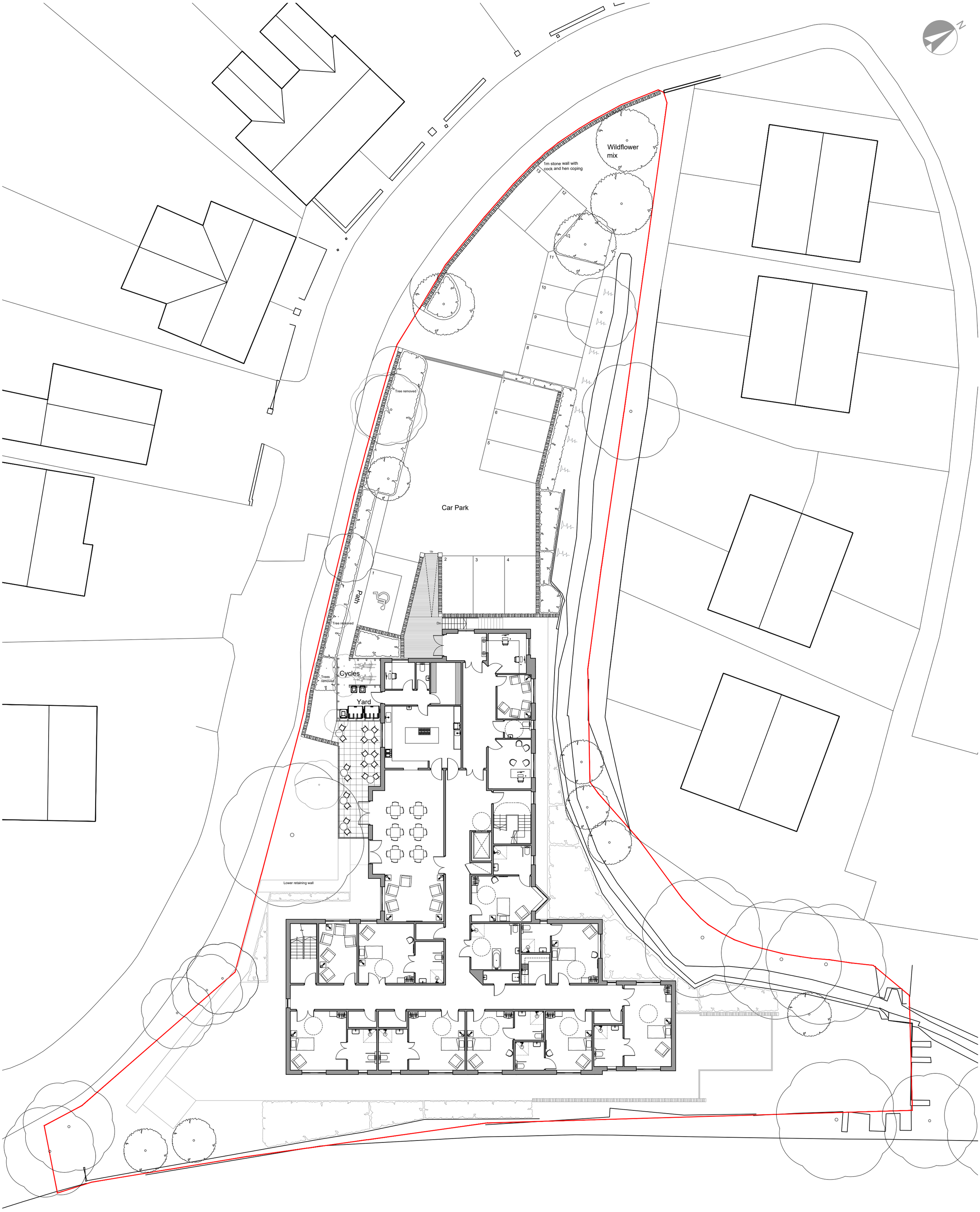
C. W. ARCHITECTS Ltd

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Project Name :	Cardonnel Court, Skewen
Project Ref :	SP803

Drawing Title :	Proposed Site Plan at Lower Ground Floor	Scale : 1:100 @ A2
Drawing Number :	SP803 - P02	

Revision:	PAC	Drawn by: ce	Date: Aug 2025



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Project Name :	Cardonnel Court, Skewen
Project Ref :	SP803

Drawing Title :	Proposed Site Plan at Upper Ground Floor	Scale : 1:100 @ A2
Drawing Number :	SP803 - P03	

Revision:	PAC	Drawn by: ce	Date: Aug 2025



Proposed Front Elevation
North-West



Proposed Front Elevation
North-West

MATERIAL KEY

1. Bradstone type cladding
2. Red brickwork
3. Vertical Yorkshire board timber cladding
4. Render in light grey
5. Windows with clear double glazing in dark grey
6. Windows with frosted double glazing in dark grey
7. Doors with clear double glazing in dark grey
8. Solid doors in dark grey
9. Door with louvres in dark grey
10. uPCV fascias and rainwater goods in dark grey
11. Cement fibre roof tiles
12. Velux roof lights
13. P.V Panels

0 1 5 10

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Project Name :	Cardonnel Court, Skewen		
Project Ref :	SP803		
Drawing Title :	Proposed Elevations	Scale :	
Drawing Number :	SP803 - P10	1:100 @ A2	
Revision:	PAC	Drawn by: ce	Date: Sept 2025



Proposed Rear Elevation

South-East



Proposed Side Elevation

South-West

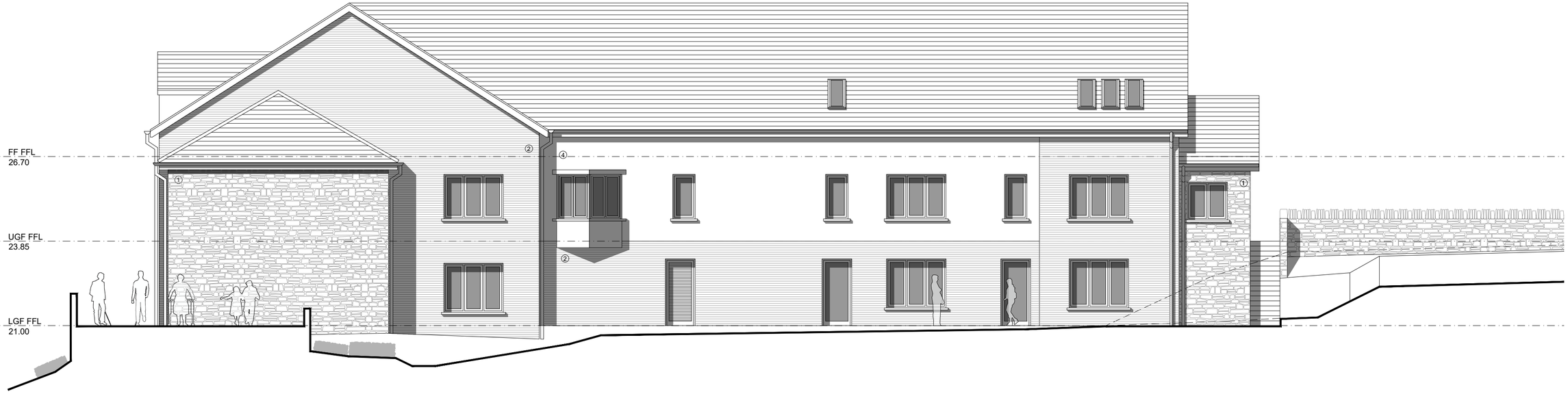
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Project Name :	Cardonnel Court, Skewen		
Project Ref :	SP803		
Drawing Title :	Proposed Elevations	Scale :	
Drawing Number :	SP803 - P11	1:100 @ A2	
Revision:	PAC	Drawn by: ce	Date: Sept 2025



Proposed Side Elevation

North-East

MATERIAL KEY

1. Bradstone type cladding
2. Red brickwork
3. Vertical Yorkshire board timber cladding
4. Render in light grey
5. Windows with clear double glazing in dark grey
6. Windows with frosted double glazing in dark grey
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Project Name :	Cardonnel Court, Skewen
Project Ref :	SP803

Drawing Title :	Proposed Elevation	Scale :
Drawing Number :	SP803 - P12	1:100 @ A2

Revision:	PAC	Drawn by: ce	Date: Sept 2025

APPENDIX B: Proposed Drainage Plans & Details

Sheet ACAD - A1 rev. C

0 2 4 6 8 10 m
SCALE 1:200

N

Dan y Graig

EXISTING COMBINED SEWER OUTFALL LOCATION UNKNOWN

EXISTING HEADWALL FROM NEIGHBOURING LAND

EXISTING LAND DRAINAGE WITH MULTIPLE HEADWALLS ON THE SITE.

LAND DRAIN DISCHARGE INTO HEADWALL UNDER THE RAILWAY IN THE DIRECTION OF THE TENNANT CANAL.

EXISTING HEADWALL FROM NEIGHBOURING LAND

EXMH1 CL:24.72 IL:22.46

EXMH1 CL:25.22 IL:24.30

EXMH2 CL:25.95 IL:24.56

EXSWMH CL:19.77 IL:16.76

225mm Ø

100mm Ø

Path (um)

Mineral Railway

21.6m

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THE DRAWING. USE FIGURED DIMENSIONS ONLY.
4. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE ENGINEER.
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, SUBCONTRACTORS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.

SITE KEY

EXISTING SITE BOUNDARY

EXISTING DRAINAGE KEY

DCWW FOUL SEWER

3m EASEMENT

LAND DRAIN

SURFACE WATER SEWER

rev.	drawn	chkd	apprvd	date	description
01	JW			12/12/25	PRE-SAB ISSUE

Client
QUORUM

Project
CARDONNEL COURT

Title
EXISTING DRAINAGE PLAN

LUTRA CONSULTANCY
Email: joel@lutraconsultancy.co.uk

date	drawn
DECEMBER 2025	JW
scale @ A1	project No.
1:200	25074

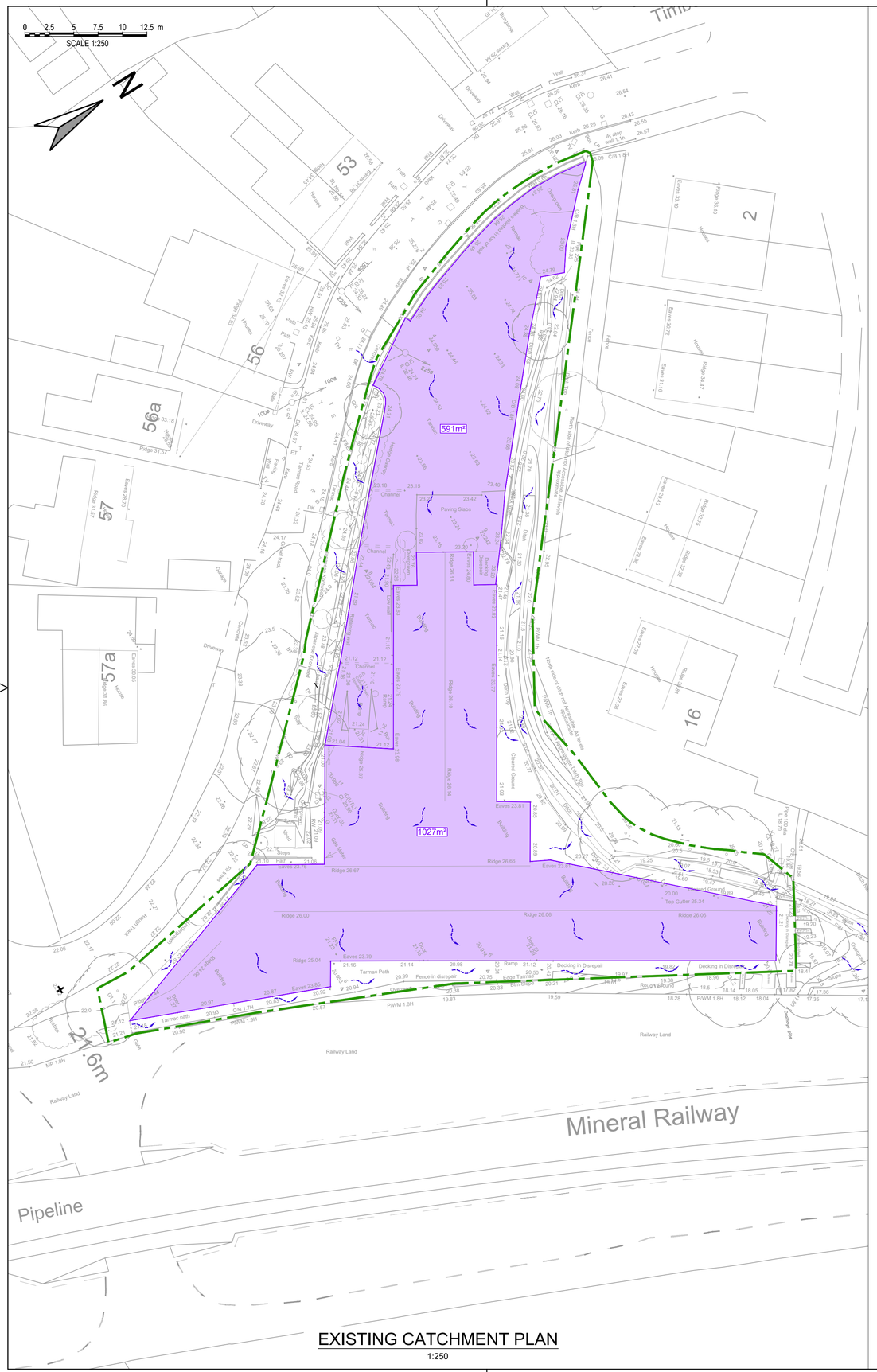
status	drg. no.	rev.
P	500	01

ORIGINAL DRAWING SIZE 841 x 594

10 0 10 20 50 100mm NATURAL SCALE

A1

Sheet ACAD - A1 rev. C



EXISTING CATCHMENT PLAN
1:250



PROPOSED CATCHMENT PLAN
1:250

NOTES:

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5. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, SUBCONTRACTORS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.

CATCHMENT KEY

- SITE BOUNDARY
- EXISTING IMPERMEABLE AREAS
- PROPOSED IMPERMEABLE AREAS
- EXCEEDANCE FLOWS

SITE ASSESSMENT

SITE AREA =	**2,465m²**
EXISTING CATCHMENT AREA =	**1,618m²**
PROPOSED CATCHMENT AREA =	**1,400m²**
BETTERMENT =	**13.5%**

rev.	drawn	chkd.	apprvd.	date	description
01	JW			18/04/24	ISSUED FOR SAB APPROVAL

Client
QUORUM

Project
CARDONNEL COURT

Title
CATCHMENT PLAN

LUTRA CONSULTANCY
Email: joel@lutraconsultancy.co.uk

date	drawn
DECEMBER 2025	JW
scale @ A1	project No.
1:250	25074

status	drg. no.	rev.
P	501	01

ORIGINAL DRAWING SIZE 841 x 594

10 0 10 20 50 100mm NATURAL SCALE

A1

Sheet ACAD - A1 rev. C

0 1.25 2.5 3.75 5.0 6.25 m
SCALE 1:125

N

NEW CONCRETE HEADWALL: AH4CA LH HEADWALL

HYDRO BRAKE
FLOW CONTROL CHAMBER
SET TO 1.2l/s WITH 1.0m DESIGN HEAD
WITH BYPASS DOOR AND SUMP

EXISTING LAND DRAINAGE TO REMAIN
UNCHANGED AND RECEIVE EXCEEDANCE FLOWS.

SURFACE WATER FLOW CONTROL
SET TO 10l/s WITH 2.4m DESIGN HEAD
TURTLE ENVRIO ORIFICE CHAMBER
WITH OVERFLOW AND SUMP

INTERNAL FOUL
SVP LOCATION TO
BE CONFIRMED

FOUL PUMPING STATION

NOTES:

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6. EXISTING DRAINAGE TAKEN FROM DCWW LOCAL RECORDS PROVIDED. THESE HAVE BEEN OVERLAID INDICATIVELY. THE SITE CONTRACTOR IS TO CONFIRM THE EXACT LOCATION OF DRAINAGE ONSITE.

SITE KEY
- EXISTING SITE BOUNDARY

EXISTING DRAINAGE KEY
- DCWW FOUL SEWER
- 3m EASEMENT
- LAND DRAIN
- SURFACE WATER SEWER

PROPOSED DRAINAGE KEY
- FOUL DRAINAGE
- FOUL MANHOLE
- FOUL RISING MAIN
- SURFACE WATER DRAINAGE
- SURFACE WATER MANHOLE
- SURFACE WATER TURTLE ENVIRO ORIFICE FLOW CHAMBER 1050mm Ø MODEL: OFCP1050225150B
- SURFACE WATER HYDRO-BRAKE VORTEX FLOW CONTROL CHAMBER MODEL: SHE-0109-6000-1400-6000
- PERFORATE PIPE
- FILTER DRAIN
- GEOCELLULAR ATTENUATION TANK
- RWP — RAIN WATER PIPE
- ACO CHANNEL HEXDRAIN

EXTERNAL WORKS KEY
- BITUMINOUS CAR PARK
- PAVED PATIO PATHS
- PERMEABLE PAVING - TOBERMORE HYDROPAVE
- SOFT LANDSCAPING - GRASS
- PROPOSED BANK
- BULL NOSED (BN) 125mm UPSTAND
- EDGE KERB (EF) FLUSH FINISH
- RETAINING WALL BY OTHERS
- +17.58 PROPOSED LEVEL

rev.	drawn	chkd.	apprvd.	date	description
01	JW			12/12/25	PRE-SAB ISSUE

Client
QUORUM

Project
CARDONNEL COURT NURSING HOME

Title
PROPOSED DRAINAGE PLAN

LUTRA CONSULTANCY
Email: joel@lutraconsultancy.co.uk

date	drawn
DECEMBER 2025	JW
scale @ A1	project No.
1:125	25074

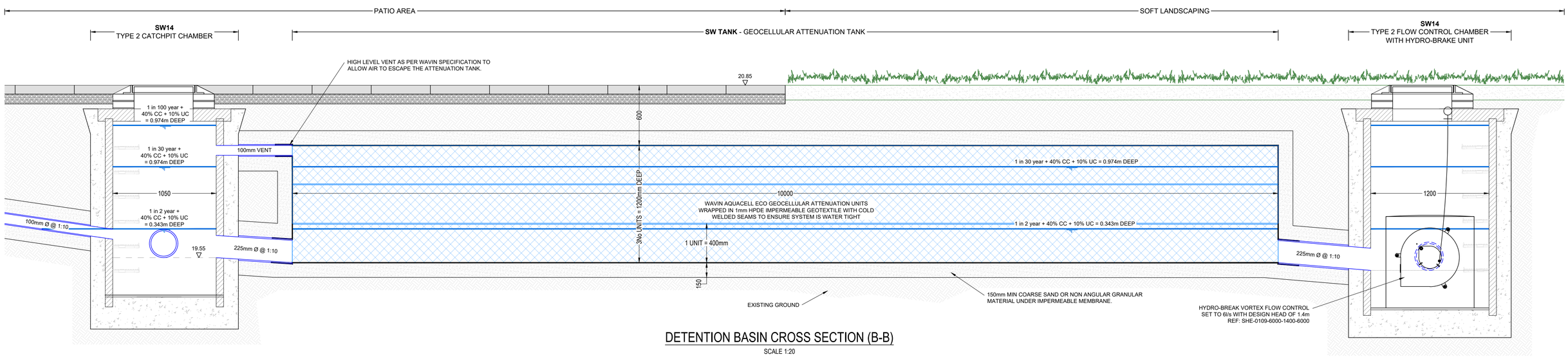
status	drg. no.	rev.
P	502	01

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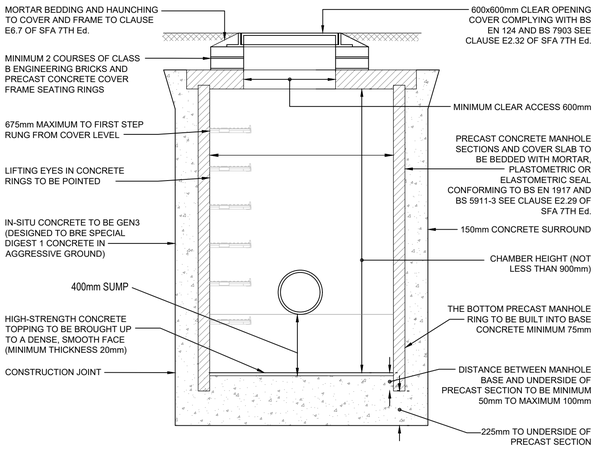
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0 200 400 600 800 1000 mm
SCALE 1:20



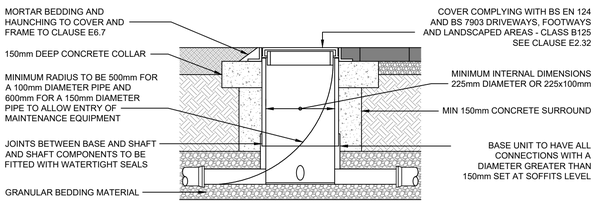
DETENTION BASIN CROSS SECTION (B-B)

SCALE 1:20



MANHOLE DETAIL TYPE 2 CATCHPIT WITH 400mm SUMP

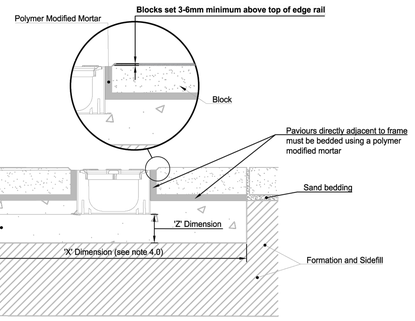
MAXIMUM DPETH FROM COVER LEVEL TO SOFFIT OF PIPE 3.0m



TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4A WITHIN PAVED AREAS

(REFER TO FIG. B.21 OF SEWERS FOR ADOPTION 7th ED) - SITED IN DRIVEWAYS/PAVED AREAS (FLEXIBLE MATERIAL DETAIL)

SCALE 1:20



1 : 5 ACO HexDrain Block Pavement

NBS Specification:
ACO HexDrain® should be specified in section Q10:180. Assistance in completing this clause can be found in ACO Technologies product entries in NBS Plus, or a model specification can be downloaded from www.aco.co.uk. For further assistance, contact the ACO Water Management Design Services Team.

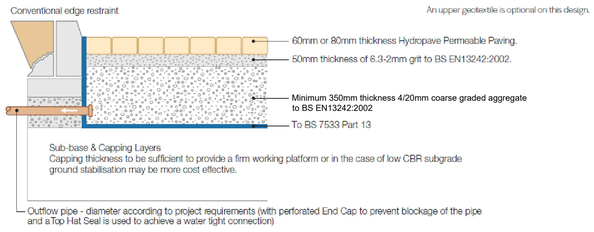
Best Practice and Workmanship:
ACO can give guidance with respect to the most suitable methods of installation for each of the products in the ACO HexDrain® range. ACO HexDrain® should be installed using levels of workmanship that accord with the National Code of Practice (UK: BS8000-0:2014) and in keeping with BS EN 1433:2002 (Drainage channels for vehicular and pedestrian areas).

Detailed installation statements and methodologies will vary for all sites as each will have different aspects deserving particular consideration, consequently the relevant approvals should be sought from the consulting engineer and/or the installer.

ACO HEX DRAIN DETAIL

NOT TO SCALE

LOADING CATEGORY B: 1-5% CBR



TOBERMORE HYDROPAVE ATTENUATION DETAIL

NOT TO SCALE

1.0 Load Class
Installation recommendations shown are ACO minimum recommendations for BS EN 1433:2002 load class requirements.

2.0 Ground Conditions
The long term performance of a channel installation to sustain vertical and lateral loads depends upon A) ground conditions B) stability of the adjacent pavement and C) a durable concrete bed and surround. The recommended installation detail may require the minimum dimensions to be revised to achieve site specific load class requirements (referred to in 1.0 above).

3.0 Temporary Installation
A channel installation is not complete until the final surfacing is laid. In any temporary condition, i.e. with the channel walls projecting above adjacent ground, site traffic should not cross channels. Loose boards, stone fill or cover plates will not protect the channel walls or grating. A temporary channel crossing should be formed by raising the ground level locally, to 3 - 6mm above top of edge rail, either side of a channel for a distance of 750 to 1000mm, to form ramps. Note that the channel load class should be adequate to carry the site traffic.

4.0 Block Pavements
The channel must be supported laterally. Blocks laid directly against a channel must be laid as a soldier course and restrained from movement by bedding securely on the concrete haunch e.g. by using a polymer modified mortar for bed and perpendicular joints (e.g. RONAFIX mortar mix C or similar). Blocks or slabs bedded on sand remote from the channel should be set at a higher level to compensate for possible settlement of the paving in service.

5.0 Channel Protection
Avoid contact between compaction equipment and top of ACO channel edge rail. The installer must ensure that the finished surface level lies above the top of the edge rail (by at least 3-6mm). Covering or protecting the grating, before concreting the haunch or laying blocks, removes the time and cost associated with cleaning the channel and grating of cement material and embedded stones. (Please note that ACO channels must be installed with the grating in place to prevent deformation of the channel).

6.0 Watertight Installation to BS EN 1433:2002
Where ACO channel joints/fittings and channel/pavement interfaces are to be sealed, an appropriate sealant should be used (e.g. Sikaflex 11FC or similar). Guidance on the necessary surface preparation and/or priming should be sought from the sealant manufacturer.

For Guidance a typical method of application follows:
- The end faces of the channels are to be sound and free from dust, oil, and grease, with any loose material or dirt removed, e.g. by mechanical wire brush. No water drops should be evident.
- Using a standard cartridge gun, apply the sealant evenly and with no flaws. The detail on the ends of a channel varies from one product to another:
- Products with a basically flat face - apply the sealant in a layer approximately 5mm thick to one face of the joint.
- Products with a sealing groove within the end face - apply the sealant in a bead of approximately 10mm diameter into the sealing groove.
- Products with a sealing groove following the inside shape of the channel - apply the sealant to the end face of the channel and to the sealant groove, such that when the joint is completed, the sealant will both cover the end face and fill the groove.
- The channel unit should be placed on the prepared concrete bedding and pressed against the previously placed channel unit. A sealed joint of approximately 1-2mm width should be formed between adjacent channel units.
- Excess sealant should be wiped from the inside face of the channel to leave a smooth finish.
- The sealant is to be left to cure for 24 hours, during which time the sealant should be kept as dry as possible.

Note: Galvanised steel and iron products have good corrosion resistance to concrete and mortar products but may experience corrosion if high chloride and/or sulphate content is present. Use only good quality concrete and consider using corrosion inhibitors where necessary. The use of protective coatings, such as paint, can minimise the risk of corrosion.

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rev.	drawn	chkd.	apprvd.	date	description
01	JW			11/12/25	PRE-SAB ISSUE

Client
QUORUM

Project
CARDONNEL COURT NURSING HOME

Title
PROPOSED DRAINAGE DETAILS

LUTRA CONSULTANCY
Email: joel@lutraconsultancy.co.uk

date	drawn
DECEMBER 2025	JW
scale @ A1	project No.
AS SHOWN	25074

status	drg. no.	rev.
P	503	01

ORIGINAL DRAWING SIZE 841 x 594

10 0 10 20 50 100mm NATURAL SCALE

A1

Sheet ACAD - A1 rev. C



Flow Control Systems
Orifice Flow Control Chamber

1050





Product Type: **Orifice Flow Control**
Model: **OFCP1050225150B**

1050mm diameter, pre-assembled flow control chamber, delivered ready to install. This model uses 150mm or 225mm main channel socket connections including two further 110mm or 225mm side inlets at 90° and 270° off centre from the outlet at 0°. Side inlets are supplied as blanked ends that can be used as required.

Application

- Above ground access for inspection and maintenance of surface water pipe systems.
- Suitable for Adoptable and Non-Adoptable applications.
- Maximum installation depth to soffit of pipe - Adoptable 3000mm and Non-Adoptable 3000mm.
- Designed for large housing or commercial developments.

Built to the following standards

- Design & Construction Guidance (DCG) - Section C7.12
- CIRIA75310.2 - 20.5 Compliance
- BS 8582 - 9.6

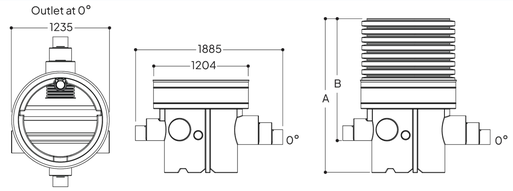
Features

- Single piece, pre-assembled chambers.
- Durable rotational moulded LLDPE base - chemical and impact resistant.
- 350mm sump depth.
- Compatible with all UK Twinwall pipe systems.
- Profiled base which improves overall strength.
- Four standard depths available.
- Access shafts are easily cut onsite to the required depth.
- Chambers can be installed in granular backfill.

Quality Assurance

Before leaving our factory, chambers are tested in accordance to required standards.

turtle
MANUFACTURED IN THE UK



Model ref.	Main Pipework Connections Ø (mm)	Optional Side Inlets Ø (mm)	Overall Depth A (mm)	Inlet Invert B (mm)	Approx. Weight (kg)
OFCP1050225150B/1.5	150, 225	110, 225	1450	1015	70
OFCP1050225150B/2	150, 225	110, 225	1970	1535	97
OFCP1050225150B/2.4	150, 225	110, 225	2385	1950	119
OFCP1050225150B/3	150, 225	110, 225	3010	2575	152

- Chambers over 1000mm soffit depth require our reduction/restriction caps to meet DCG.
- Inlet Invert measurements accurate to main channel socket. This measurement will vary depending on pipework used.
- We provide a range of adaptors to connect to various pipework dimensions and pipework types inlcuding Marley Quantum, Polysewer and UltraRib.

Our BLOK Filter Technology Within The Oriflo Range

We have an alternative model, the **OFCC1050225150B,** of this flow control that boasts an in-built silt protection system. The alternative protected model features a filter to prevent total suspended solids (TSS) including silt migrating past the filter, protecting the orifice plate and stopping potential blockage.



What information do we need to design your ORIFLO chamber?

We have a large range of flow control chambers allowing us to help tailor your choice to what would be best for your implementation. For this we will require:

- Orifice size
- Pipework sizes and configurations
- Invert depths

If you are unsure on the orifice size, you can use our Oriflo Orifice Size Calculator on our website to calculate what orifice size you would need for your chamber.

www.turtleenviro.co.uk/oriflo-OFCP1050225150B/#oriflo-calculator

ORIFLO
ORIFICE PLATE FLOW CONTROL CHAMBERS

email: sales@turtleenviro.co.uk | sales & technical support: tel. 01913036315 | **www.turtleenviro.co.uk**

ODSOFCP1050225150B/03/24

Technical Specification		
Control Point	Head (m)	Flow (l/s)
Primary Design	1.400	6.000
Flush-Flo™	0.411	5.989
Kick-Flo®	0.857	4.776
Mean Flow		5.246

hydro-int.com/patents

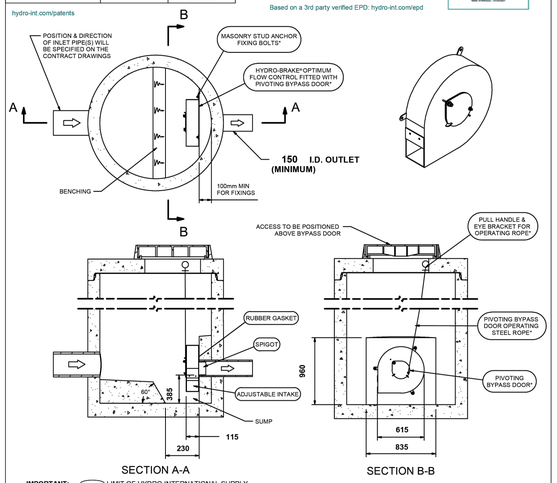
This Hydro-Brake® Optimum includes:

- All in 3 mm Grade 304L stainless steel
- Integral pivoting by-pass door allowing clear line of sight through to outlet, c/w operating rope
- Media blasted for corrosion resistance
- Variable flow rate post installation via adjustable inlet (if necessary)
- Indicative Weight: 20 kg
- Product Carbon Footprint: 87.94 kgCO2e

Based on a 3rd party verified EPD: hydro-int.com/epd

BBA APPROVAL INSPECTION TESTING CERTIFICATION

wrc approved FT5835422



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

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

DESIGN ADVICE !

The head/flow characteristics of this SHE-0109-6000-1400-6000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve. **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International
A CRH COMPANY

DATE	08/12/2025 11:14
SITE	Cardonnel Court
DESIGNER	Joel Wall
REF	25074

SHE-0109-6000-1400-6000
Hydro-Brake® Optimum

© 2025 Hydro International Ltd • Unit 2, Rivermead Court • Kenn Business Park • Windmill Road • Kenn • Clevedon • BS21 6FT • Tel: 01275 878371 • Website: hydro-int.com • Email: enquiries@hydro-int.com

joel@lutraconsultancy.co.uk

NOTES:

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rev.	drawn	chkd.	apprvd	date	description
01	JW			220424	ISSUED FOR SAB APPROVAL

Client: QUORUM

Project: CARDONNEL COURT NURSING HOME

Title: PROPOSED FLOW CONTROL DETAILS

LUTRA CONSULTANCY
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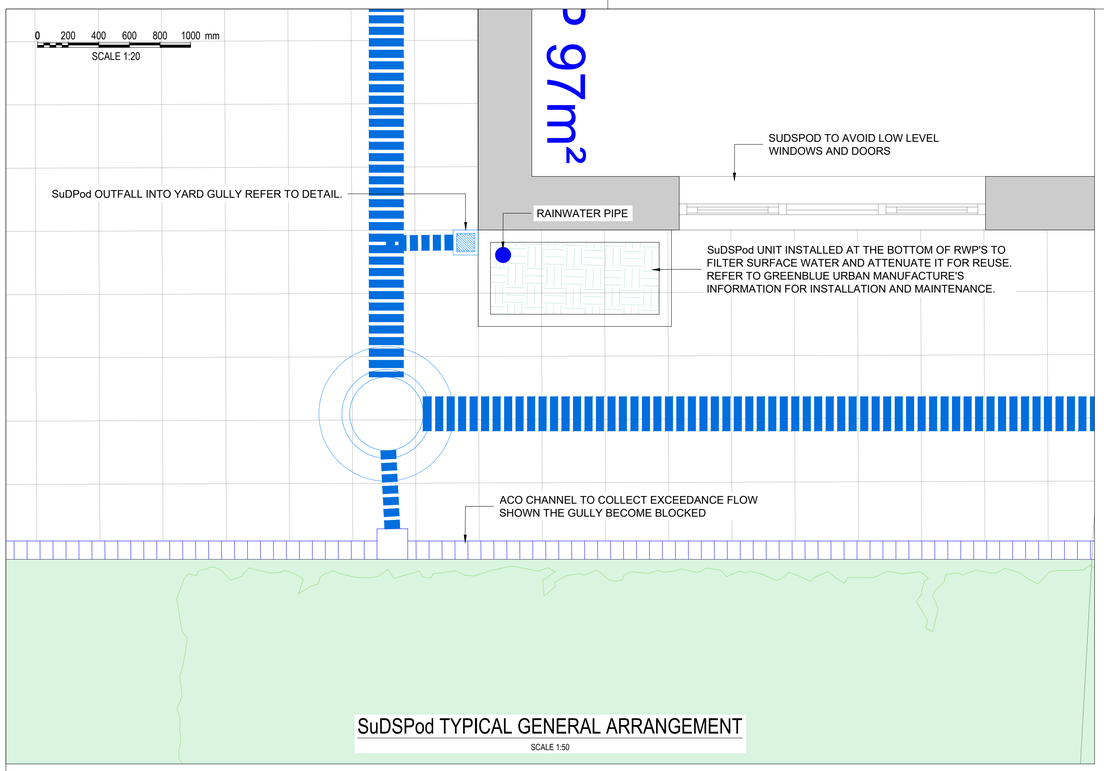
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DECEMBER 2025	JW
scale @ A1: NOT TO SCALE	project No.: 25074

status	drg. no.	rev.
P	503	01

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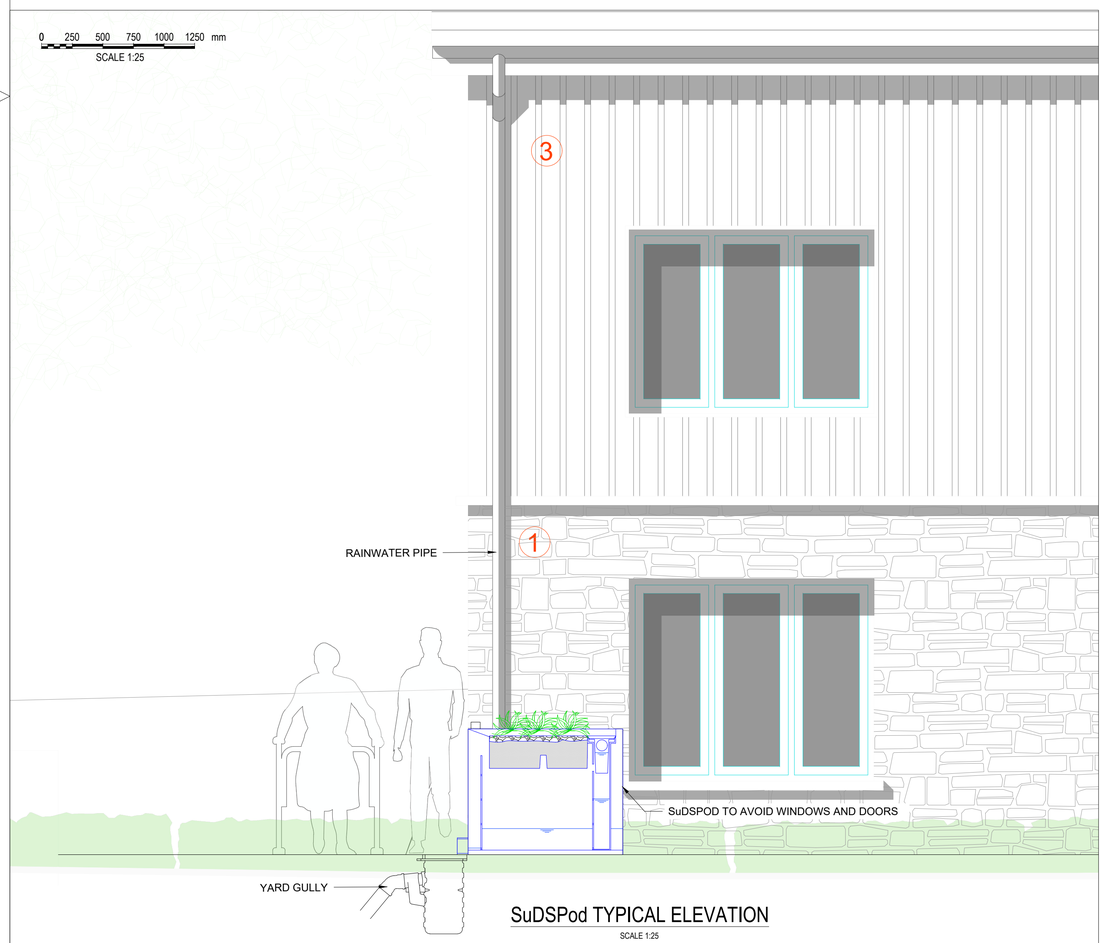
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A1



SuDSPod TYPICAL GENERAL ARRANGEMENT

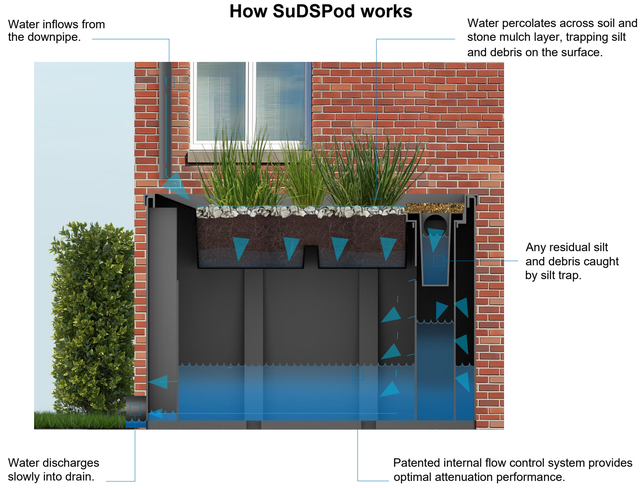
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SuDSPod TYPICAL ELEVATION

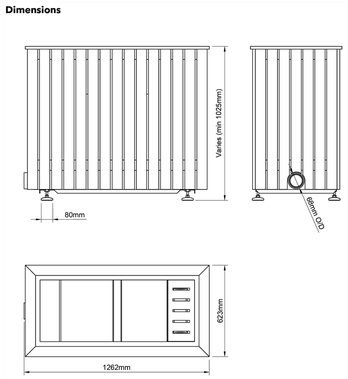
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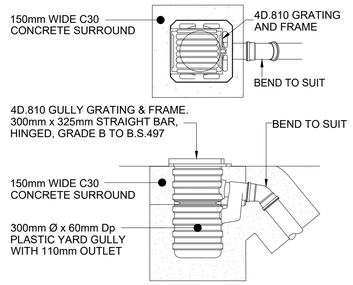
How SuDSPod works



GREENBLUE URBAN SUDSPOD DETAIL

NOT TO SCALE





OVERFLOW - YARD GULLY DETAIL

SCALE 1:20

South



Carex Pendula
South, East or West

Iris pseudacorus
South or East

Caltha palustris
South, East or West

Juncus inflexus
South, East or West

North



Astilbe chinensis
North, East or West

Mentha aquatica
North, South, East or West

Asplenium scolopendrium
North, East or West

Acorus gramineus Ogon
North, South, East or West

GREENBLUE URBAN SUDSPOD PLANTING SCHEDULE

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SOILS:

1. SOIL USED IN PLANTING AREAS TO BE A TOPSOIL MULTIPURPOSE. SOIL USED IN SUDS FEATURES ARE REQUIRED TO MEET THE FILTRATION SPECIFICATION SET OUT BELOW. ADVICE FROM A SOIL OR LANDSCAPE SCIENTIST SHOULD BE CONSIDERED TO ENSURE THAT SOILS ACHIEVE THE DESIRED PLANT GROWTH AS WELL AS BEING SUITED TO THE SPECIFIC SUDS FUNCTIONS PROPOSED.

FILTRATION SOIL SPECIFICATION:

2. THE SATURATED HYDRAULIC CONDUCTIVITY (PERMEABILITY) OF THE SOIL, WHICH IS TO BE CHECKED IN SITU USING THE SINGLE RING INFILTRATION TEST METHOD TO BS EN ISO 22282-5:2012 SHOULD BE BETWEEN 100mm/hr AND 300mm/hr OR CONFIRMED BY THE SUPPLIER. THE TOTAL POROSITY SHOULD BE >30% WHEN TESTED IN ACCORDANCE WITH BS 1377-2:1990

FERTILISER:

3. FERTILISER COMPRISING OF ORGANIC MATERIAL TO BE USED FOR NEW PLANTING, WITH INORGANIC FERTILIISERS OF THE APPROPRIATE NPK COMPOSITION ONLY USED TO ADDRESS AND SOIL NUTRIENT DEFICIENCIES. WHERE FERTILISER ARE USED WITHIN SUDS, TO REDUCE RAPID RUNOFF THEY SHOULD BE WORKING INTO THE SOIL DURING CULTIVATION, AND DUE CONSIDERATION IS TO BE GIVEN TO POTENTIAL CONTAMINATION OF THE RECEIVING WATERCOURSE.

MULCH:

4. PLANTING BEDS THAT ARE PART OF A SUDS, WHERE THE FLOW OF WATER IS ACROSS A PLANTED AREA OR WHICH IS OUTLET ABOVE GROUND, SHOULD USE GRAVEL OR PEBBLES.

MAINTENANCE:

5. ALL LANDSCAPE AREAS TO BE MAINTAINED IN ACCORDANCE WITH B.S. 7370 PART 3:1991 AND PART 4:1993; INCLUDING WEED CONTROL.
6. REPLACEMENT PLANS SUBSTITUTION SHOULD SUIT THE RECOMMEND PLANTING OR ALTERNATIVE SPECIES LISTED IN THE RAIN GARDEN GUIDANCE WHICH ARE A SIMILAR SIZE, FORM AND WATER DEMAND.

rev.	drawn	chkd.	apprvd	date	description
01	JW			12/12/25	PRE-SAB ISSUE

Client
QUORUM

Project
CARDONNEL COURT NURSING HOME

Title
SuDSPod GENERAL ARRANGMENET

LUTRA CONSULTANCY
Email: joel@lutraconsultancy.co.uk

date	drawn
DECEMBER 2025	JW
scale @ A1	project No.
AS SHOWN	25074

status	drg. no.	rev.
P	505	01

APPENDIX C: Drainage Calculations

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

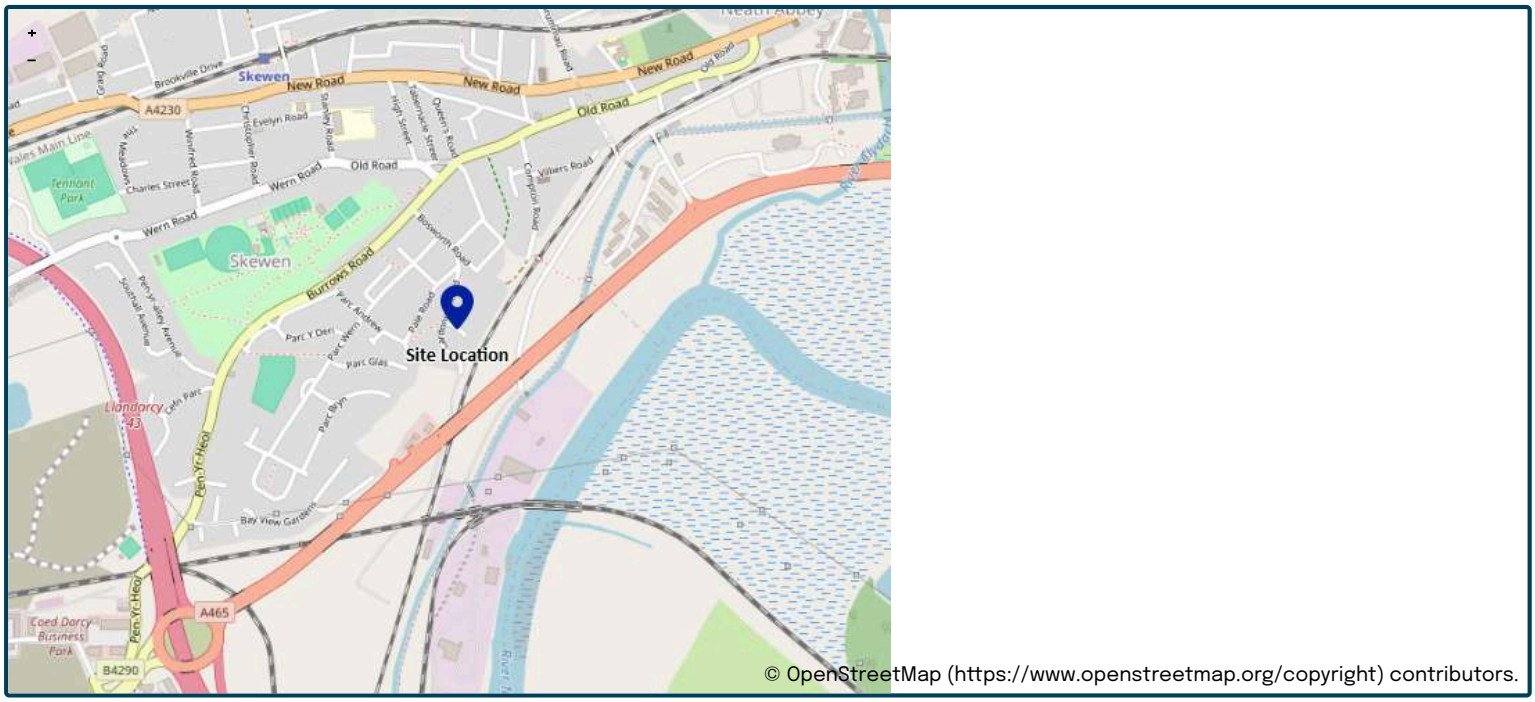
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	06/12/2025
Calculated by	Joel Wall
Reference	25074
Model version	2.2.2

Location

Site name	Cardonnel Court
Site location	Neath



Site easting (British National Grid)	272814
Site northing (British National Grid)	196751

Site details

Total site area (ha)	0.2465 ha

Greenfield runoff

Method

Method	FEH statistical (2025)

FEH statistical (2025)

	My value		Map value
SAAR9120 (mm)	1336 mm		
BFIHOST19scaled	0.444		
QMed-QBar conversion	1.075		1.075
QMed (l/s)	2.6 l/s		
QBar (FEH statistical 2025) (l/s)	2.8 l/s		

Growth curve factors

	My value		Map value
Hydrological region	9		9
1 year growth factor	0.88		
2 year growth factor	0.93		
10 year growth factor	1.42		
30 year growth factor	1.78		
100 year growth factor	2.18		
200 year growth factor	2.46		

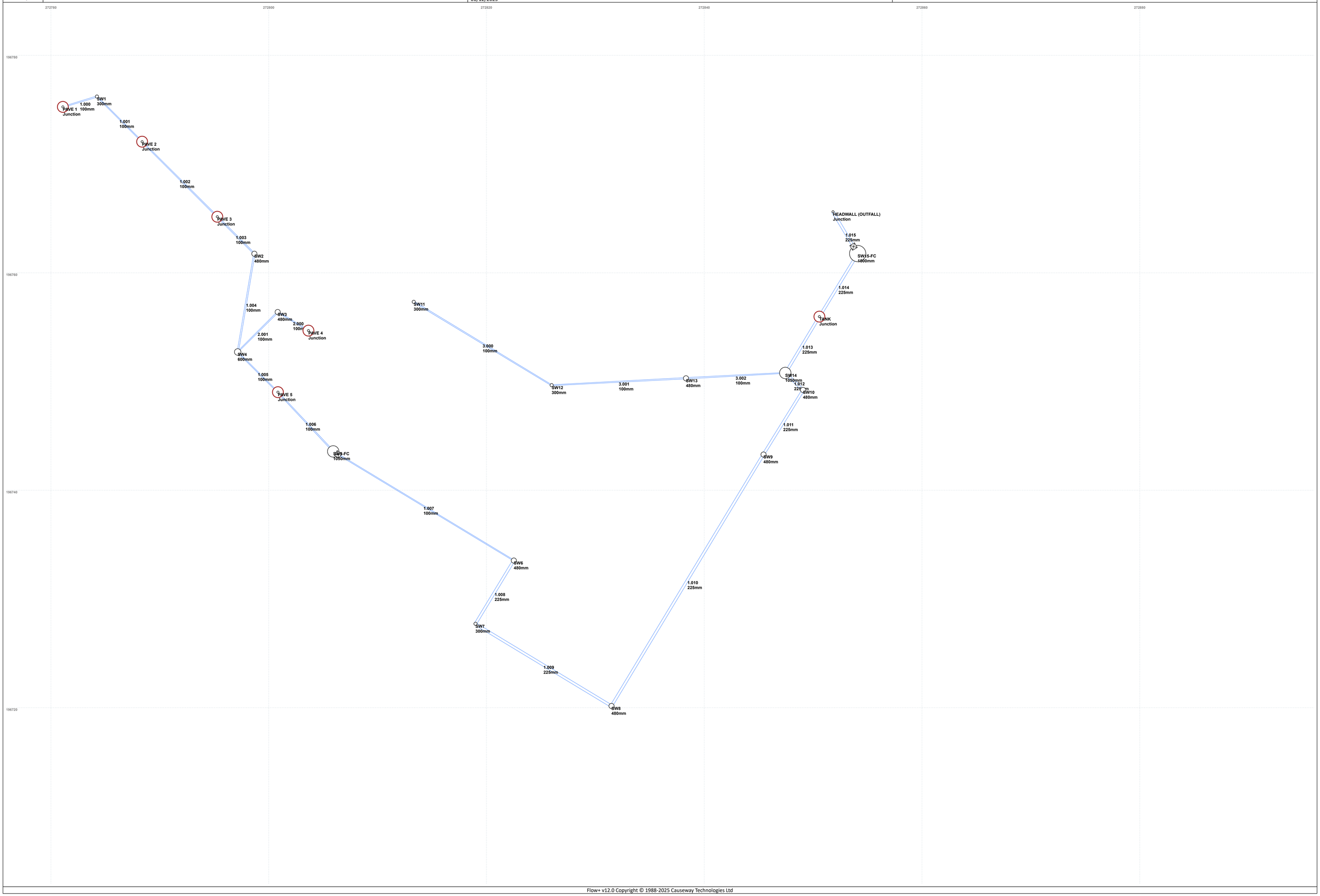
Results

Method	FEH statistical (2025)
Flow rate 1 year (l/s)	2.5 l/s
Flow rate 2 year (l/s)	2.6 l/s
Flow rate 10 years (l/s)	4.0 l/s
Flow rate 30 years (l/s)	5.0 l/s
Flow rate 100 years (l/s)	6.1 l/s
Flow rate 200 years (l/s)	6.9 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.



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Node Name		PAVE 1	SW1	PAVE 2	PAVE 3	SW2	SW4	PAVE 5	SW5-FC
A1 drawing Hor Scale 300 Ver Scale 100 Datum (m) -2.000									
Link Name		1.000	1.001	1.002	1.003	1.004	1.005	1.006	
Section Type		100mm	100mm	100mm	100mm	100mm	100mm	100mm	
Slope (1:X)		40.0	20.0	20.0	20.0	30.3	20.0	20.0	
Cover Level (m)		25.000	24.950	24.650	24.100	23.850	23.750	23.700	23.850
Invert Level (m)		24.300	24.218 / 24.218	23.925 / 23.437	23.437	23.196 / 23.196	22.894 / 22.744	22.483 / 22.483	22.111
Length (m)		3.272	5.868	9.764	4.814	9.164	5.227	7.447	

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Node Name		SW5-FC	SW6	SW7	SW8	SW9	SW10	SW14	TANK	SW15-FC	HEADWALL (OUTFALL)
A1 drawing Hor Scale 300 Ver Scale 100 Datum (m) -4.000											
Link Name		1.007	1.008	1.009	1.010	1.011	1.012	1.013	1.014	1.015	
Section Type		100mm	225mm	225mm	225mm	225mm	225mm	225mm	225mm	225mm	
Slope (1:X)		32.3	80.0	80.0	100.0	100.0	100.0	168.2	80.0	38.8	
Cover Level (m)		23.850	21.000	21.000	20.850	20.850	20.850	20.850	20.800	20.800	19.400
Invert Level (m)		21.000	20.400 20.275	20.190 20.190	20.008 20.008	19.738 19.738	19.668 19.665	19.645	19.609	19.000	18.915 18.915 18.800
Length (m)		19.392	6.800	14.600	27.015	6.961	2.258	6.057	6.781	4.463	

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Node Name		PAVE 4	SW3	SW4
A1 drawing Hor Scale 300 Ver Scale 100 Datum (m) -2.000				
Link Name		2.000	2.001	
Section Type		100mm	100mm	
Slope (1:X)		80.0	80.0	
Cover Level (m)		23.550	23.750	23.750
Invert Level (m)		22.850	22.809	22.744
Length (m)		3.301	5.195	

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Node Name		SW11	SW12	SW13	SW14
					
A1 drawing Hor Scale 300 Ver Scale 100 Datum (m) -4.000					
Link Name		3.000	3.001	3.002	
Section Type		100mm	100mm	100mm	
Slope (1:X)		40.0	40.0	64.8	
Cover Level (m)		21.290	21.000	20.850	20.850
Invert Level (m)		20.590	20.220 20.220	19.911 19.911	19.770
Length (m)		14.805	12.353	9.130	

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Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
PAVE 1		5.00	25.000		272781.095	196775.263	0.700
SW1			24.950	300	272784.226	196776.212	0.732
PAVE 2	0.014	5.00	24.650		272788.375	196772.062	0.725
PAVE 3	0.010	5.00	24.100		272795.280	196765.158	0.663
SW2			23.850	480	272798.684	196761.754	0.654
PAVE 4	0.012	5.00	23.550		272803.650	196754.683	0.700
SW3			23.750	480	272800.826	196756.392	0.941
SW4			23.750	600	272797.152	196752.719	1.006
PAVE 5	0.007	5.00	23.700		272800.848	196749.023	1.217
SW5-FC	0.017	5.00	23.850	1050	272805.923	196743.573	2.850
SW6	0.015	5.00	21.000	480	272822.514	196733.534	0.725
SW7	0.010	5.00	21.000	300	272818.994	196727.716	0.810
SW8	0.010	5.00	20.850	480	272831.485	196720.158	0.842
SW9	0.012	5.00	20.850	480	272845.447	196743.285	1.112
SW10	0.005	5.00	20.850	480	272849.073	196749.227	1.182
SW11	0.011	5.00	21.290	300	272813.322	196757.329	0.700
SW12	0.013	5.00	21.000	300	272825.989	196749.665	0.780
SW13			20.850	480	272838.326	196750.297	0.939
SW14	0.006	5.00	20.850	1050	272847.443	196750.790	1.205
TANK			20.800		272850.578	196755.972	1.800
SW15-FC			20.800	1500	272854.093	196761.771	1.885
HEADWALL (OUTFALL)			19.400		272851.828	196765.617	0.600

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	PAVE 1	SW1	3.272	0.600	24.300	24.218	0.082	40.0	100	5.04	46.7
1.001	SW1	PAVE 2	5.868	0.600	24.218	23.925	0.293	20.0	100	5.10	46.5
1.002	PAVE 2	PAVE 3	9.764	0.600	23.925	23.437	0.488	20.0	100	5.19	46.2
1.003	PAVE 3	SW2	4.814	0.600	23.437	23.196	0.241	20.0	100	5.24	46.0
1.004	SW2	SW4	9.164	0.600	23.196	22.894	0.302	30.3	100	5.35	45.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.223	9.6	0.0	0.600	0.632	0.000	0.0	0	0.000
1.001	1.734	13.6	0.0	0.632	0.625	0.000	0.0	0	0.000
1.002	1.734	13.6	2.3	0.625	0.563	0.014	0.0	28	1.288
1.003	1.734	13.6	4.0	0.563	0.554	0.024	0.0	37	1.508
1.004	1.406	11.0	4.0	0.554	0.756	0.024	0.0	41	1.284

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.005	SW4	PAVE 5	5.227	0.600	22.744	22.483	0.261	20.0	100	5.40	45.5
1.006	PAVE 5	SW5-FC	7.447	0.600	22.483	22.111	0.372	20.0	100	5.47	45.2
1.007	SW5-FC	SW6	19.392	0.600	21.000	20.400	0.600	32.3	100	5.71	44.4
1.008	SW6	SW7	6.800	0.600	20.275	20.190	0.085	80.0	225	5.79	44.2
1.009	SW7	SW8	14.600	0.600	20.190	20.008	0.182	80.0	225	5.95	43.6
1.010	SW8	SW9	27.015	0.600	20.008	19.738	0.270	100.0	225	6.30	42.6
1.011	SW9	SW10	6.961	0.600	19.738	19.668	0.070	100.0	225	6.39	42.4
2.000	PAVE 4	SW3	3.301	0.600	22.850	22.809	0.041	80.0	100	5.06	46.6
2.001	SW3	SW4	5.195	0.600	22.809	22.744	0.065	80.0	100	5.16	46.3
3.000	SW11	SW12	14.805	0.600	20.590	20.220	0.370	40.0	100	5.20	46.1
3.001	SW12	SW13	12.353	0.600	20.220	19.911	0.309	40.0	100	5.37	45.6
1.012	SW10	SW14	2.258	0.600	19.668	19.645	0.023	100.0	225	6.41	42.3
3.002	SW13	SW14	9.130	0.600	19.911	19.770	0.141	64.8	100	5.53	45.0
1.013	SW14	TANK	6.057	0.600	19.645	19.609	0.036	168.2	225	6.52	42.0
1.014	TANK	SW15-FC	6.781	0.600	19.000	18.915	0.085	80.0	225	6.59	41.8
1.015	SW15-FC	HEADWALL (OUTFALL)	4.463	0.600	18.915	18.800	0.115	38.8	225	6.63	41.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.005	1.734	13.6	5.9	0.906	1.117	0.036	0.0	46	1.667
1.006	1.734	13.6	7.0	1.117	1.639	0.043	0.0	51	1.751
1.007	1.362	10.7	9.6	2.750	0.500	0.060	0.0	75	1.540
1.008	1.463	58.2	12.0	0.500	0.585	0.075	0.0	69	1.157
1.009	1.463	58.2	13.4	0.585	0.617	0.085	0.0	73	1.195
1.010	1.307	52.0	14.6	0.617	0.887	0.095	0.0	81	1.125
1.011	1.307	52.0	16.4	0.887	0.957	0.107	0.0	87	1.161
2.000	0.861	6.8	2.0	0.600	0.841	0.012	0.0	37	0.748
2.001	0.861	6.8	2.0	0.841	0.906	0.012	0.0	37	0.748
3.000	1.223	9.6	1.8	0.600	0.680	0.011	0.0	29	0.936
3.001	1.223	9.6	4.0	0.680	0.839	0.024	0.0	45	1.166
1.012	1.307	52.0	17.1	0.957	0.980	0.112	0.0	88	1.172
3.002	0.958	7.5	3.9	0.839	0.980	0.024	0.0	51	0.968
1.013	1.005	40.0	21.6	0.980	0.966	0.142	0.0	118	1.025
1.014	1.463	58.2	21.5	1.575	1.660	0.142	0.0	94	1.355
1.015	2.106	83.7	21.4	1.660	0.375	0.142	0.0	78	1.774

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	3.272	40.0	100	Circular	25.000	24.300	0.600	24.950	24.218	0.632
1.001	5.868	20.0	100	Circular	24.950	24.218	0.632	24.650	23.925	0.625
1.002	9.764	20.0	100	Circular	24.650	23.925	0.625	24.100	23.437	0.563
1.003	4.814	20.0	100	Circular	24.100	23.437	0.563	23.850	23.196	0.554

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	PAVE 1		Junction		SW1	300	Manhole	Adoptable
1.001	SW1	300	Manhole	Adoptable	PAVE 2		Junction	
1.002	PAVE 2		Junction		PAVE 3		Junction	
1.003	PAVE 3		Junction		SW2	480	Manhole	Adoptable

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Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	9.164	30.3	100	Circular	23.850	23.196	0.554	23.750	22.894	0.756
1.005	5.227	20.0	100	Circular	23.750	22.744	0.906	23.700	22.483	1.117
1.006	7.447	20.0	100	Circular	23.700	22.483	1.117	23.850	22.111	1.639
1.007	19.392	32.3	100	Circular	23.850	21.000	2.750	21.000	20.400	0.500
1.008	6.800	80.0	225	Circular	21.000	20.275	0.500	21.000	20.190	0.585
1.009	14.600	80.0	225	Circular	21.000	20.190	0.585	20.850	20.008	0.617
1.010	27.015	100.0	225	Circular	20.850	20.008	0.617	20.850	19.738	0.887
1.011	6.961	100.0	225	Circular	20.850	19.738	0.887	20.850	19.668	0.957
2.000	3.301	80.0	100	Circular	23.550	22.850	0.600	23.750	22.809	0.841
2.001	5.195	80.0	100	Circular	23.750	22.809	0.841	23.750	22.744	0.906
3.000	14.805	40.0	100	Circular	21.290	20.590	0.600	21.000	20.220	0.680
3.001	12.353	40.0	100	Circular	21.000	20.220	0.680	20.850	19.911	0.839
1.012	2.258	100.0	225	Circular	20.850	19.668	0.957	20.850	19.645	0.980
3.002	9.130	64.8	100	Circular	20.850	19.911	0.839	20.850	19.770	0.980
1.013	6.057	168.2	225	Circular	20.850	19.645	0.980	20.800	19.609	0.966
1.014	6.781	80.0	225	Circular	20.800	19.000	1.575	20.800	18.915	1.660
1.015	4.463	38.8	225	Circular	20.800	18.915	1.660	19.400	18.800	0.375

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	SW2	480	Manhole	Adoptable	SW4	600	Manhole	Adoptable
1.005	SW4	600	Manhole	Adoptable	PAVE 5		Junction	
1.006	PAVE 5		Junction		SW5-FC	1050	Manhole	Adoptable
1.007	SW5-FC	1050	Manhole	Adoptable	SW6	480	Manhole	Adoptable
1.008	SW6	480	Manhole	Adoptable	SW7	300	Manhole	Adoptable
1.009	SW7	300	Manhole	Adoptable	SW8	480	Manhole	Adoptable
1.010	SW8	480	Manhole	Adoptable	SW9	480	Manhole	Adoptable
1.011	SW9	480	Manhole	Adoptable	SW10	480	Manhole	Adoptable
2.000	PAVE 4		Junction		SW3	480	Manhole	Adoptable
2.001	SW3	480	Manhole	Adoptable	SW4	600	Manhole	Adoptable
3.000	SW11	300	Manhole	Adoptable	SW12	300	Manhole	Adoptable
3.001	SW12	300	Manhole	Adoptable	SW13	480	Manhole	Adoptable
1.012	SW10	480	Manhole	Adoptable	SW14	1050	Manhole	Adoptable
3.002	SW13	480	Manhole	Adoptable	SW14	1050	Manhole	Adoptable
1.013	SW14	1050	Manhole	Adoptable	TANK		Junction	
1.014	TANK		Junction		SW15-FC	1500	Manhole	Adoptable
1.015	SW15-FC	1500	Manhole	Adoptable	HEADWALL (OUTFALL)		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PAVE 1	272781.095	196775.263	25.000	0.700					
						0	1.000	24.300	100
SW1	272784.226	196776.212	24.950	0.732	300	1	1.000	24.218	100
									
						0	1.001	24.218	100

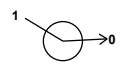
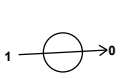
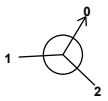
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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PAVE 2	272788.375	196772.062	24.650	0.725		1	1.001	23.925	100
						0	1.002	23.925	100
PAVE 3	272795.280	196765.158	24.100	0.663		1	1.002	23.437	100
						0	1.003	23.437	100
SW2	272798.684	196761.754	23.850	0.654	480	1	1.003	23.196	100
						0	1.004	23.196	100
PAVE 4	272803.650	196754.683	23.550	0.700		0	2.000	22.850	100
SW3	272800.826	196756.392	23.750	0.941	480	1	2.000	22.809	100
						0	2.001	22.809	100
SW4	272797.152	196752.719	23.750	1.006	600	1	2.001	22.744	100
						2	1.004	22.894	100
						0	1.005	22.744	100
PAVE 5	272800.848	196749.023	23.700	1.217		1	1.005	22.483	100
						0	1.006	22.483	100
SW5-FC	272805.923	196743.573	23.850	2.850	1050	1	1.006	22.111	100
						0	1.007	21.000	100
SW6	272822.514	196733.534	21.000	0.725	480	1	1.007	20.400	100
						0	1.008	20.275	225
SW7	272818.994	196727.716	21.000	0.810	300	1	1.008	20.190	225
						0	1.009	20.190	225
SW8	272831.485	196720.158	20.850	0.842	480	1	1.009	20.008	225
						0	1.010	20.008	225
SW9	272845.447	196743.285	20.850	1.112	480	1	1.010	19.738	225
						0	1.011	19.738	225
SW10	272849.073	196749.227	20.850	1.182	480	1	1.011	19.668	225
						0	1.012	19.668	225

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW11	272813.322	196757.329	21.290	0.700	300				
						0	3.000	20.590	100
SW12	272825.989	196749.665	21.000	0.780	300		1	3.000	20.220	100
						0	3.001	20.220	100
SW13	272838.326	196750.297	20.850	0.939	480		1	3.001	19.911	100
						0	3.002	19.911	100
SW14	272847.443	196750.790	20.850	1.205	1050		1	3.002	19.770	100
							2	1.012	19.645	225
						0	1.013	19.645	225
TANK	272850.578	196755.972	20.800	1.800			1	1.013	19.609	225
						0	1.014	19.000	225
SW15-FC	272854.093	196761.771	20.800	1.885	1500		1	1.014	18.915	225
						0	1.015	18.915	225
HEADWALL (OUTFALL)	272851.828	196765.617	19.400	0.600			1	1.015	18.800	225

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	20.0		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	40	10	0
30	40	10	0
100	40	10	0
200	40	10	0

Node SW5-FC Online Orifice Control

Flap Valve	x	Invert Level (m)	21.000	Diameter (m)	0.055
Downstream Link	1.007	Design Depth (m)	2.400	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	10.0		

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Node SW15-FC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.015	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0109-6000-1400-6000
Invert Level (m)	18.915	Min Outlet Diameter (m)	0.150
Design Depth (m)	1.400	Min Node Diameter (mm)	1200
Design Flow (l/s)	6.0		

Node PAVE 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	24.580	Slope (1:X)	50.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.420
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	5.000		

Node PAVE 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	24.230	Slope (1:X)	20.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.420
Safety Factor	3.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.500		

Node PAVE 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	23.680	Slope (1:X)	20.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	7	Depth (m)	0.420
Safety Factor	3.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.30	Length (m)	7.700		

Node PAVE 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.930	Slope (1:X)	20.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	25	Depth (m)	
Safety Factor	3.0	Width (m)	7.700	Inf Depth (m)	
Porosity	0.30	Length (m)	5.000		

Node PAVE 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	23.100	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	24	Depth (m)	0.600
Safety Factor	2.0	Width (m)	3.550	Inf Depth (m)	
Porosity	0.30	Length (m)	7.000		

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	19.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	160

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	1.200	50.0	0.0	1.201	0.0	0.0

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Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +40% CC +10% A 15 minute summer	138.804	39.277
2 year +40% CC +10% A 15 minute winter	97.406	39.277
2 year +40% CC +10% A 30 minute summer	95.129	26.918
2 year +40% CC +10% A 30 minute winter	66.757	26.918
2 year +40% CC +10% A 60 minute summer	67.798	17.917
2 year +40% CC +10% A 60 minute winter	45.044	17.917
2 year +40% CC +10% A 120 minute summer	49.527	13.089
2 year +40% CC +10% A 120 minute winter	32.905	13.089
2 year +40% CC +10% A 180 minute summer	41.404	10.655
2 year +40% CC +10% A 180 minute winter	26.914	10.655
2 year +40% CC +10% A 240 minute summer	34.520	9.123
2 year +40% CC +10% A 240 minute winter	22.934	9.123
2 year +40% CC +10% A 360 minute summer	28.074	7.224
2 year +40% CC +10% A 360 minute winter	18.249	7.224
2 year +40% CC +10% A 480 minute summer	22.865	6.042
2 year +40% CC +10% A 480 minute winter	15.191	6.042
2 year +40% CC +10% A 600 minute summer	19.113	5.228
2 year +40% CC +10% A 600 minute winter	13.059	5.228
2 year +40% CC +10% A 720 minute summer	17.268	4.628
2 year +40% CC +10% A 720 minute winter	11.605	4.628
2 year +40% CC +10% A 960 minute summer	14.412	3.795
2 year +40% CC +10% A 960 minute winter	9.547	3.795
2 year +40% CC +10% A 1440 minute summer	10.639	2.851
2 year +40% CC +10% A 1440 minute winter	7.150	2.851
30 year +40% CC +10% A 15 minute summer	313.292	88.651
30 year +40% CC +10% A 15 minute winter	219.854	88.651
30 year +40% CC +10% A 30 minute summer	220.358	62.354
30 year +40% CC +10% A 30 minute winter	154.637	62.354
30 year +40% CC +10% A 60 minute summer	158.873	41.985
30 year +40% CC +10% A 60 minute winter	105.551	41.985
30 year +40% CC +10% A 120 minute summer	101.025	26.698
30 year +40% CC +10% A 120 minute winter	67.119	26.698
30 year +40% CC +10% A 180 minute summer	79.210	20.384
30 year +40% CC +10% A 180 minute winter	51.489	20.384
30 year +40% CC +10% A 240 minute summer	63.581	16.803
30 year +40% CC +10% A 240 minute winter	42.242	16.803
30 year +40% CC +10% A 360 minute summer	49.624	12.770
30 year +40% CC +10% A 360 minute winter	32.257	12.770
30 year +40% CC +10% A 480 minute summer	39.500	10.439
30 year +40% CC +10% A 480 minute winter	26.243	10.439
30 year +40% CC +10% A 600 minute summer	32.561	8.906
30 year +40% CC +10% A 600 minute winter	22.247	8.906
30 year +40% CC +10% A 720 minute summer	29.153	7.813
30 year +40% CC +10% A 720 minute winter	19.593	7.813
30 year +40% CC +10% A 960 minute summer	24.121	6.352
30 year +40% CC +10% A 960 minute winter	15.978	6.352
30 year +40% CC +10% A 1440 minute summer	17.642	4.728
30 year +40% CC +10% A 1440 minute winter	11.856	4.728
100 year +40% CC +10% A 15 minute summer	380.568	107.687
100 year +40% CC +10% A 15 minute winter	267.065	107.687
100 year +40% CC +10% A 30 minute summer	271.404	76.798
100 year +40% CC +10% A 30 minute winter	190.459	76.798

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Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC +10% A 60 minute summer	198.515	52.462
100 year +40% CC +10% A 60 minute winter	131.889	52.462
100 year +40% CC +10% A 120 minute summer	123.138	32.542
100 year +40% CC +10% A 120 minute winter	81.810	32.542
100 year +40% CC +10% A 180 minute summer	95.507	24.577
100 year +40% CC +10% A 180 minute winter	62.082	24.577
100 year +40% CC +10% A 240 minute summer	76.199	20.137
100 year +40% CC +10% A 240 minute winter	50.625	20.137
100 year +40% CC +10% A 360 minute summer	59.114	15.212
100 year +40% CC +10% A 360 minute winter	38.426	15.212
100 year +40% CC +10% A 480 minute summer	47.056	12.436
100 year +40% CC +10% A 480 minute winter	31.263	12.436
100 year +40% CC +10% A 600 minute summer	38.857	10.628
100 year +40% CC +10% A 600 minute winter	26.550	10.628
100 year +40% CC +10% A 720 minute summer	34.873	9.346
100 year +40% CC +10% A 720 minute winter	23.437	9.346
100 year +40% CC +10% A 960 minute summer	28.997	7.636
100 year +40% CC +10% A 960 minute winter	19.208	7.636
100 year +40% CC +10% A 1440 minute summer	21.359	5.724
100 year +40% CC +10% A 1440 minute winter	14.355	5.724
200 year +40% CC +10% A 15 minute summer	422.012	119.415
200 year +40% CC +10% A 15 minute winter	296.149	119.415
200 year +40% CC +10% A 30 minute summer	303.482	85.875
200 year +40% CC +10% A 30 minute winter	212.970	85.875
200 year +40% CC +10% A 60 minute summer	222.844	58.891
200 year +40% CC +10% A 60 minute winter	148.052	58.891
200 year +40% CC +10% A 120 minute summer	136.671	36.118
200 year +40% CC +10% A 120 minute winter	90.801	36.118
200 year +40% CC +10% A 180 minute summer	105.633	27.183
200 year +40% CC +10% A 180 minute winter	68.664	27.183
200 year +40% CC +10% A 240 minute summer	84.176	22.245
200 year +40% CC +10% A 240 minute winter	55.924	22.245
200 year +40% CC +10% A 360 minute summer	65.299	16.804
200 year +40% CC +10% A 360 minute winter	42.446	16.804
200 year +40% CC +10% A 480 minute summer	52.136	13.778
200 year +40% CC +10% A 480 minute winter	34.638	13.778
200 year +40% CC +10% A 600 minute summer	43.203	11.817
200 year +40% CC +10% A 600 minute winter	29.519	11.817
200 year +40% CC +10% A 720 minute summer	38.908	10.428
200 year +40% CC +10% A 720 minute winter	26.149	10.428
200 year +40% CC +10% A 960 minute summer	32.559	8.574
200 year +40% CC +10% A 960 minute winter	21.568	8.574
200 year +40% CC +10% A 1440 minute summer	24.100	6.459
200 year +40% CC +10% A 1440 minute winter	16.197	6.459

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Results for 2 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.55%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	PAVE 1	1	24.300	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SW1	1	24.218	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PAVE 2	10	23.960	0.035	3.5	0.0147	0.0000	OK
15 minute summer	PAVE 3	10	23.484	0.047	6.0	0.0156	0.0000	OK
15 minute summer	SW2	10	23.251	0.055	5.9	0.0100	0.0000	OK
15 minute summer	PAVE 4	10	22.900	0.050	3.0	0.0187	0.0000	OK
30 minute summer	SW3	21	22.900	0.091	2.8	0.0165	0.0000	OK
30 minute summer	SW4	21	22.892	0.148	8.4	0.0419	0.0000	SURCHARGED
30 minute summer	PAVE 5	21	22.847	0.364	9.6	0.0462	0.0000	SURCHARGED
30 minute summer	SW5-FC	21	22.759	1.759	13.5	1.7537	0.0000	SURCHARGED
15 minute summer	SW6	11	20.349	0.074	11.4	0.0471	0.0000	OK
15 minute summer	SW7	11	20.268	0.078	13.8	0.0265	0.0000	OK
15 minute summer	SW8	11	20.094	0.086	16.2	0.0382	0.0000	OK
15 minute summer	SW9	11	19.849	0.111	19.0	0.0464	0.0000	OK
15 minute summer	SW10	11	19.808	0.140	20.0	0.0382	0.0000	OK
15 minute summer	SW11	10	20.626	0.036	2.7	0.0151	0.0000	OK
15 minute summer	SW12	10	20.277	0.057	5.9	0.0250	0.0000	OK
15 minute summer	SW13	11	19.982	0.071	5.8	0.0128	0.0000	OK
15 minute summer	SW14	11	19.787	0.142	27.1	0.1388	0.0000	OK
180 minute summer	TANK	120	19.343	0.343	21.4	16.2907	0.0000	SURCHARGED
180 minute summer	SW15-FC	120	19.342	0.427	19.4	0.7540	0.0000	SURCHARGED
15 minute summer	HEADWALL (OUTFALL)	1	18.800	0.000	5.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	PAVE 1	1.000	SW1	0.0	0.000	0.000	0.0000	
15 minute summer	SW1	1.001	PAVE 2	0.0	0.000	0.000	0.0070	
15 minute summer	PAVE 2	1.002	PAVE 3	3.5	1.156	0.255	0.0294	
15 minute summer	PAVE 3	1.003	SW2	5.9	1.473	0.435	0.0194	
15 minute summer	SW2	1.004	SW4	5.9	1.375	0.531	0.0391	
15 minute summer	PAVE 4	2.000	SW3	3.0	0.762	0.441	0.0146	
30 minute summer	SW3	2.001	SW4	2.8	0.648	0.413	0.0398	
30 minute summer	SW4	1.005	PAVE 5	8.0	1.630	0.587	0.0409	
30 minute summer	PAVE 5	1.006	SW5-FC	9.5	1.751	0.700	0.0583	
30 minute summer	SW5-FC	Orifice	SW6	8.3				
15 minute summer	SW6	1.008	SW7	11.4	0.976	0.196	0.0798	
15 minute summer	SW7	1.009	SW8	13.8	1.053	0.236	0.1907	
15 minute summer	SW8	1.010	SW9	16.1	0.960	0.309	0.4528	
15 minute summer	SW9	1.011	SW10	18.8	0.826	0.361	0.1579	
15 minute summer	SW10	1.012	SW14	19.8	0.764	0.382	0.0591	
15 minute summer	SW11	3.000	SW12	2.7	0.747	0.279	0.0532	
15 minute summer	SW12	3.001	SW13	5.8	1.112	0.608	0.0649	
15 minute summer	SW13	3.002	SW14	5.8	1.019	0.774	0.0521	
15 minute summer	SW14	1.013	TANK	26.9	1.055	0.674	0.1546	
180 minute summer	TANK	1.014	SW15-FC	19.4	0.632	0.333	0.2697	
180 minute summer	SW15-FC	Hydro-Brake®	HEADWALL (OUTFALL)	6.0				49.9

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Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.55%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	PAVE 1	1	24.300	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SW1	1	24.218	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PAVE 2	11	23.980	0.055	7.9	0.0234	0.0000	OK
30 minute summer	PAVE 3	20	23.756	0.319	12.9	0.2001	0.0000	SURCHARGED
30 minute summer	SW2	21	23.602	0.406	11.3	0.0735	0.0000	FLOOD RISK
60 minute summer	PAVE 4	41	23.374	0.524	7.9	3.8942	0.0000	FLOOD RISK
60 minute summer	SW3	41	23.371	0.562	4.7	0.1018	0.0000	SURCHARGED
60 minute summer	SW4	40	23.367	0.623	9.2	0.1762	0.0000	SURCHARGED
30 minute summer	PAVE 5	23	23.314	0.831	10.9	1.6780	0.0000	SURCHARGED
30 minute summer	SW5-FC	21	23.251	2.251	14.0	2.2443	0.0000	SURCHARGED
15 minute summer	SW6	10	20.372	0.097	17.6	0.0614	0.0000	OK
15 minute summer	SW7	10	20.295	0.105	23.1	0.0359	0.0000	OK
15 minute summer	SW8	10	20.125	0.117	28.5	0.0519	0.0000	OK
180 minute summer	SW9	136	19.976	0.238	19.5	0.0996	0.0000	SURCHARGED
180 minute summer	SW10	136	19.975	0.307	20.6	0.0842	0.0000	SURCHARGED
15 minute summer	SW11	12	20.776	0.186	6.2	0.0772	0.0000	SURCHARGED
15 minute summer	SW12	12	20.662	0.442	12.7	0.1933	0.0000	SURCHARGED
15 minute summer	SW13	12	20.206	0.295	10.6	0.0533	0.0000	SURCHARGED
180 minute summer	SW14	140	19.975	0.330	27.4	0.3217	0.0000	SURCHARGED
180 minute summer	TANK	140	19.974	0.974	27.4	46.2760	0.0000	SURCHARGED
180 minute summer	SW15-FC	140	19.973	1.058	15.4	1.8700	0.0000	SURCHARGED
15 minute summer	HEADWALL (OUTFALL)	1	18.800	0.000	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	PAVE 1	1.000	SW1	0.0	0.000	0.000	0.0000	
15 minute summer	SW1	1.001	PAVE 2	0.0	0.000	0.000	0.0130	
15 minute summer	PAVE 2	1.002	PAVE 3	7.9	1.314	0.576	0.0597	
30 minute summer	PAVE 3	1.003	SW2	11.3	1.613	0.828	0.0377	
30 minute summer	SW2	1.004	SW4	9.7	1.469	0.883	0.0717	
60 minute summer	PAVE 4	2.000	SW3	4.7	0.783	0.689	0.0258	
60 minute summer	SW3	2.001	SW4	5.2	0.663	0.768	0.0406	
60 minute summer	SW4	1.005	PAVE 5	8.1	1.516	0.597	0.0409	
30 minute summer	PAVE 5	1.006	SW5-FC	9.1	1.730	0.669	0.0583	
30 minute summer	SW5-FC	Orifice	SW6	9.4				
15 minute summer	SW6	1.008	SW7	17.5	1.018	0.301	0.1171	
15 minute summer	SW7	1.009	SW8	22.9	1.174	0.395	0.2854	
15 minute summer	SW8	1.010	SW9	28.3	1.012	0.545	0.8162	
180 minute summer	SW9	1.011	SW10	19.5	0.837	0.376	0.2768	
180 minute summer	SW10	1.012	SW14	20.6	0.774	0.397	0.0898	
15 minute summer	SW11	3.000	SW12	5.7	0.827	0.597	0.1158	
15 minute summer	SW12	3.001	SW13	10.6	1.354	1.103	0.0967	
15 minute summer	SW13	3.002	SW14	10.5	1.345	1.398	0.0714	
180 minute summer	SW14	1.013	TANK	27.4	1.060	0.686	0.2409	
180 minute summer	TANK	1.014	SW15-FC	15.4	0.610	0.265	0.2697	
180 minute summer	SW15-FC	Hydro-Brake®	HEADWALL (OUTFALL)	6.0				95.4

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Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.55%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	PAVE 1	1	24.300	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SW1	1	24.218	0.000	0.0	0.0000	0.0000	OK
30 minute summer	PAVE 2	20	24.029	0.104	9.4	0.0442	0.0000	SURCHARGED
30 minute summer	PAVE 3	21	23.894	0.457	15.8	0.8519	0.0000	FLOOD RISK
30 minute summer	SW2	22	23.741	0.545	11.7	0.0987	0.0000	FLOOD RISK
60 minute summer	PAVE 4	43	23.550	0.700	9.9	5.9911	0.0000	FLOOD RISK
60 minute summer	SW3	43	23.547	0.738	5.8	0.1336	0.0000	FLOOD RISK
60 minute summer	SW4	42	23.543	0.799	9.8	0.2263	0.0000	FLOOD RISK
60 minute summer	PAVE 5	42	23.481	0.998	9.7	2.9417	0.0000	FLOOD RISK
60 minute summer	SW5-FC	38	23.398	2.398	11.4	2.3905	0.0000	SURCHARGED
120 minute winter	SW6	116	20.401	0.126	12.7	0.0799	0.0000	OK
120 minute winter	SW7	116	20.401	0.211	15.2	0.0720	0.0000	OK
120 minute winter	SW8	116	20.400	0.392	17.7	0.1731	0.0000	SURCHARGED
120 minute winter	SW9	116	20.398	0.660	20.7	0.2758	0.0000	SURCHARGED
120 minute winter	SW10	116	20.397	0.729	21.9	0.1997	0.0000	SURCHARGED
30 minute summer	SW11	20	21.071	0.481	7.4	0.2001	0.0000	FLOOD RISK
30 minute summer	SW12	20	20.925	0.705	13.7	0.3083	0.0000	FLOOD RISK
120 minute winter	SW13	116	20.399	0.488	5.9	0.0883	0.0000	SURCHARGED
120 minute winter	SW14	116	20.396	0.751	29.3	0.7324	0.0000	SURCHARGED
120 minute winter	TANK	116	20.395	1.395	29.3	57.0238	0.0000	SURCHARGED
120 minute winter	SW15-FC	116	20.394	1.479	19.7	2.6129	0.0000	SURCHARGED
15 minute summer	HEADWALL (OUTFALL)	1	18.800	0.000	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	PAVE 1	1.000	SW1	0.0	0.000	0.000	0.0000	
15 minute summer	SW1	1.001	PAVE 2	0.0	0.000	0.000	0.0197	
30 minute summer	PAVE 2	1.002	PAVE 3	9.1	1.316	0.668	0.0764	
30 minute summer	PAVE 3	1.003	SW2	11.7	1.648	0.860	0.0377	
30 minute summer	SW2	1.004	SW4	10.3	1.444	0.933	0.0717	
60 minute summer	PAVE 4	2.000	SW3	5.8	0.821	0.852	0.0258	
60 minute summer	SW3	2.001	SW4	6.3	0.810	0.938	0.0406	
60 minute summer	SW4	1.005	PAVE 5	8.0	1.575	0.587	0.0409	
60 minute summer	PAVE 5	1.006	SW5-FC	8.5	1.686	0.621	0.0583	
60 minute summer	SW5-FC	Orifice	SW6	9.7				
120 minute winter	SW6	1.008	SW7	12.7	1.015	0.219	0.2090	
120 minute winter	SW7	1.009	SW8	15.2	1.082	0.262	0.5726	
120 minute winter	SW8	1.010	SW9	17.7	0.976	0.341	1.0744	
120 minute winter	SW9	1.011	SW10	20.7	0.840	0.399	0.2768	
120 minute winter	SW10	1.012	SW14	21.9	0.779	0.422	0.0898	
30 minute summer	SW11	3.000	SW12	5.8	0.800	0.608	0.1158	
30 minute summer	SW12	3.001	SW13	12.0	1.534	1.250	0.0967	
120 minute winter	SW13	3.002	SW14	5.9	1.021	0.784	0.0714	
120 minute winter	SW14	1.013	TANK	29.3	1.074	0.733	0.2409	
120 minute winter	TANK	1.014	SW15-FC	19.7	0.695	0.338	0.2697	
120 minute winter	SW15-FC	Hydro-Brake®	HEADWALL (OUTFALL)	6.2				101.2

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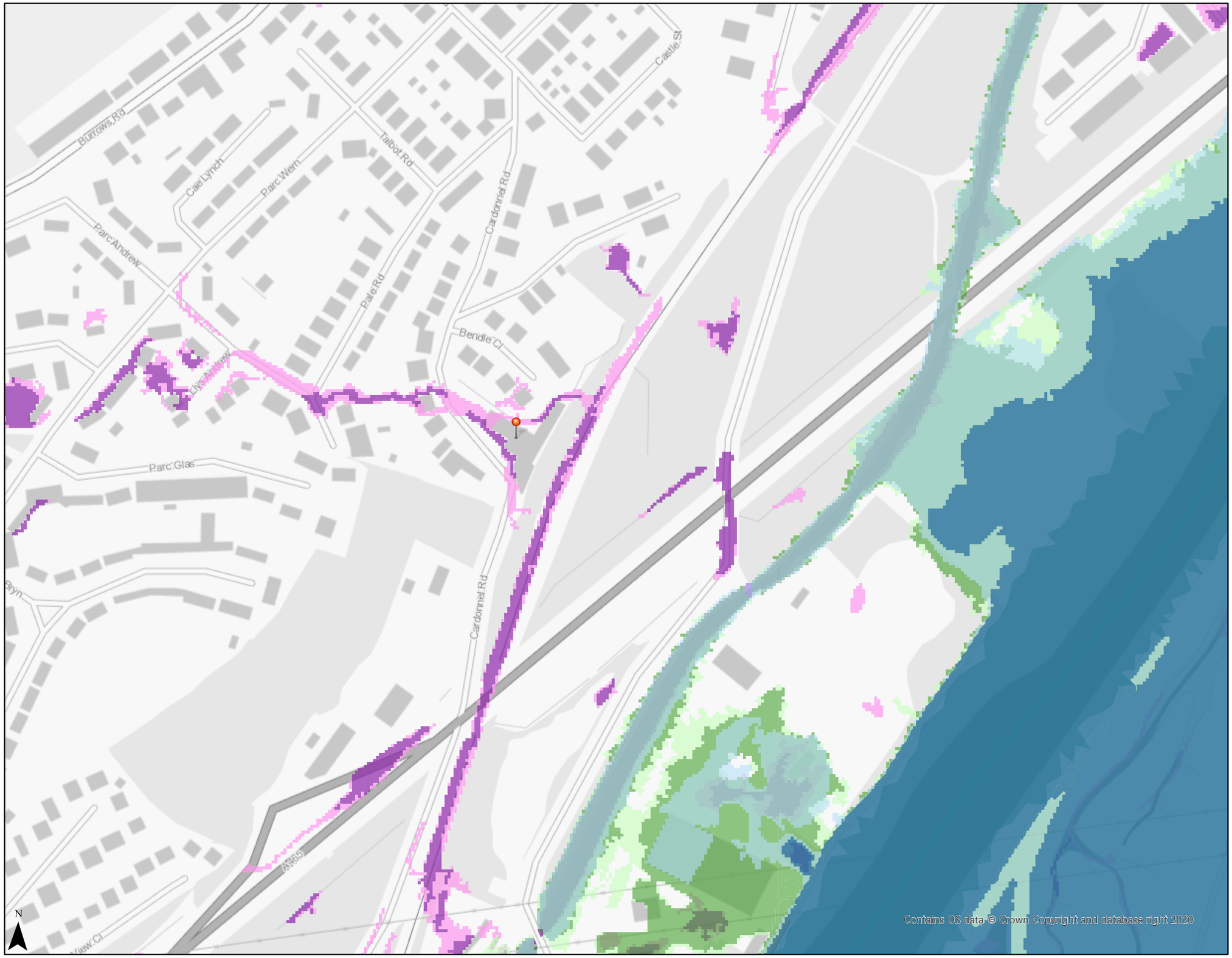
Results for 200 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.55%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	PAVE 1	1	24.300	0.000	0.0	0.0000	0.0000	OK
15 minute summer	SW1	1	24.218	0.000	0.0	0.0000	0.0000	OK
30 minute summer	PAVE 2	19	24.141	0.216	10.5	0.0919	0.0000	SURCHARGED
30 minute summer	PAVE 3	21	23.955	0.518	17.3	1.3239	0.0000	FLOOD RISK
30 minute summer	SW2	23	23.809	0.613	11.8	0.1110	0.0000	FLOOD RISK
60 minute summer	PAVE 4	39	23.550	0.700	11.0	5.9937	2.2239	FLOOD
60 minute summer	SW3	40	23.567	0.758	5.8	0.1371	0.0000	FLOOD RISK
60 minute summer	SW4	40	23.594	0.850	9.6	0.2406	0.0000	FLOOD RISK
60 minute summer	PAVE 5	40	23.561	1.078	9.7	3.5469	0.0000	FLOOD RISK
60 minute summer	SW5-FC	38	23.491	2.491	11.2	2.4839	0.0000	SURCHARGED
180 minute winter	SW6	136	20.844	0.569	12.1	0.3616	0.0000	FLOOD RISK
180 minute winter	SW7	136	20.839	0.649	14.2	0.2221	0.0000	FLOOD RISK
180 minute winter	SW8	136	20.830	0.822	16.2	0.3635	0.0000	FLOOD RISK
180 minute winter	SW9	136	20.814	1.076	18.7	0.4500	0.0000	FLOOD RISK
180 minute winter	SW10	136	20.809	1.141	19.7	0.3125	0.0000	FLOOD RISK
30 minute summer	SW11	20	21.206	0.616	8.2	0.2564	0.0000	FLOOD RISK
30 minute summer	SW12	19	21.000	0.780	15.2	0.3409	0.2511	FLOOD
180 minute winter	SW13	136	20.812	0.901	5.0	0.1630	0.0000	FLOOD RISK
180 minute winter	SW14	136	20.805	1.160	25.9	1.1315	0.0000	FLOOD RISK
120 minute winter	TANK	106	20.800	1.800	31.5	57.0238	3.7808	FLOOD
120 minute winter	SW15-FC	106	20.799	1.884	19.8	3.3293	0.0000	FLOOD RISK
15 minute summer	HEADWALL (OUTFALL)	1	18.800	0.000	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	PAVE 1	1.000	SW1	0.0	0.000	0.000	0.0000	
15 minute summer	SW1	1.001	PAVE 2	0.0	0.000	0.000	0.0230	
30 minute summer	PAVE 2	1.002	PAVE 3	9.8	1.314	0.717	0.0764	
30 minute summer	PAVE 3	1.003	SW2	11.8	1.615	0.865	0.0377	
30 minute summer	SW2	1.004	SW4	10.1	1.471	0.916	0.0717	
60 minute summer	PAVE 4	2.000	SW3	5.8	0.799	0.856	0.0258	
60 minute summer	SW3	2.001	SW4	6.4	0.814	0.942	0.0406	
60 minute summer	SW4	1.005	PAVE 5	7.8	1.552	0.572	0.0409	
60 minute summer	PAVE 5	1.006	SW5-FC	8.5	1.670	0.627	0.0583	
60 minute summer	SW5-FC	Orifice	SW6	9.9				
180 minute winter	SW6	1.008	SW7	12.1	1.026	0.207	0.2704	
180 minute winter	SW7	1.009	SW8	14.1	1.074	0.243	0.5807	
180 minute winter	SW8	1.010	SW9	16.2	0.970	0.313	1.0744	
180 minute winter	SW9	1.011	SW10	18.7	0.837	0.361	0.2768	
180 minute winter	SW10	1.012	SW14	19.7	0.774	0.380	0.0898	
30 minute summer	SW11	3.000	SW12	6.6	0.841	0.686	0.1158	
30 minute summer	SW12	3.001	SW13	12.4	1.585	1.291	0.0967	
180 minute winter	SW13	3.002	SW14	5.0	0.990	0.664	0.0714	
180 minute winter	SW14	1.013	TANK	25.9	1.047	0.649	0.2409	
120 minute winter	TANK	1.014	SW15-FC	19.8	0.686	0.341	0.2697	
120 minute winter	SW15-FC	Hydro-Brake®	HEADWALL (OUTFALL)	6.9				108.5

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APPENDIX D: NRW Flood Maps



Cyfoeth Naturiol Cymru
Natural Resources Wales

Flood Map for Planning - Detail

Enter title (max 35 characters)

Legend

TAN15 Defended Zones

- Rivers
- Sea
- Rivers and Sea

Rivers

- Flood Zone 3
- Flood Zone 2

Sea

- Flood Zone 3
- Flood Zone 2

Surface Water and Small Watercourses

- Flood Zone 3
- Flood Zone 2
- Recorded Flood Extents
- Shoreline Management Plan policies

Coastal Erosion Risk with No Active Intervention scenario

- Short-term (2005-2025)
- Medium-term (2005-2055)
- Long-term (2005-2105)
- Flood Risk from Reservoirs
- Main Rivers

Scale at A3: 1:2,500

Date: 16/10/2025

0.1 0.05 0 0.1

km

British National Grid

Disclaimer

https://naturalresources.wales/flooding/disclaimer-for-our-flood-and-coastal-erosion-risk-maps/?lang=en

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APPENDIX E: Manufacture information – Flow control and SuDSPod

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.400	6.000
Flush-Flo™	0.411	5.989
Kick-Flo®	0.857	4.776
Mean Flow		5.246

This Hydro-Brake® Optimum includes:

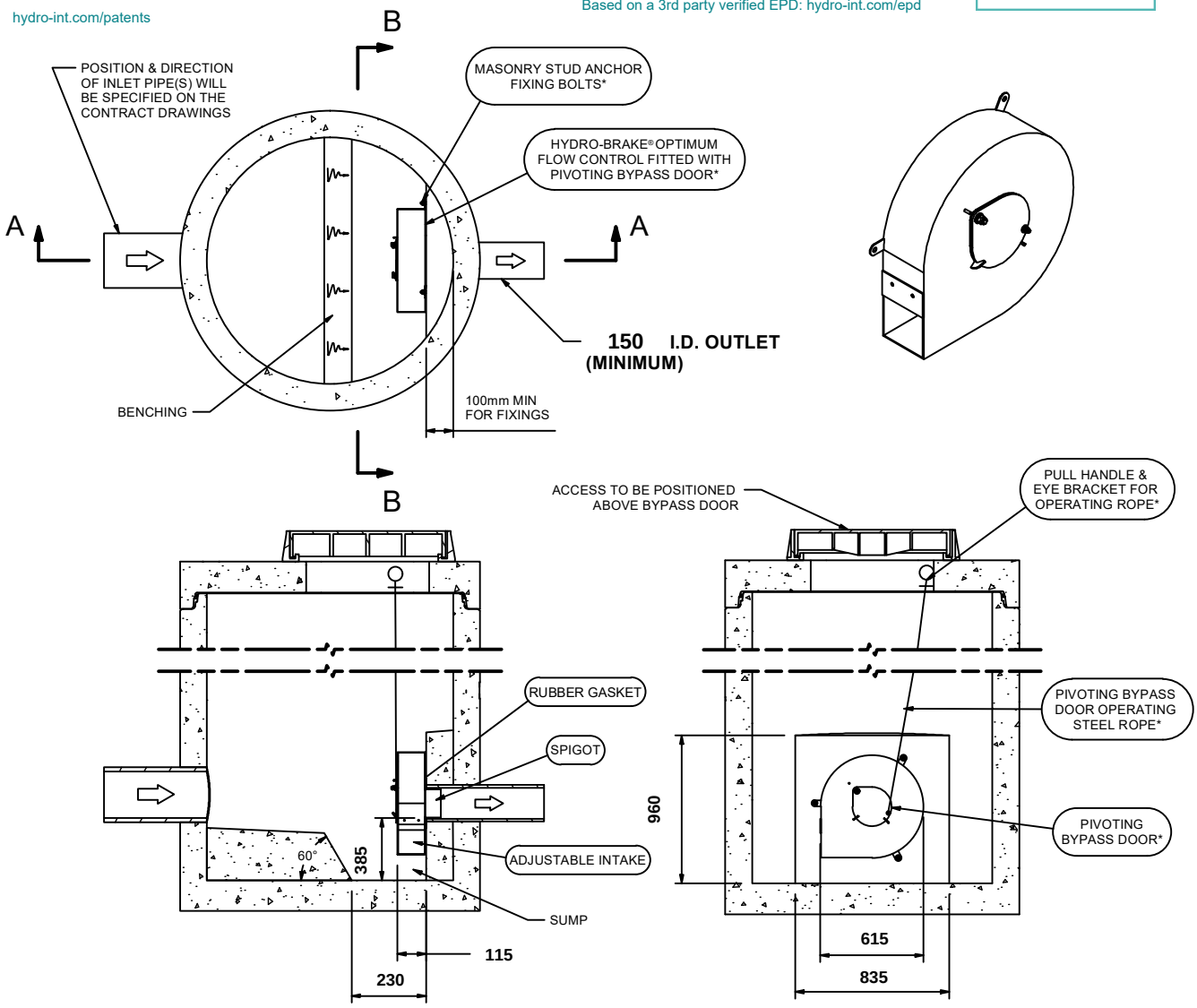
- •All in 3 mm Grade 304L stainless steel
- • Integral pivoting by-pass door allowing clear line of sight through to outlet, c/w operating rope
- • Media blasted for corrosion resistance
- • Variable flow rate post installation via adjustable inlet (if necessary)
- • Indicative Weight: 20 kg
- • Product Carbon Footprint: 87.94 kgCO2e

Based on a 3rd party verified EPD: hydro-int.com/epd

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

wrc approved PT/503/0422 Valid: 01/04/2022 - 31/03/2027

hydro-int.com/patents



SECTION A-A

SECTION B-B

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

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

DESIGN ADVICE

The head/flow characteristics of this SHE-0109-6000-1400-6000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	08/12/2025 11:14
SITE	Cardonnel Court
DESIGNER	Joel Wall
REF	25074

SHE-0109-6000-1400-6000
Hydro-Brake® Optimum

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joel@lutraconsultancy.co.uk

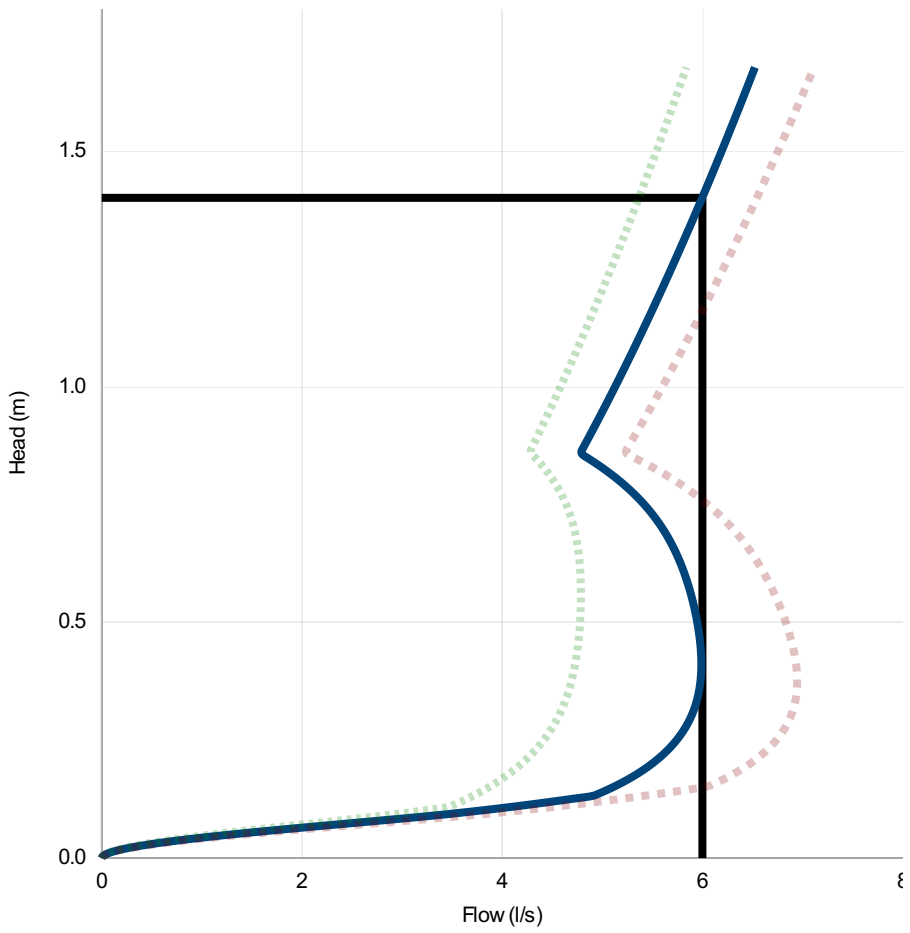
Technical Specification

	Original Setting		Minimum Setting		Maximum Setting	
Control Point	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**
Primary Design	1.400	6.000	1.400	5.365	1.400	6.544
Flush-Flo™	0.411	5.989	0.560	4.787	0.375	6.947
Kick-Flo®	0.857	4.776	0.860	4.272	0.858	5.220
Mean Flow		5.246		4.424		5.890

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

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PT/503/0422
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Head (m)	Flow (l/s)
0.000	0.000
0.048	1.209
0.097	3.601
0.145	5.051
0.193	5.452
0.241	5.707
0.290	5.863
0.338	5.949
0.386	5.985
0.434	5.986
0.483	5.962
0.531	5.919
0.579	5.858
0.628	5.777
0.676	5.667
0.724	5.518
0.772	5.316
0.821	5.046
0.869	4.806
0.917	4.928
0.966	5.047
1.014	5.162
1.062	5.274
1.110	5.384
1.159	5.492
1.207	5.597
1.255	5.700
1.303	5.801
1.352	5.900
1.400	5.997

DESIGN ADVICE

The head/flow characteristics of this SHE-0109-6000-1400-6000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

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

Hydro International
A CRH COMPANY

DATE	08/12/2025 11:14
Site	Cardonnel Court
DESIGNER	Joel Wall
Ref	25074

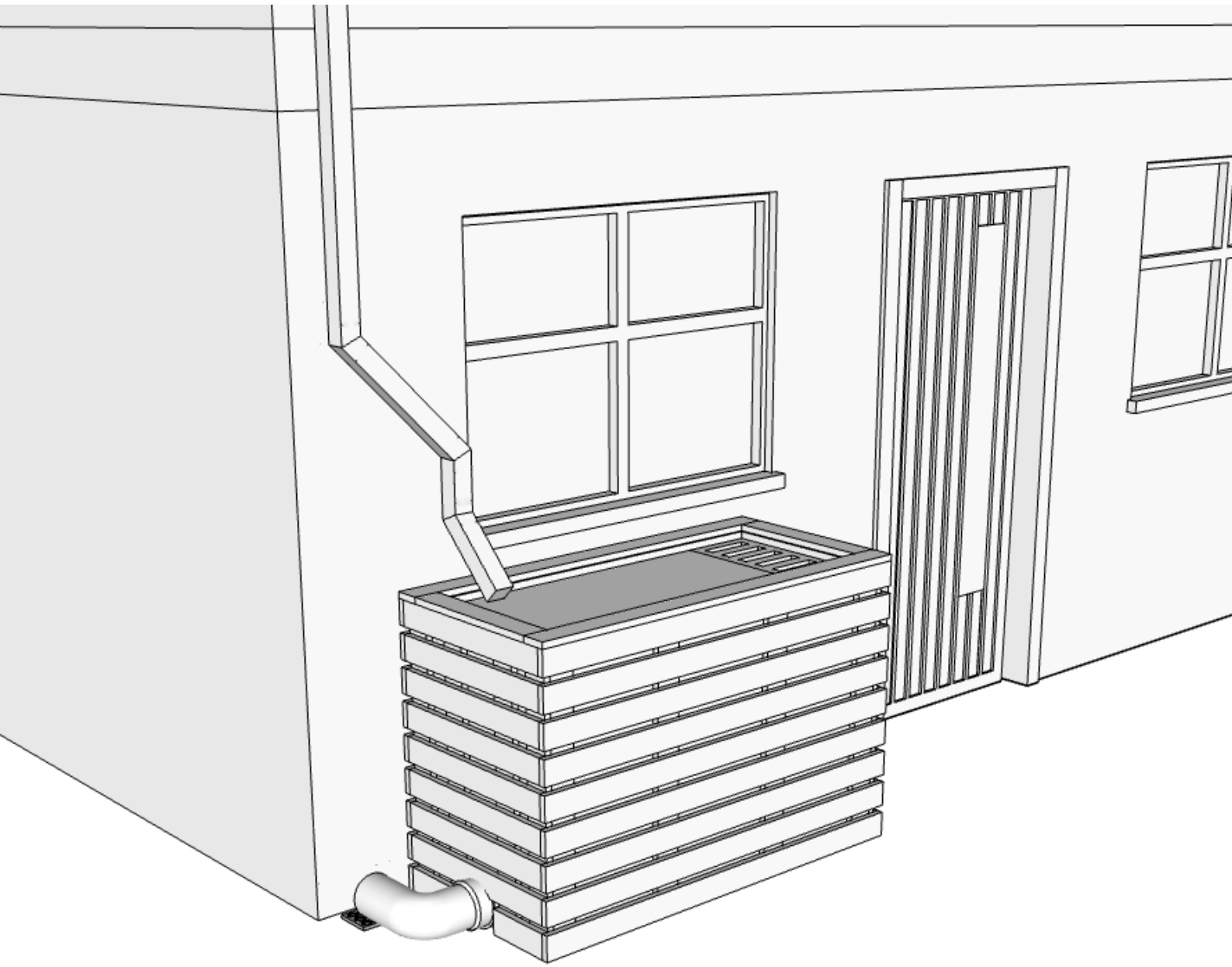
SHE-0109-6000-1400-6000

Hydro-Brake® Optimum

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SuDSPod

Quick start guide



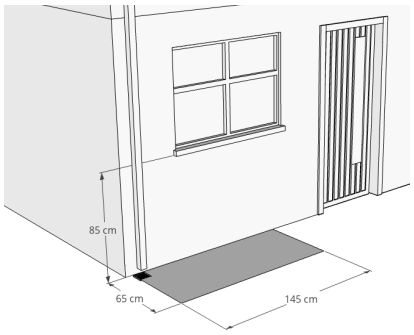
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Creating healthier urban spaces in harmony with nature

SuDSPod
Quick start guide

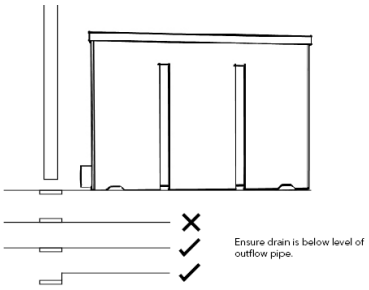
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CHECK LOCATION
CHECK DOWNPIPE & OUTLET TYPES
PLAN PARTS REQUIRED



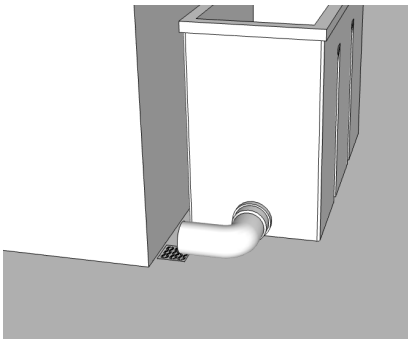
2 - BASE

PREPARE BASE
POSITION SuDSPod



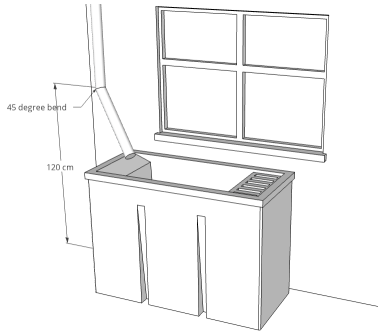
3 - OUTLET

OUTLET CONNECTION



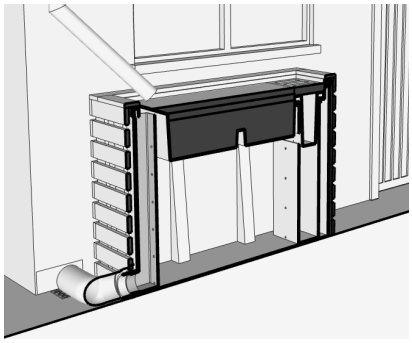
4 - INLET

INLET CONNECTION



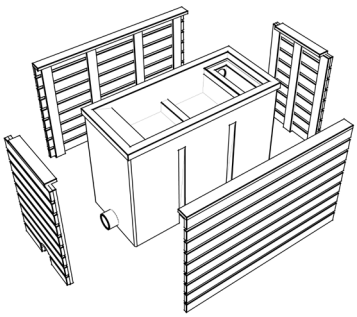
5 - PLANTS

FILTER BLOCK, SOIL,
PLANTING



6 - CLADDING

CLADDING



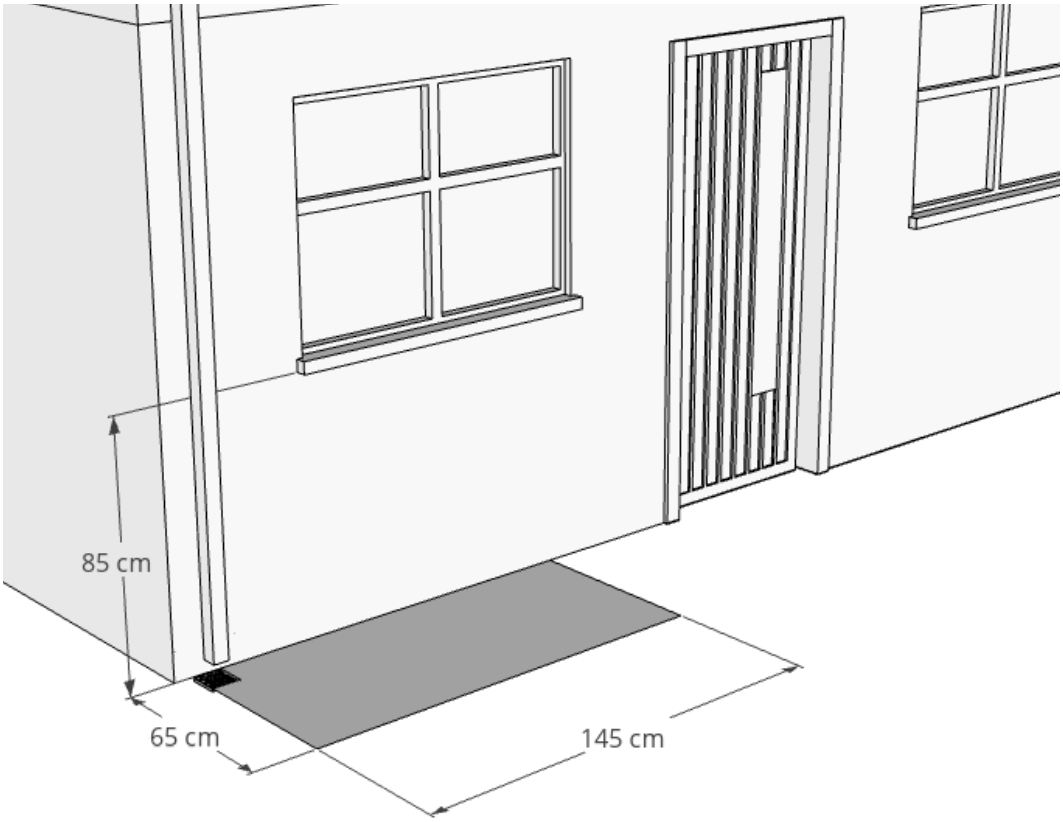
Scan QR code to discover more on SuDSPod

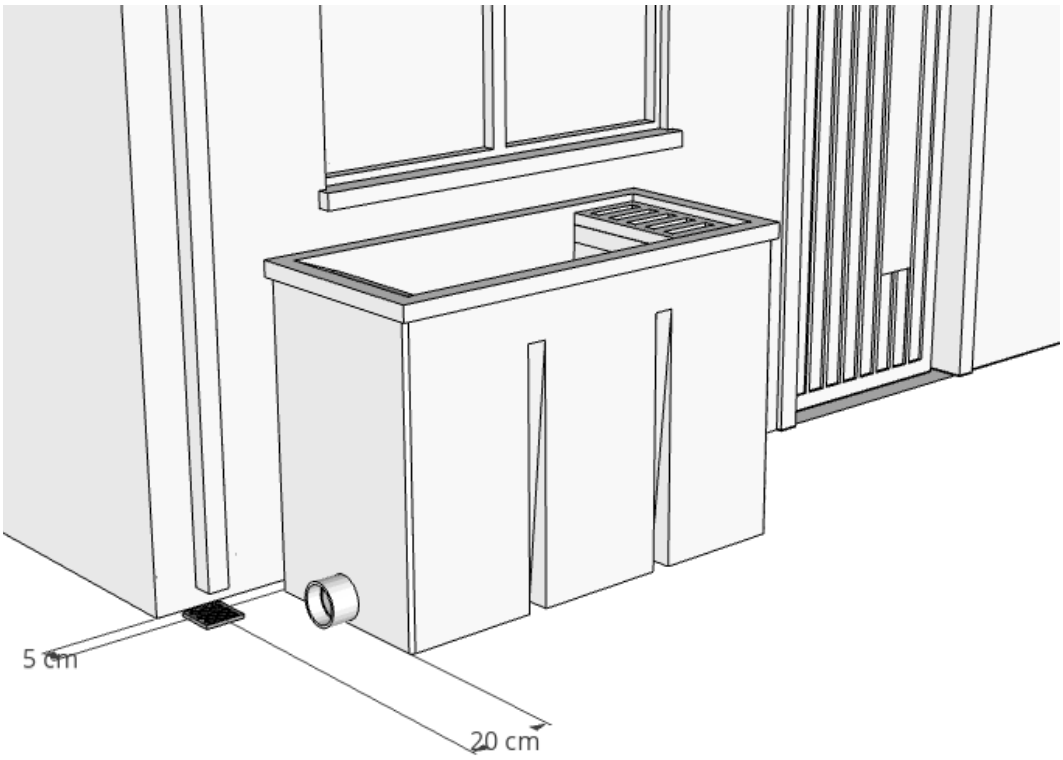
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1 Location and base





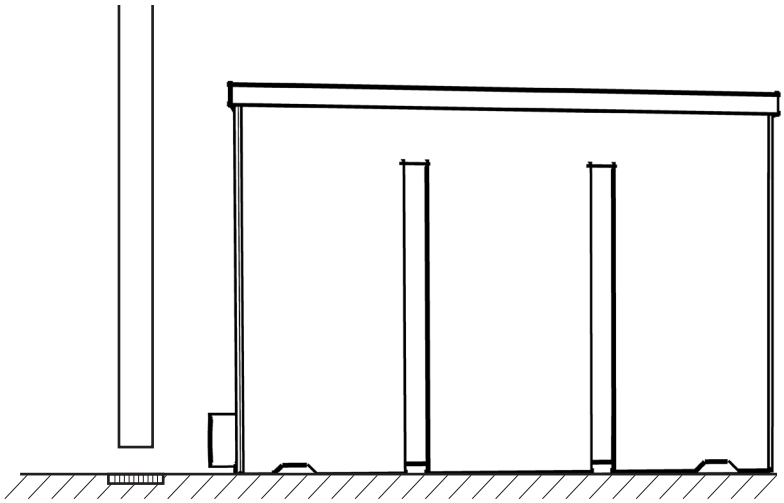
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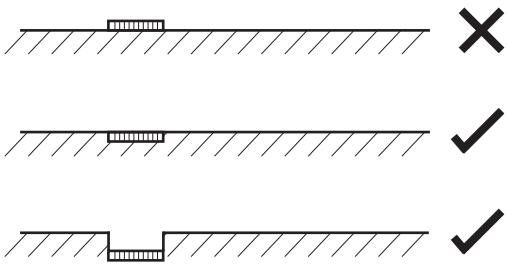
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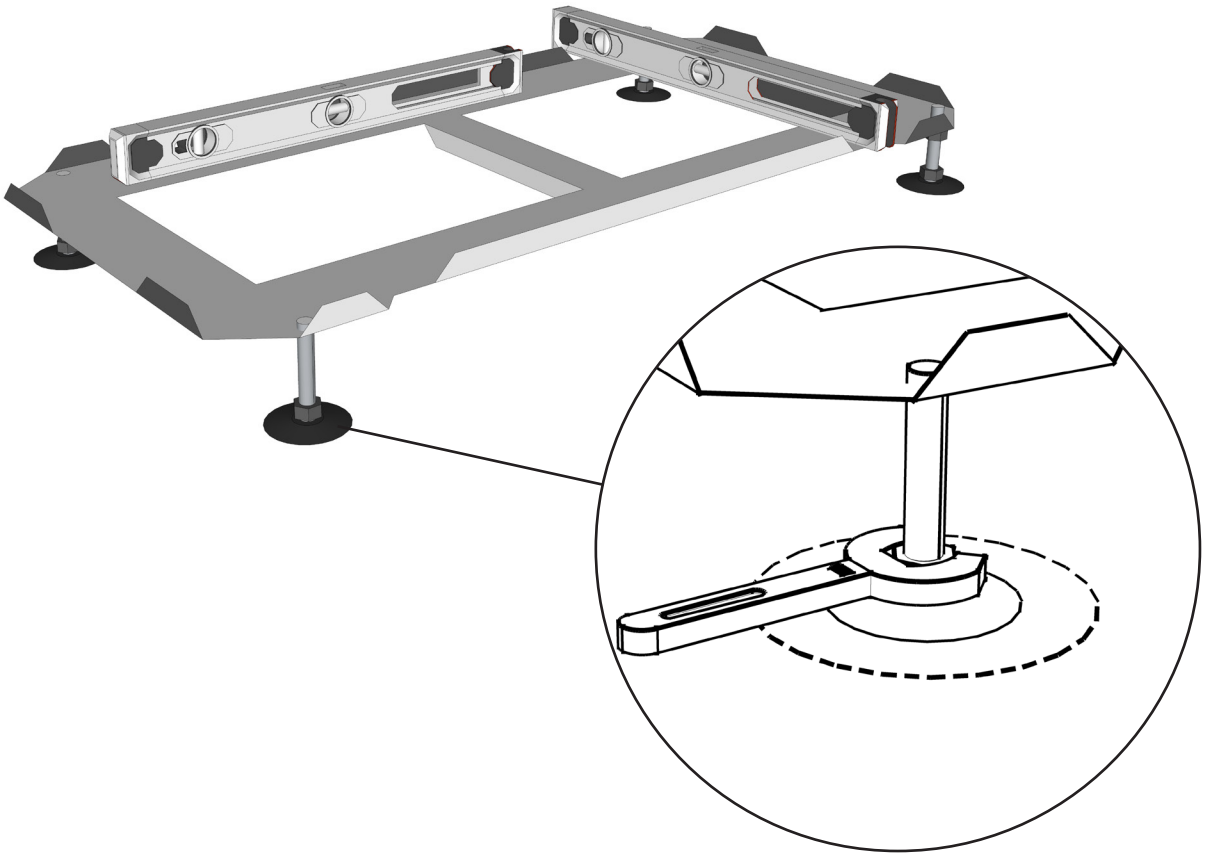
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Optional levelling frame





Ensure drain is below level of outflow pipe.



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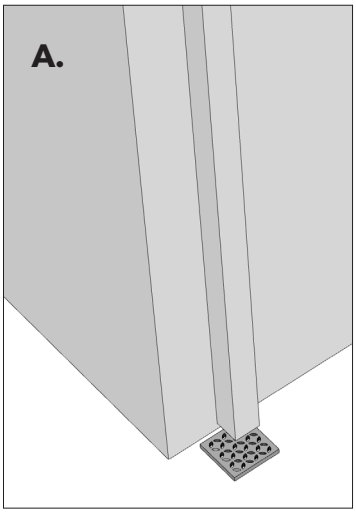
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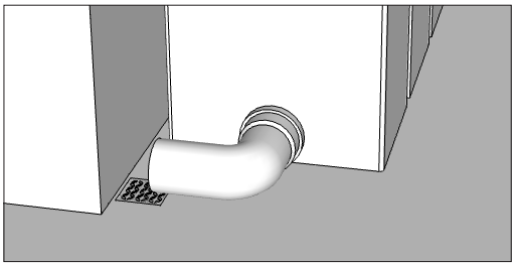
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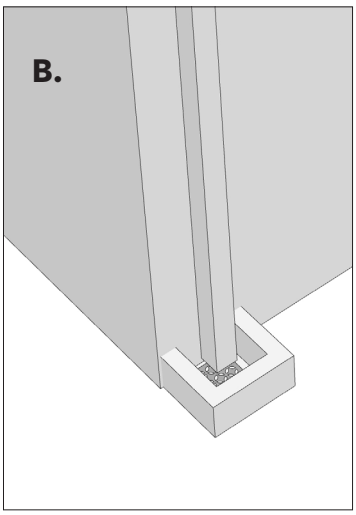
Outlet Connections

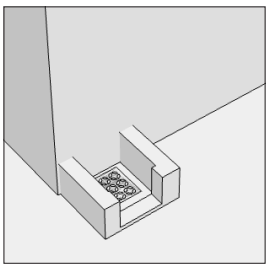
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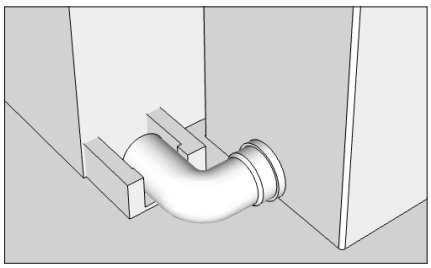




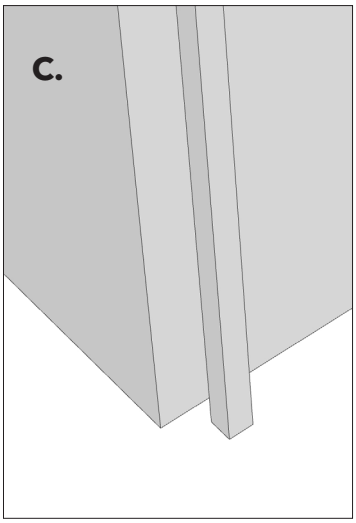
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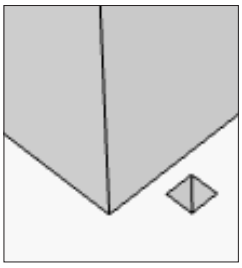


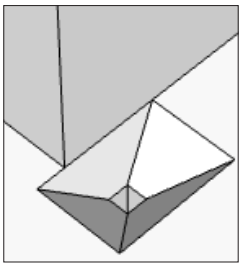


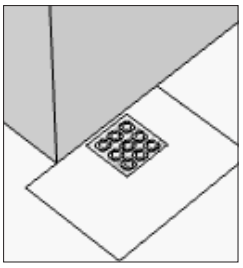


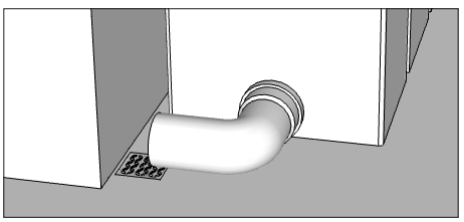
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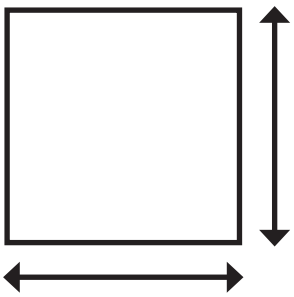
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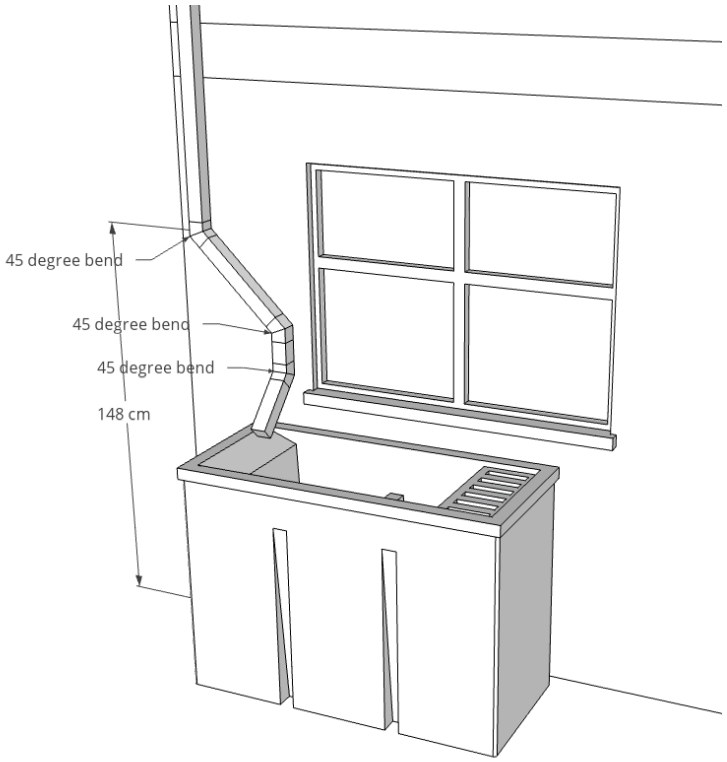
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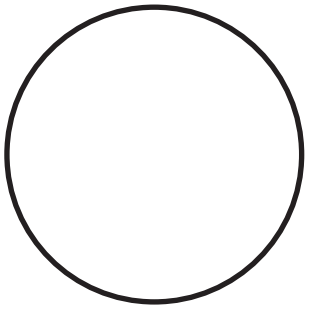
Inlet Connections

Check downpipe shape and size - procure correct pipe fittings

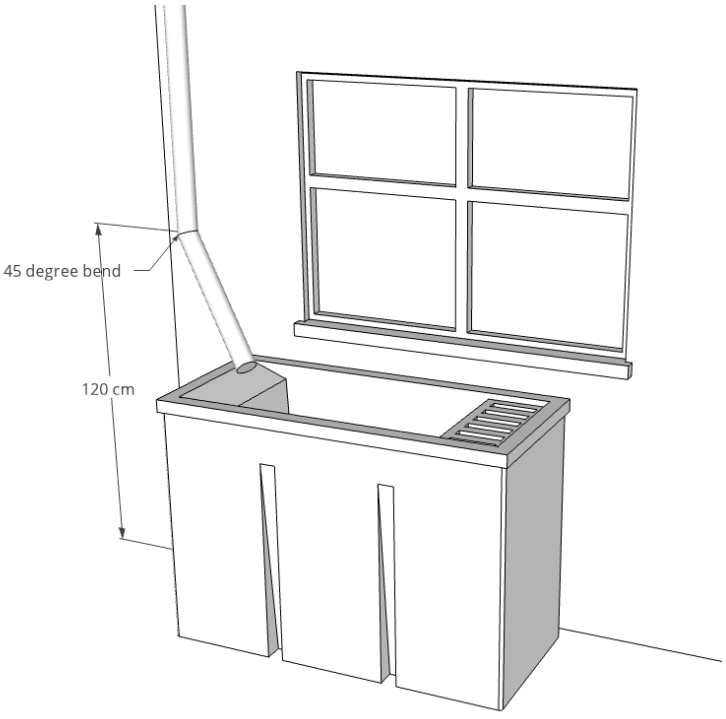


Measure size





Measure diameter

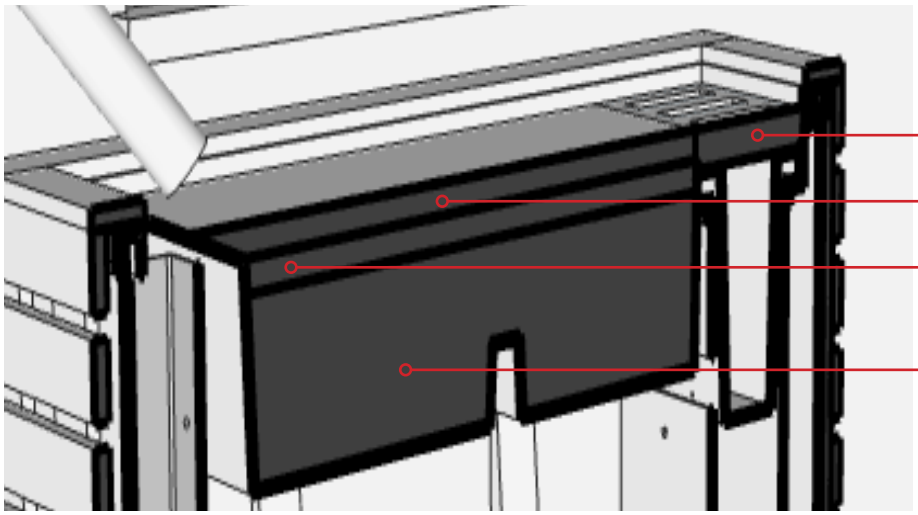


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5 **Filter block, soil, planting**





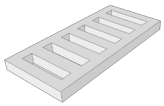
SuDSPod Soil x 3



Slate mulch x 1



Gravel x 1



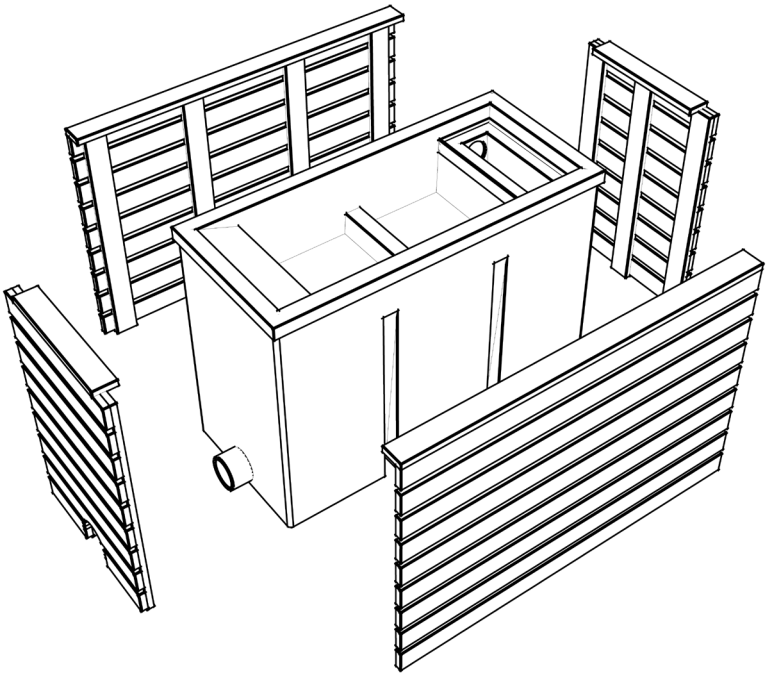
ArboResin Filter Block x 1

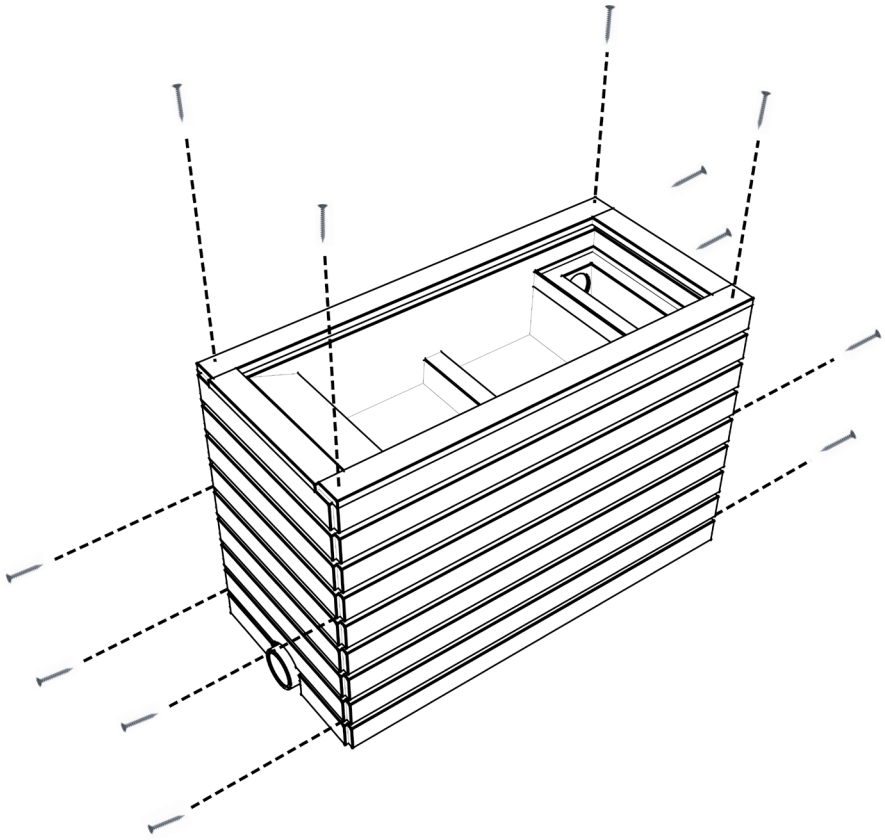
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6 Cladding





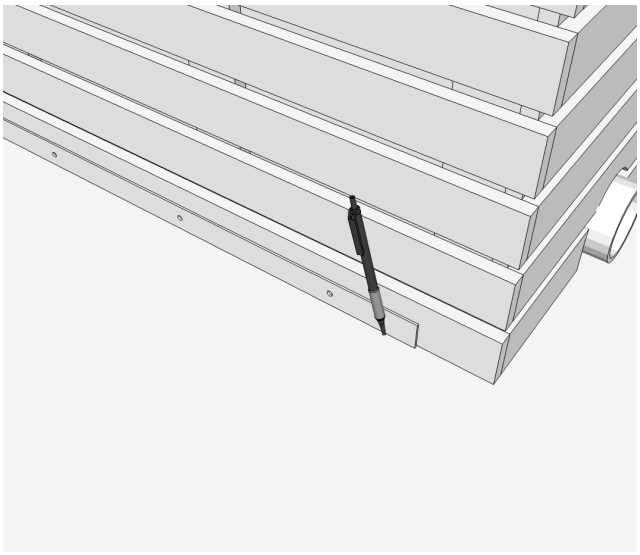
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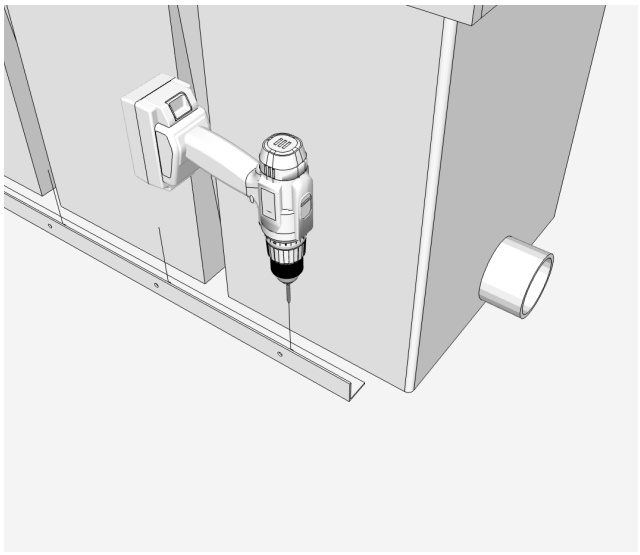
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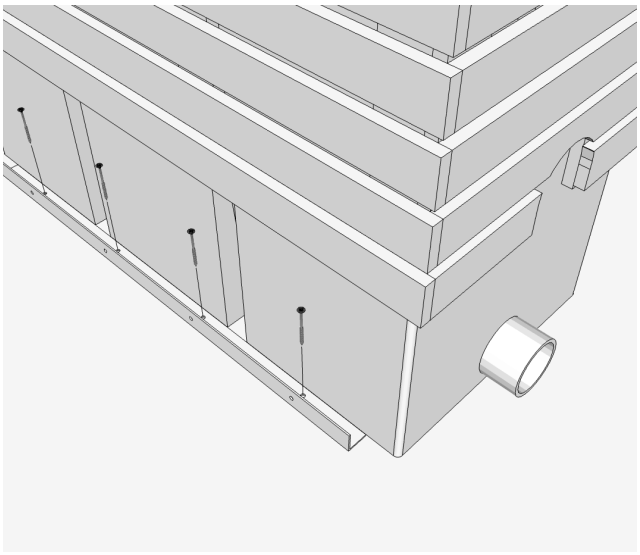
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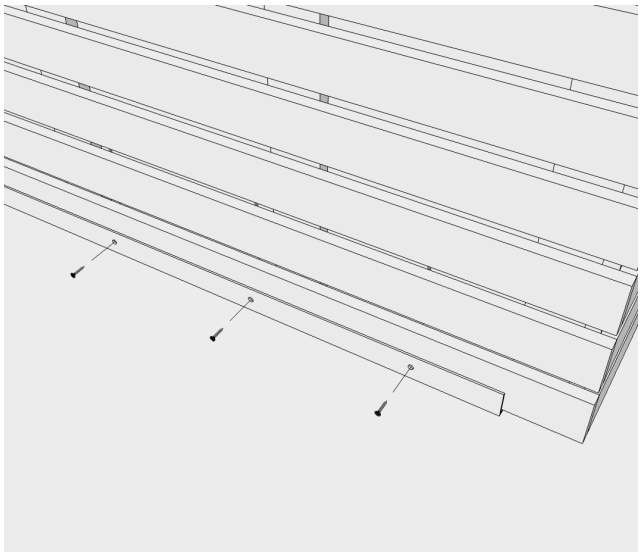
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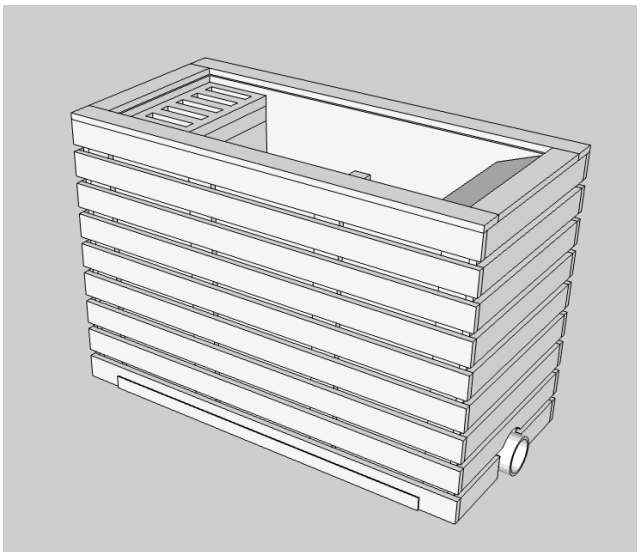
Optional if required: ground anchor











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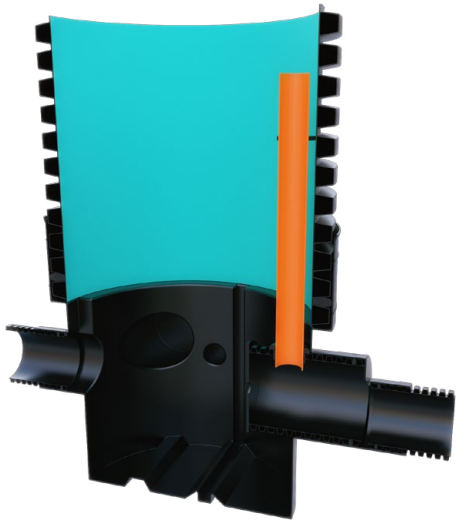
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Flow Control Systems
Orifice Flow Control Chamber

1050





Product Type: **Orifice Flow Control**
Model: **OFCP1050225150B**

1050mm diameter, pre-assembled flow control chamber, delivered ready to install. This model uses 150mm or 225mm main channel socket connections including two further 110mm or 225mm side inlets at 90° and 270° off centre from the outlet at 0°. Side inlets are supplied as blanked ends that can be used as required.

Application

- Above ground access for inspection and maintenance of surface water pipe systems.
- Suitable for Adoptable and Non-Adoptable applications.
- Maximum installation depth to soffit of pipe - Adoptable 3000mm and Non-Adoptable 3000mm.
- Designed for large housing or commercial developments.

Built to the following standards

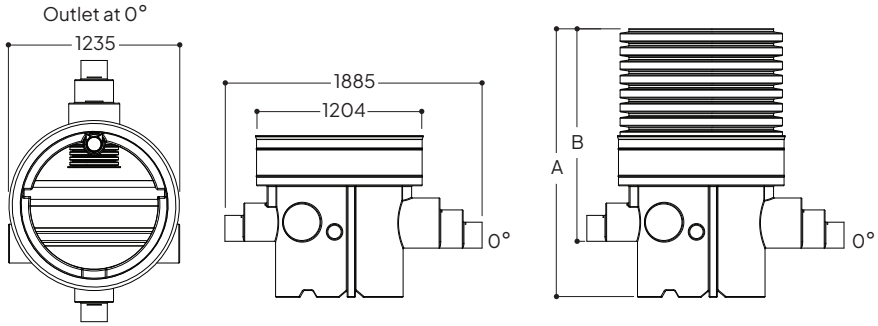
- Design & Construction Guidance (DCG) - Section C7.12
- CIRIA75310.2 - 20.5 Compliance
- BS 8582 - 9.6

Features

- Single piece, pre-assembled chambers.
- Durable rotational moulded LLDPE base - chemical and impact resistant.
- 350mm sump depth.
- Compatible with all UK Twinwall pipe systems.
- Profiled base which improves overall strength.
- Four standard depths available.
- Access shafts are easily cut onsite to the required depth.
- Chambers can be installed in granular backfill.

Quality Assurance

Before leaving our factory, chambers are tested in accordance to required standards.



Model ref.	Main Pipework Connections Ø (mm)	Optional Side Inlets Ø (mm)	Overall Depth **A** (mm)	Inlet Invert **B** (mm)	Approx. Weight (kg)
OFCP1050225150B/1.5	150, 225	110, 225	1450	1015	70
OFCP1050225150B/2	150, 225	110, 225	1970	1535	97
OFCP1050225150B/2.4	150, 225	110, 225	2385	1950	119
OFCP1050225150B/3	150, 225	110, 225	3010	2575	152

- Chambers over 1000mm soffit depth require our reduction/restriction caps to meet DCG.
- Inlet Invert measurements accurate to main channel socket. This measurement will vary depending on pipework used.
- We provide a range of adaptors to connect to various pipework dimensions and pipework types inlcuding Marley Quantum, Polysewer and UltraRib.

Our BLOK Filter Technology Within The Oriflo Range

We have an alternative model, the **OFCC1050225150B,** of this flow control that boasts an in-built silt protection system. The alternative protected model features a filter to prevent total suspended solids (TSS) including silt migrating past the filter, protecting the orifice plate and stopping potential blockage.



What information do we need to design your ORIFLO chamber?

We have a large range of flow control chambers allowing us to help tailor your choice to what would be best for your implementation. For this we will require:

- Orifice size
- Pipework sizes and configurations
- Invert depths

If you are unsure on the orifice size, you can use our Oriflo Orifice Size Calculator on our website to calculate what orifice size you would need for your chamber.

www.turtleenviro.co.uk/oriflo-OFCP1050225150B/#oriflo-calculator

turtle
MANUFACTURED IN THE UK

ORIFLO
ORIFICE PLATE FLOW CONTROL CHAMBERS

email: sales@turtleenviro.co.uk | sales & technical support: tel. 0191 3036315 | **www.turtleenviro.co.uk**

ODSOFCP1050225150B/03/24

Tobermore



Hydropave Permeable Paving Maintenance Guidelines

v1.0

Guidelines for the maintenance of Tobermore Hydropave Permeable Paving

To ensure optimum performance of Hydropave permeable paving, Tobermore provide the following maintenance guidelines.

These guidelines are provided as a general maintenance regime but may be altered if necessary depending on the specific paved area or any factors which may impact the paving.

Hydropave permeable paving relies upon its ability to infiltrate surface water through its joints into a sub-base beneath. Hydropave Permeable Paving requires much less maintenance than is perceived by many however maintenance of the pavement should be carried out when necessary to ensure the infiltration of the paving is maintained and the paving is kept looking at its best.
During design, construction and after construction care should be taken to ensure that the paved area is protected and maintained to minimise clogging of the joints.

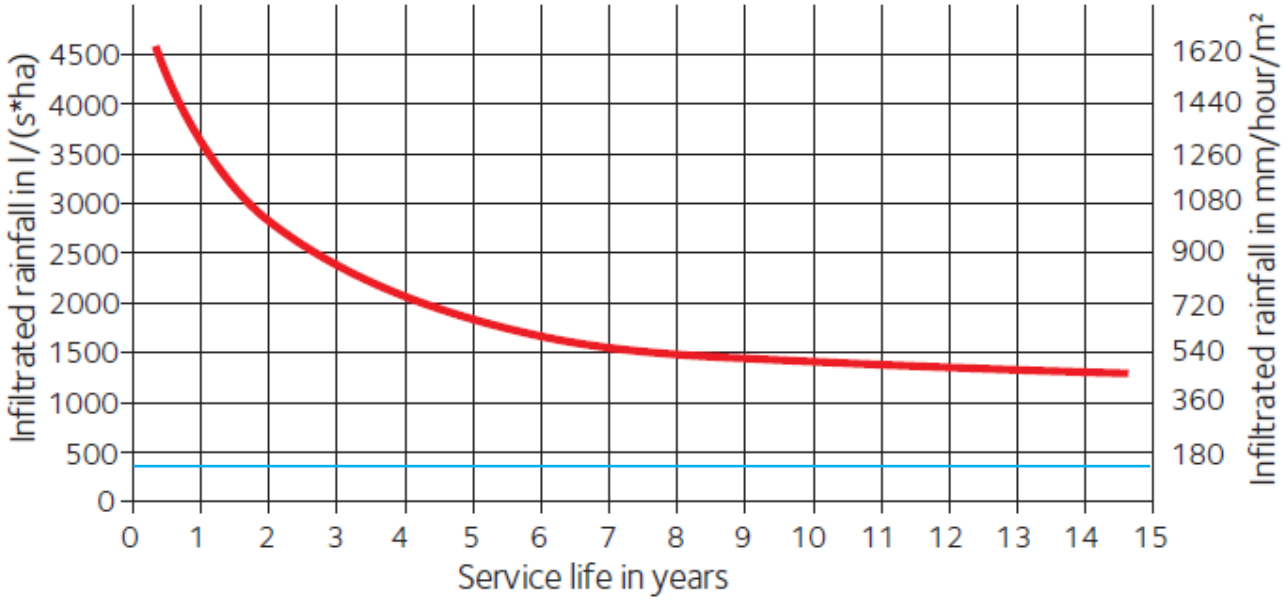
With age and use, detritus and silt collects in jointing material at the top of the joints. This forms a thin crust like layer over the joints however this does not severely impact the ability of the joints to infiltrate surface water. Research has demonstrated that whilst the infiltration rate of the joints decreases over time it stabilises and still exceeds UK & Ireland hydrological requirements.

Rainfall experienced in the UK & Ireland is typically 20mm per hour with an extreme rainfall event being 75mm per hour. Research has concluded that the infiltration capacity of a newly installed Hydropave Concrete Block pavement is over 4,000mm per hour. The bedding course and sub-base aggregates will have even higher infiltration capacity.

The UK guidelines require the infiltration rate of the surface joints to be 400mm an hour which is only 10% of the actual rate of newly installed permeable paving. Even allowing for clogging over the long term there is a large factor of safety built in. See Figure 1.

Figure 1.

©Dr. Soenke Borgwardt.
"Long-term in-situ infiltration performance of permeable concrete block pavements"



Red Line: Reduction in surface infiltration over time
Blue Line: 100mm/hour extreme storm

General Maintenance Guidelines

Routine visual inspections.
A major benefit of permeable paving over traditional drainage systems is the ability to quickly and cost effectively assess that it is working correctly. This can be done by visually inspecting the paving during heavy rainfall or following heavy rainfall.
In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required. Any infiltration issues are shown up by water ponding on the surface of the paving. If ponding is not visible then remedial action is not required. If ponding is visible see section on Remedial Action for ponding.
In the unlikely event that individual blocks are damaged these should be removed and replaced. See section on structural maintenance.
Frequency: Once a year during or following heavy rainfall.

Remedial maintenance for ponding.
If surface water ponding is visible the joints should be brushed and vacuumed.
Brushing and vacuuming should be carried out in a manner which ensures that the paving blocks are not damaged and that jointing material is not removed from the joints. Any jointing material which is removed must be replaced, refer to Figure 2 for correct grading of jointing material. The size of sweeper used will be dependent on the overall size of the paved area. A range of large mechanical sweepers are now available as well as smaller lightweight equipment. These are available from specialist companies.
The structural integrity of permeable paving will be compromised if the joints are not filled to the top with jointing aggregate.
It is good practice to complete a trial area first and then any adjustments to suction rates can be made if necessary.
The effectiveness of Hydropave Permeable Paving is not significantly compromised by moss, leaves or weeds on the surface as these are not impenetrable barriers.
Frequency: As and when required.

Maintenance for aesthetics of the joints.
To help maintain the overall appearance of the paving joints it is recommended that the surface of the paving including the joints is brushed and vacuumed at least once a year. Brushing the paving either mechanically or manually helps to agitate the jointing material and breaks up the thin layer of crust. Brushing also helps to prevent any vegetation growing in the joints.
Joints must be topped up with jointing material if any is removed during the brushing or vacuuming process, refer to Figure 2 for correct grading of jointing material.
Frequency: Recommended annually however maintenance for aesthetics of the joints can be carried out at the discretion of the developer/client.

Maintenance for aesthetics of the paving blocks.
Brushing with soapy water and a stiff brush will revive the colour of concrete block permeable paving.
For a deeper clean of the block surface a pressure washer can be used to maintain the appearance and colour of the paving blocks. A pressure washer set to a light / medium pressure should be all that is required to remove general dirt and grime. **High pressure should not be used as this can damage the surface of the blocks.**

Tips:
- Hold the lance of the pressure washer at a 30 to 45 degree angle to the paved surface to avoid removal of the jointing material.
- After cleaning is finished ensure that any jointing material which has been removed is topped up with the correct material, refer to Figure 2 for correct grading of jointing material.

Maintenance during the winter months.
Hydropave Permeable Paving generally requires less de-icing than conventional concrete block paving.
The controlled use of conventional road de-icing techniques can be used without affecting the overall performance of the paving.
Some de-icing salts may leave temporary discoloration after the thaw. Normal weathering should soon remove this discoloration from the paving.
De-icing salts should be applied before snow or ice develops as this helps protect the concrete surface.
It is unlikely that the levels of chloride in the ground will increase significantly by employing conventional de-icing techniques.
Frequency: As required during winter.

Controlling weeds.
Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed and adequate Health & Safety measures should also be put in place when handling chemicals.
Frequency: As required.

Structural Maintenance.
If a visual inspection has indicated that individual blocks have been damaged these blocks should be removed and replaced with new blocks.
If rutting of the surface has occurred the area needs to be lifted and reinstated immediately as it may be a hazard to users.
Any blocks which are removed need to be reinstated correctly ensuring that the correct sub-base, bedding and jointing aggregates are used. The installation method should be in accordance with BS 7533 Part 3. In particular, the joints should be filled to the top to ensure structural integrity, refer to Figure 2 for correct grading of jointing material. Any geotextiles or impermeable membranes which are damaged during the reinstating process should be replaced. If the blocks are not damaged they can be lifted, cleaned and re-used.
Frequency: As required

Jointing Material in Accordance with BS 7533 Part 13 Figure 2.

BS Sieve Size (BS EN 993-1) mm	Percentage Passing
14	100
10	98-100
6.3	80-99
2.0	0-20
1.0	0-5

Guidelines to minimise maintenance and ensure the long-term performance of Hydropave Permeable Paving.

Pre- construction (Design stage)

- It is essential that the system is designed correctly by a qualified engineer. Refer to BS 7533 Part 13
- The design and detailing of the project should ensure that soil from soft landscaping is prevented from spilling onto the paving.

During construction.

- It is essential that the paving is installed by an experienced contractor who is familiar with installing permeable paving and its components. Refer to BS7533 Part 3
- Mud / soil and other contaminants should be prevented from entering the sub-base, bedding course and jointing aggregates.
- Do not allow muddy construction traffic to use the paved area once completed.
- Do not allow soft landscaping to spill onto the paving surface. See Figure 3.

After construction.

- Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.
- The joints between to permeable paving should be filled to the top with the correct aggregate, refer to Figure 2 for correct grading of jointing material.

Figure 3.



Maintenance overview

SCHEDULE	ACTION	FREQUENCY
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / vacuum joints as required Replace any lost jointing material	Recommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING !	Do not replace the jointing grit with kiln dried sand as this will block the joints and prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	

Further information on the maintenance of permeable paving can be found at *www.circia.org*

Important Information

Any technical information provided by Tobermore in relation to any product (whether before or after order) is provided by way of GUIDANCE ONLY and, to the fullest extent permitted by law, without liability on the part of Tobermore for any loss or damage suffered as a result of relying upon it. Such technical information should not be relied upon in substitution for obtaining independent expert advice prior to using any product from both a suitably qualified engineer and building contractor, in particular, as to the suitability of the product for use at the intended site for the intended scheme.

GUIDELINES FOR INSTALLING HYDROPAVE PERMEABLE PAVING FOR DOMESTIC APPLICATIONS.

Product
All products should be carefully inspected for defects or damage upon delivery and prior to being laid or fitted.

Product Information
Within Tobermore, design and development of products is a continuing process, and product information is subject to change without notice. Accordingly, please check with Tobermore to ensure that the product information you have represents the most up-to-date product information.

Prior to Installation
It is good practice to sort products to ensure consistency of colour, texture and dimensional tolerance. Any defects must be reported without delay. If products are installed with any form of defect which was clearly apparent prior to installation the installer will be responsible for all costs incurred to rectify the issue.

Important: ***Check the area to be paved for services such as gas or electric and if necessary, contact the provider for advice.***

Health & Safety
Always wear appropriate PPE (Personal Protective Equipment) during construction.

SUITABILITY OF HYDROPAVE PERMEABLE PAVING

Hydropave Permeable Paving can be used on driveways, patios and paths where the intent is to infiltrate water back into the ground. The paving should only be used to deal with water landing on it and not from other adjacent impermeable areas or roofs. In some regions of the UK and Ireland the ground conditions may not be suitable for the infiltration of water or it may have an adverse affect on the properties foundations, particularly with older properties. In these instances it is best to seek professional advice or contact your local Building Control office.

Hydropave permeable paving should only be used in areas where the sub-grade strength is greater than 5% or where there is an existing driveway which would demonstrate the sub-grade is greater than 5%.
The table below can be used as a guide to determine the strength of a sub-grade. If you are in any doubt please seek advice from an experienced paving contractor.

Soil Type	Condition	Simple Soil Test	CBR (strength of ground)
Rock	Hard	Requires digger to excavate	5% +
Sand / gravel	Compact	Resistance when driving a 50mm square peg into the ground	5% +
Clay Sandy Sandy Clay	Stiff	Very difficult to mould by hand	5% - 2%
Clay Sandy Clay	Firm	Very difficult to mould by hand. Spade required to excavate.	5% - 2%
Sand Silty Clay Clayey Sand	Loose	50mm square peg can be easily driven into the ground	2%
Silt Sandy Clay Silty Clay Clay	Soft	Easily moulded by fingers	< 2%
Silt	Very soft	Squeezes through fingers very easily	Seek advice

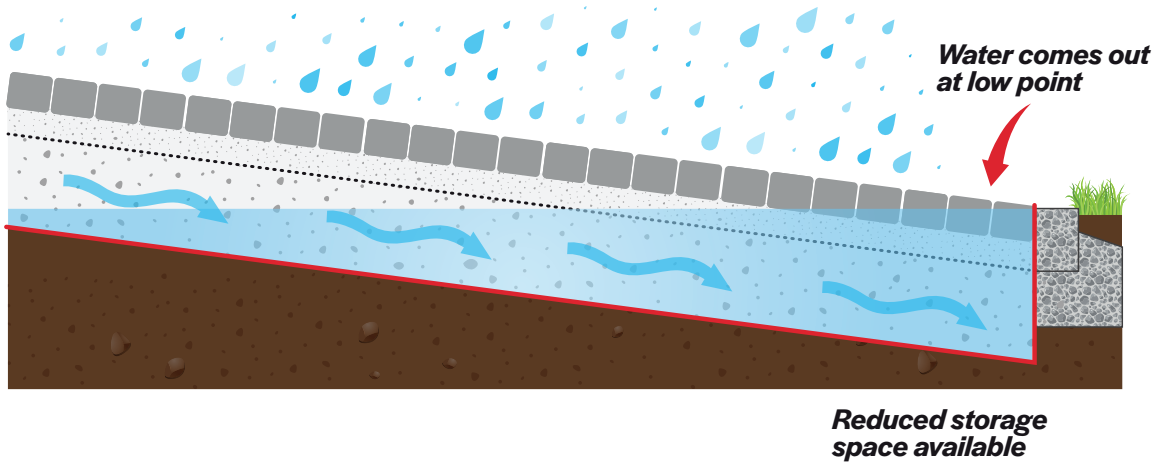
IMPORTANT: HYDROPAVE PERMEABLE PAVING ON SLOPES

On sloping sites, the water will run to the low end of the sub-base and therefore the volume available for storage will be greatly reduced, *see Figure 1.*

Also, if the slope is too steep water will flow over the surface and not infiltrate through the joints. It is very important therefore that slopes have a maximum gradient of 1 in 20 (5%). **Important:** Check dams, increasing the sub-base depth for extra storage or the use of geocellular storage (plastic boxes) at the lower end of the site to increase storage capacity may be required on slopes. Consulting with an engineer is advised.

On sites with slopes the installation of the paving should commence at the lowest point and work upwards.

Figure 1



Permeability of soil
To enable infiltration of water back into the ground certain criteria needs to be met. This involves completing a test to determine the permeability of the soil.

Soil permeability test
A square test hole measuring 400mm x 400mm x 400mm should be dug for every 20-25m2 of driveway. There should be at least two holes spaced evenly apart. Topsoil or the existing driveway should be removed first to expose the sub-grade material before digging the hole.

Fill the hole with water and allow it to drain away. Repeat this process 3 times. If the water completely drains away the soil will be suitable for permeable paving.

If the water does not drain then this indicates that the soil does not have sufficient permeability and you should not proceed using permeable paving.

Excavation
To calculate the depth of excavation required, add the depth of the sub-base, 50mm laying course and the depth of the block.

For example, 150mm (typical sub-base depth) + 50mm laying course + 60mm block = Total excavation of 260mm approximately.

Important:
The finished level of the paving must be a minimum 150mm below the damp proof course of the property.

Edge restraints
Kerb edge restraints must be installed prior to the sub-base material. The use of edge restraints will prevent any movement of the blocks.

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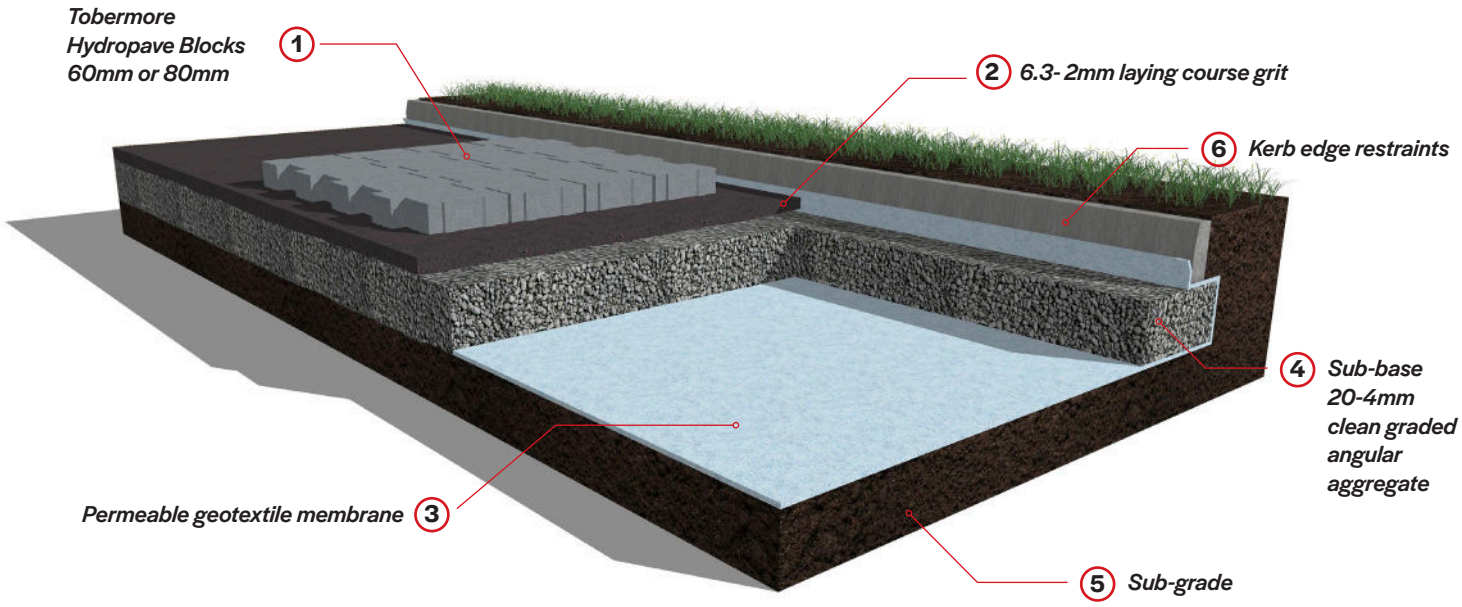
Sub-base depth and material

The depth of sub-base aggregate will be dependent on the existing ground conditions and the type and frequency of vehicles using the paving. As a general guide a depth of between 150mm and 250mm is usually sufficient for a domestic driveway and 100mm for a path or patio.

The sub-base aggregate must be 20 – 4mm clean graded angular aggregate. (MOT Type 1 must NOT be used) A permeable geotextile membrane should be placed on top of the sub-grade to separate the soil from the sub-base aggregate. See Figure 2.

Figure 2

Typical cross section of a Hydropave permeable driveway



The laying course should be 50mm in thickness. The material must be 6.3 – 2mm clean graded angular grit. *(Sharp sand must NOT be used.)*

Below is a table providing approximate quantities of sub-base and laying course aggregates for various sizes of driveways.

	10m2	20m2	30m2	40m2	50m2	60m2	70m2	80m2	90m2	100m2
20-4mm clean aggregate for sub-base in tonnes based on a sub-base of 200mm	4	8	12	16	20	24	28	32	36	40
6.3-2mm grit in tonnes based on a depth of 50mm	1	2	3	4	5	6	7	8	9	10

10kgs of 6.3 -2mm jointing grit is required per m2 of paving.

INSTALLATION

Geotextile
Place a suitable permeable geotextile membrane onto the sub-grade.
The geotextile can be overlapped by 300mm at joints if necessary. It should be brought up at the sides to just below the finished level of the paving and trimmed off. See Figure 2.

Sub-base
Install the 20 – 4mm clean graded angular aggregate in maximum layers of 75mm and compact it using a vibrating plate compactor. Take care to prevent any dirt or other contaminants from entering the sub-base aggregate as this could affect permeability.

Laying course
Spread out the 6.3 – 2mm clean graded angular grit over the sub-base. Screed the material to achieve a thickness of 50mm. The 6.3-2mm grit will not compact in the same way as sharp sand would, therefore it is important to try and achieve the target depth of 50mm during the screeding process. It is often helpful to carry out a trial area to determine the characteristics of the material when screeded and compacted.

Installing the Hydropave paving units
When the circumstances allow complete one area of paving by using products taken from the same batch. This is achieved by checking the batch code label displayed on the packs.

Always, thoroughly mix products from a minimum of three packs.
Where products are supplied in packs with vertical slices always take them "vertically slice by slice" this ensures that colours are distributed evenly.

When the circumstances do not allow the use of products from the same batch then it is extremely important to minimise possible colour banding /shading by always, thoroughly mixing products from a minimum of three packs concurrently with some overlap between deliveries / batches.

Install whole paving units first onto the laying course. Use string lines regularly to ensure joints are correctly aligned and to maintain the laying pattern. The permitted manufacturing tolerances of the units should be factored into the installation process.

Individual units should interlock with neighbouring units, however joint widths can be varied slightly to allow straight lines to be achieved or to maintain the laying pattern / bond.

Cutting in
Once all full-size units have been installed fill the remaining gaps with cut units. To prevent cut units becoming loose or breaking no unit should be cut to less than one quarter of its original size. In- board cutting should be used to avoid small cut pieces. Units should be measured and cut to maintain the permeable joint width in the range of 3-6mm. On curves the maximum joint width should be 6mm. Cutting may be carried out using a water and dust suppressed diamond tipped power saw or a block-splitting guillotine. It must however be noted that the aesthetic finish achieved will depend greatly upon the choice of cutting mechanism and the skill of the installer. Cutting should be carried out in an area away from the newly installed paving to prevent cutting dust staining the product.

Joint filling and compaction

Before jointing and compacting commences brush the area to ensure any dirt or debris is removed. Brush the 6.3 -2mm grit into the joints and sweep off any excess material which could scratch the surface of the paving during compaction. Compact the paving using a vibrating plate compactor with a protective rubber mat. Repeat this process 2-3 times or until all joints are completely filled to the top.

Any joints that are not filled can lead to movement of the paving during trafficking, which can also cause blocks to chip and become loose. We recommend that after a few weeks of use, any joints that are not full should be topped up. Joints should always be kept filled. Care must be taken to ensure that the permeable joints do not become contaminated as work continues. Particular care must be taken when planting or carrying out areas of soft landscaping to prevent soil from entering the joints.

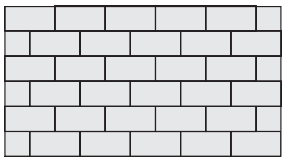
Laying patterns

45° and 90° degree stretcher bond pattern and herringbone patterns are suitable for driveways.

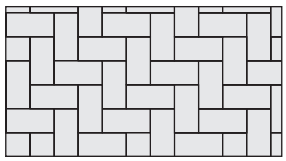
Basket weave pattern should not be used on driveways.

For paths and patios any laying pattern is suitable.

HYDROPAVE FUSION

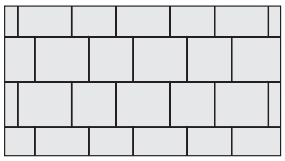


Stretcher bond
200x100mm



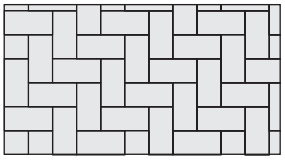
Herringbone 90°
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HYDROPAVE FUSION DUO



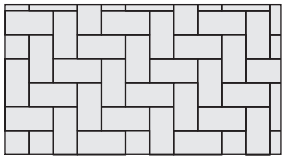
Stretcher bond
208x173mm, 173x173mm

HYDROPAVE 240



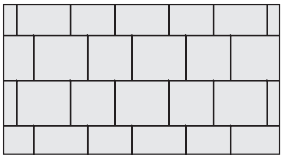
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240x120mm

HYDROPAVE TEGULA 240



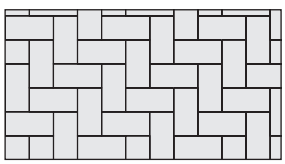
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240x120mm

HYDROPAVE TEGULA DUO



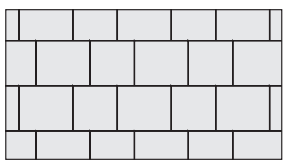
Stretcher bond
208x173mm, 173x173mm

HYDROPAVE PEDESTA



Herringbone 90°
200x100mm

HYDROPAVE SHANNON DUO



Stretcher bond
208x173mm, 173x173mm

Maintenance

Please refer to the table below for advice.

Schedule	Action	Frequency
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / Vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / Vacuum joints Replace any lost jointing material	Reccommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed Control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING!	Do not replace the jointing grit with kiln dried sand as this will block the joins and prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	

Instructions & Warnings

CORE TERMS (PAVING & WALLING)

Product
All products should be carefully inspected for defects or damage upon delivery and prior to being laid or fitted.
Product Information

Within Tobermore, design and development of products is a continuing process, and product information is subject to change without notice. Accordingly, please check with Tobermore to ensure that the product information you have represents the most up-to-date product information.

Prior to installation
It is good practice to sort products to ensure consistency of colour, texture and dimensional tolerance.

Installation
All products should be installed in accordance with the latest British Standard.
Colour & Texture

Tobermore produces paving and walling products with excellent density and durability. Products are manufactured using naturally occurring raw materials including aggregates, granite aggregates, pigments and sand. Although every effort is taken to ensure consistency, inevitably due to the presence of these naturally extracted raw materials variations in colour, shade and texture can occur. Therefore, colours and textures illustrated are representations and should not be expected to be an exact match.
Batch codes should be checked prior to installation to reduce the risk of product shading and ensure consistency of finish. When multiple packs are being installed in one area, please ensure you check that they are all from the same production batch. This can be done by checking the batch code label that is displayed on the packs. This is of particular importance when installing single colours such as Golden, Buff, Natural, Charcoal and Red. Tobermore therefore recommends that products are thoroughly mixed on site by drawing from a minimum of four pallets.
We would always recommend that when purchasing products, especially in larger quantities, that they are all ordered and manufactured in one batch to reduce the chances of colour / shade or texture variation.
Please note that the colour of new products will inevitably vary compared to those which have been installed for a period of time as weathering does take place.
All colour illustrations in Tobermore's brochures are as accurate as the printing process will allow. For a more accurate colour match please refer to actual product samples, which can be provided.

Staining
Some chemicals that are commonly used in gardens such as lawn feed containing Ferrous Sulphate can stain concrete products. Any chemicals that are spilt must be removed immediately by rinsing away with clean water. Please check the information on the instruction label of the container holding the chemical.

Moisture
Occasionally, after installation, some units may show variations in shade and have a patchy appearance. This is due to the varying amounts of moisture within the concrete and the ground. The drying out process of concrete continues in-situ after installation. Some units may also retain more moisture than neighbouring units and take longer to dry out. This is caused by the variations in density of the naturally extracted aggregates used in the manufacturing process. Given time and natural weathering, the capillaries within the surface of the concrete will gradually close and any patches or moisture retention will dissipate as the product matures. This does not affect long-term performance.

Efflorescence
Efflorescence is a white crystalline deposit that occurs naturally on the surface of concrete materials. Tobermore use market leading technology to significantly suppress the occurrence of efflorescence, however, if it occurs, it may mask the colour of the product for a period of time, but tends to be washed away gradually by rain. Tobermore do not replace products with efflorescence. Packs of products which have had packaging removed should always be re-covered with appropriate packaging to prevent the occurrence of secondary efflorescence.

Surface Scratches
Minor scuffs or bruises may occur during delivery, movement onsite, and installation (for example, during any plate vibrating process). In Tobermore's experience, these marks usually weather off through time. (EasyClean products are protected with a glue dot)
To reduce the risk of surface scratches we strongly recommend the use of a vibrating plate with a rubber protective mat.

Ordering
Please ensure that your contractor accurately measures the area on site before ordering products. In Tobermore's experience, dimensions taken from a project plan can vary significantly from the final layout. Depending on the layout of the project, we recommend ordering an additional 2 - 5% of material to allow for cutting, detailing and wastage.

Manufacturing & Quality Systems
Tobermore is a BS EN ISO 9001, BS EN ISO 14001 and BES 6001 registered company. Tobermore uses an integrated management system to manage all health & safety and environmental issues.

Product Maintenance
Routine cleaning and maintenance is required to keep the overall appearance of products in pristine condition.
All concrete products can develop algae, lichen, and moss growths due to environmental conditions and may require cleaning. Areas adjacent to plant borders and trees may discolour from transfer of plant-life. Tobermore cannot accept responsibility for any of these conditions.

Laying multi-blend coloured paving blocks, flags and walling products
To achieve an even blend of colour when laying multi-blend paving blocks, flags and walling products, it is desirable to mix from 3 or 4 different pallets.

Queries & Complaints
Please contact one of Tobermore's Paving & Walling Centres or offices (contact details at www.tobermore.co.uk) with any queries or complaints. Any complaints must be notified to Tobermore without delay.

CORE TERMS (PAVING ONLY)

Product Maintenance
Light coloured paving blocks and flags emphasise tyre marks and oil spills on the driveway. Please note that these products will need more maintenance if overall appearance is to be maintained.

Initial Cleaning
When an area has just been paved, allow it to settle for a few days. After this, you may wish to lightly hose down the paving to remove any excess sand or dirt. The area should then be treated with a weed killer suppressant two – three times per year as required.

General Cleaning
Paving requires regular maintenance, including regular sweeping to prevent the build up of detritus. Tobermore recommends that paving is cleaned two – three times per year.

For general cleaning of dirt and algae, vigorous brushing with a stiff yard brush with plenty of hot detergent solution (washing up liquid or non-bio washing powder), thoroughly rinsed with clean water, should suffice. Repeated treatment may be required for paved areas sited beneath trees or in permanent/near permanent shade.
A light power hose at medium pressure is generally all that is required to clean general dirt and grime. Any jointing material which is removed must be replaced. Do not use high pressure powerwashers as aggressive power-washing can damage the product surface. A trial area should be tested before large scale powerwashing takes place. (Important: EasyClean products should not be pressure washed. Please refer to specific EasyClean information)

Moss, Lichen and Algae
Thick growths of moss or lichen must be removed first by scraping out the joints and then treating the area with a moss killer such as anti-moss paving cleaner. Anti-moss is designed to remove moss, lichens and algae. It is best applied in dry weather. After being applied it will take a few days to be fully effective. Once the moss and lichens have been killed, they can easily be brushed off. Anti-moss also leaves a residue in the sand joint which will help reduce the likelihood of re-growth. The manufacturer's instructions should always be followed when using any cleaning agent.

Weeds
Large weeds should be removed by hand and then the area treated with a weed killer (available from any good garden centre). Smaller weeds can then be treated directly with weed killer and these weeds should start to die within days. The manufacturer's instructions should always be followed when using any weed killing agent.
Block Paving Sealer
It is possible to seal block paving with a resin material which combats staining and weed growth and which also enhances colour and appearance. The acrylic sealer is sprayed onto the block paving and forms a 'skin' on top of the paving and the jointing material giving an easily maintained finish. The manufacturer's instructions should always be followed when using any sealing agent. (Important: Do not use sealers on EasyClean products)

FOR HYDROPAVE PRODUCTS
Installation - Hydropave
Tobermore recommends that its Hydropave products be installed in conjunction with a BS EN 7533-13:2009 designed permeable paving system.
Note: A permeable paving design relies heavily on using the correct aggregates. Prior to installation, we would ask you to test both the 4/20mm coarse graded aggregate and also the 6.3-2mm bedding and jointing grit as per the relevant British Standard specification (BS EN 13242:2002). In particular, the material should be categorised as LA20 according to Table 9, SZ18 according to Table 10 and MDE15 according to Table 11 within this standard. The grit should be insoluble in dilute hydrochloric acid and should be naturally occurring material. In our experience, incorrect use of aggregates is one of the most common reasons for failure of a permeable paving system.

Joint Filling
All joints must be filled to the top with 6.3 – 2mm grit to prevent movement and spalling of the blocks. We recommend that after a few weeks use, any joints which have settled and are not full, are topped up with grit. Joints should be kept filled at all times. You will need approximately one tonne of grit for every 100m2 of 80mm paving.

Note: Care should be taken that the permeable joints do not become cont
aminated as work on the scheme is completed. Special care needs to be taken when soft landscaping is carried out so that soil does not enter the joints. When this type of work is being carried out, the surface of the permeable paving should be protected by an appropriate cover to protect the joints from being contaminated.

Hydropave Maintenance
Please refer to Tobermore's detailed 'Permeable Paving Maintenance Guidelines' available on our website: www.tobermore.co.uk

Wavin Limited
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Edlington
Doncaster
South Yorkshire DN12 1BY
Tel: 01709 856300 Fax: 01709 856301
e-mail: info@wavin.co.uk
website: www.wavin.com

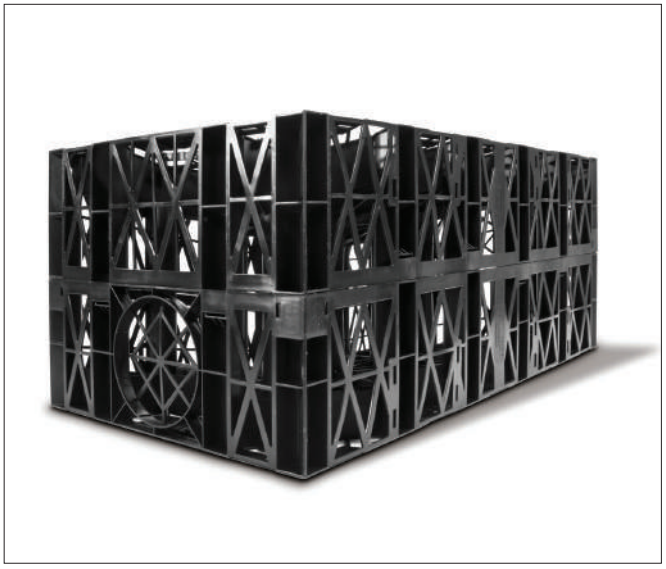
Agrément Certificate
03/4018
Product Sheet 4

WAVIN AQUACELL ATTENUATION AND INFILTRATION SYSTEMS

AQUACELL ECO

This Agrément Certificate Product Sheet(1) relates to AquaCell Eco, comprising black recycled polypropylene modular units for use either as below-ground storage tanks or as a soakaway to manage run-off from impermeable surfaces.

(1) Hereinafter referred to as 'Certificate'.



CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Hydraulic design — data is provided in this Certificate to assist in the design of a below-ground water management system incorporating AquaCell Eco (see section 6).

Structural design — the system has adequate strength and stiffness to resist short- and long-term loading when designed in accordance with this Certificate (see section 7).

Maintenance — data is provided in this Certificate to assist in planning the maintenance of a completed system (see section 11).

Durability — the system will have a service life in excess 50 years when installed in accordance with this Certificate (see section 12).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Second issue: 2 November 2016

Originally certificated on 15 June 2012

Brian Chamberlain
Head of Technical Excellence

Claire Curtis-Thomas
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

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Regulations

In the opinion of the BBA, AquaCell Eco, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	H3(3)	Rainwater drainage
Comment:		The system can be used in a construction to meet this Requirement. See section 6 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system components are acceptable. See section 12 and the *Installation* part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The system can contribute to satisfying this Regulation. See sections 11 and 12 and the *Installation* part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.6	Surface water drainage
Comment:		The system can contribute to a construction satisfying this Standard, with reference to clauses 3.6.1[1][2] to 3.6.5[1][2]. See section 6 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The system can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		All comments in relation to the system under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1[1][2] and Schedule 6[1][2]. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i)(iii)(b)	Fitness of materials and workmanship
Comment:		The system is acceptable. See section 12 and the *Installation* part of this Certificate.
Regulation:	82	Rainwater drainage
Comment:		The system can be used in a construction to satisfy this Regulation. See section 6 of this Certificate.

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

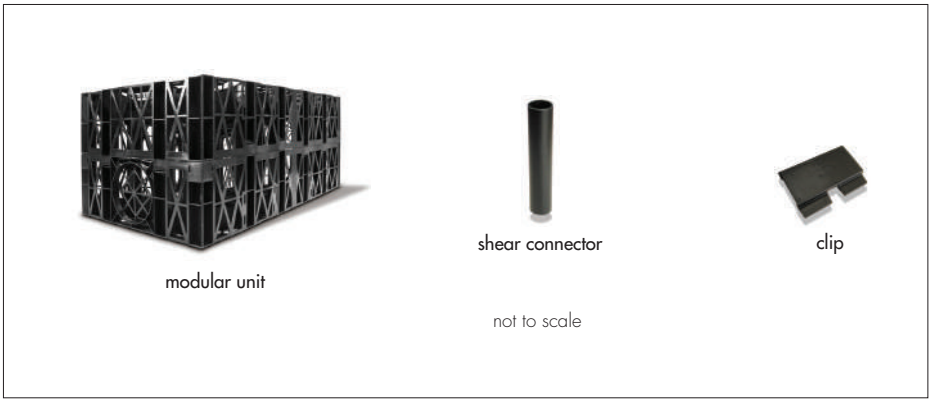
See sections: 1 *Description* (1.2), 3 *Delivery and site handling* (3.1) and 15 *Procedure* (15.1) of this Certificate.

Technical Specification

1 Description

1.1 AquaCell Eco consists of individual recycled black polypropylene modular units, polypropylene shear connectors to hold units together vertically, and polypropylene clips to hold units together horizontally (see Figure 1).

Figure 1 System components



1.2 The overall unit dimensions and characteristics of AquaCell Eco are shown in Table 1.

Table 1 Characteristics of modular units

Characteristic (unit)	Value
Unit dimensions per storage cell (nominal) (mm) (L x W x H)	1000 x 500 x 400
Unit volume per storage cell (nominal) (m^3)	0.20
Storage volume per storage cell (nominal) (m^3)	0.19
Void ratio (%)	95
Weight (nominal) (kg)	7

1.3 The polypropylene modular units have preformed sockets to enable connection to 160 mm diameter pipework. Alternatively, connection to 150 mm or 225 mm pipework is possible using an adaptor. Adaptors and connecting pipework for use with the system are outside the scope of this Certificate.

1.4 Ancillary items necessary for use with the system (according to best practice), but outside the scope of this Certificate, are:

- adaptors and connecting pipework
- air vents
- inspection points
- inspection chamber modules
- silt traps and sediment separators
- permeable geotextile — wrapped around each assembly when used for infiltration
- geomembrane — wrapped around each assembly when used for storage (attenuation)
- protective fleece — wrapped around each assembly when used for storage (attenuation), to give added protection to the geomembrane
- granular material/coarse sand.

2 Manufacture

2.1 The system components are injection-moulded using recycled polypropylene to one specification.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management system of Wavin UK (Holdings) Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by SGS UK Ltd (Certificate GB08/74586).

3 Delivery and site handling

3.1 The system is supplied to site in packs of 12 or 15 units, secured with straps, with plastic feet attached to the underside to enable placing and movement by a fork-lift. Each pack of units carries a label bearing the system type, part number, operator's initials, individual pallet sequential number and date of manufacture.

3.2 Each unit is supplied with two shear connectors and three clips.

3.3 The packs should be carefully placed on level ground and should not be stacked on site. Loose individual units should not be stored more than two units high.

3.4 The units contain an inhibitor to resist the effects of ultraviolet light for up to six months. However, prolonged exposure to direct sunlight should be avoided.

3.5 The units should not be stored near fuel bowsers, fuel tanks or other solvents, to avoid potential chemical damage.

3.6 The units are resistant to damage that could occur with normal handling. They should be stored way from the possibility of impacts by vehicles and other construction plant.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on AquaCell Eco.

Design Considerations

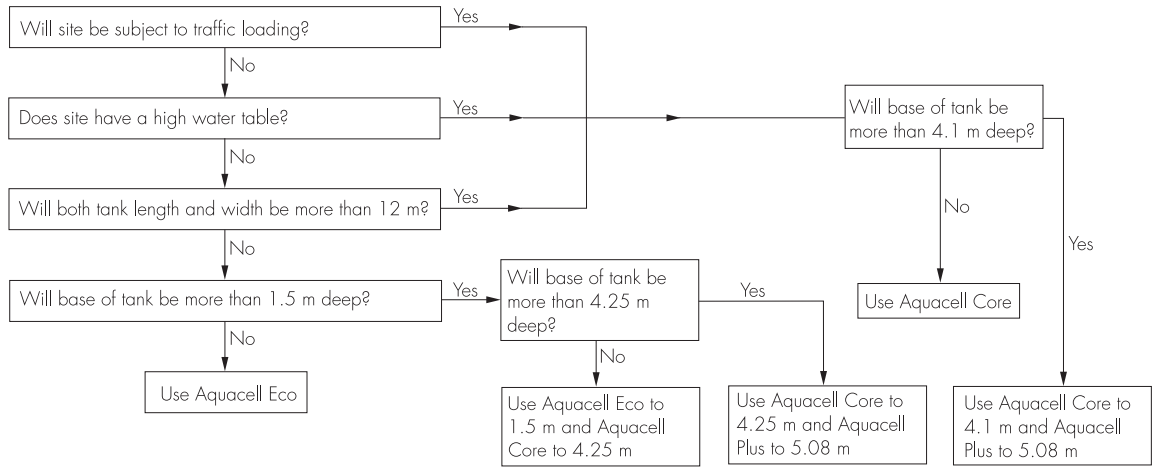
4 General

4.1 The design of AquaCell Eco must be in accordance with the Certificate holder's design guidelines. Guidance on the application of sustainable drainage systems (SUDS) for new developments can be found in The National Planning Policy Framework and The SUDS Manual (C697) published by the Construction Industry Research and Information Association (CIRIA).

4.2 The system is satisfactory for the management of stormwater run-off from impermeable surfaces and can be used in three main ways (see Figure 2):

- infiltration — water is stored within the system during rainfall and allowed to drain away by soaking into the surrounding ground over a period of time after the rain has ceased
- attenuation — water is stored within the system during rainfall and released at a reduced flow rate through a flow control device into an appropriate outfall. This reduces peak flows in the watercourse, thereby minimising the risk of flooding
- a combination of infiltration and attenuation.

Figure 2 Sustainable drainage system selection and design



(1) This Certificate covers Aquacell Eco units only — the validity of Certificates covering other Aquacell units can be checked on the BBA website: www.bbacerts.co.uk.

(2) Maximum burial depths assume ideal soil conditions and should be verified by site investigations (see section 6 of this Certificate for information relating to structural design). Maximum burial depths for a variety of soil types are given in Table 7.

4.3 The design of a system for a specific project must always be preceded by a detailed audit of the proposed site to establish:

- existing factors and considerations applicable to the site
- predicted factors relating to the site's use following the planned development, and the parameters within which the installation is required to function
- the type of function of application suggested by this audit.

4.4 Once the project criteria have been established from the site audit, there are two main parts to the design procedure of individual installations: hydraulic design and structural design.

5 Practicability of installation

The system is designed to be installed by a competent general builder or contractor with experience of this type of system.

6 Hydraulic design

Infiltration

Calculation principles



6.1 There are two approaches, either of which can be adopted: CIRIA Report 156 *Infiltration drainage — Manual of good practice* and BRE Digest 365 *Soakaway design*. Further information on the design of SUDS may be obtained from *The SUDS Manual* (C697).

6.2 A simplified approach can be used on a small site (ie a single-house development), where detailed site infiltration rate information may not be required or available (see Table 2). In Approved Document H, a storage volume equal to the area to be drained multiplied by 10 mm, for areas up to 25 m^2 is allowed. Beyond this size, design should be carried out in accordance with BS EN 752 : 2008 or BRE Digest 365. BS EN 752 : 2008 suggests a storage volume equal to 20 mm multiplied by the area to be drained. In Scotland, guidance for the design of single-house soakaways is given in Mandatory Standard 3.6, clause 3.6.5(1).

(1) Technical Handbook (Domestic).

Table 2 Simplified soakaway design for single-house development(1)

Number of units	Storage volume (m^3)	Maximum area to be drained (m^2)
1	0.19	19(2)
2	0.38	25(2)
3	0.57	28.5(3)
4	0.76	38(3)
5	0.95	47.5(3)
6	1.14	57(3)

(1) When doubt exists over suitability of ground for infiltration permeability, figures should be derived by test (see BRE Digest 365).

(2) In accordance with Approved Document H.

(3) In accordance with BS EN 752 : 2008, clause NA 4.4.8.

6.3 When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found in Tables 3 and 4 of this Certificate.

Table 3 Data for use in hydraulic design — one unit wide trench configuration

Number of units high	System volume (m^3) per metre length of trench	Vertical surface area (m^2) (both sides) per metre length of the system	Area beneath system (m^2) per metre length of trench
1	0.19	0.8	0.5
2	0.38	1.6	0.5

Table 4 Data for use in hydraulic design — three-dimensional systems, two units high

System length (number of units long) (1.2 m side)	2 units wide (0.5 m side)			4 units wide (0.5 m side)			8 units wide (0.5 m side)		
	Volume (m^3)	Area around sides and ends (m^2)	Area under base (m^2)	Volume (m^3)	Area around sides and ends (m^2)	Area under base (m^2)	Volume (m^3)	Area around sides and ends (m^2)	Area under base (m^2)
1	0.76	3.2	1.0	1.52	4.8	2.0	3.04	8.0	4.0
2	1.52	4.8	2.0	3.04	6.4	4.0	6.08	9.6	8.0
4	3.04	8.0	4.0	6.08	9.6	8.0	12.16	12.8	16.0
8	6.08	14.4	8.0	12.16	16.0	16.0	24.32	19.2	32.0
10	7.6	17.6	10.0	15.2	19.2	20.0	30.4	22.4	40.0
100	76.0	161.6	100.0	152.0	163.2	200.0	304.0	166.4	400.0

6.4 For calculations, the size and volume of the units are given in Table 1. The total areas of the base and sides are required as water is absorbed through the geotextile soil interface. Storage volume is 95% of the total volume. As an example, using Table 4, for a typical linear trench 40 m long and two units deep the volume is 0.38 by 40 = 15.2 m^3 and the side area 1.6 by 40 = 64 m^2.

Attenuation

Calculation principles

6.5 The anticipated total run-off volume from the site is estimated. The most commonly-used method for evaluating storm rainfall events in the UK is the Wallingford Procedure by which the total rainfall level of storms over defined time periods ranging from five minutes up to 48 hours is assessed. The allowable discharge rate from the site to an appropriate outfall is established, but will normally be set by the Environment Agency, Scottish Environmental Protection Agency or Planning Authorities. The volume to be stored underground in the system is then determined and the number of units needed to contain this volume is calculated on the basis that the storage volume is equal to 95% of the total volume of the system.

Connections

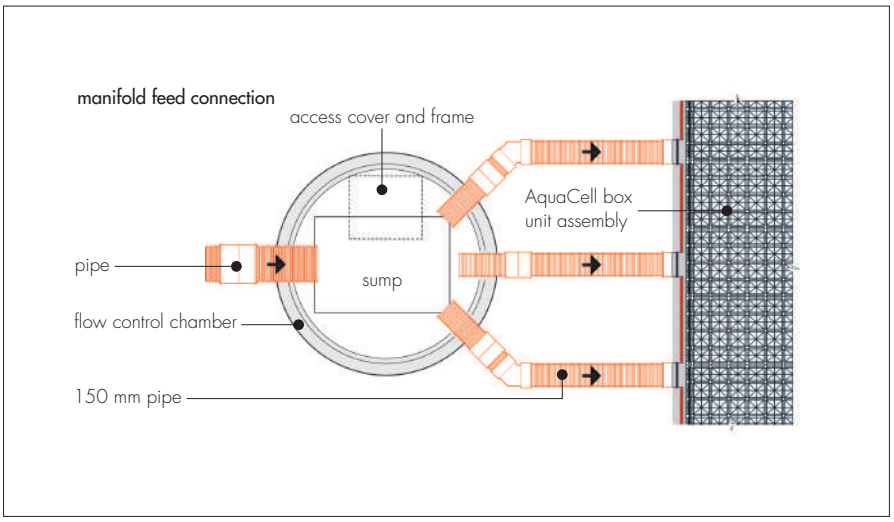
6.6 Connection is made to the units using a preformed socket and adaptor or a flange adaptor.

6.7 It is recommended that all connections into storage applications (using a geomembrane) are made using a flange adaptor. Adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

Manifold design

6.8 The units are manufactured to allow a connection to be formed by insertion of 160 mm diameter pipes to BS EN 13476-3 : 2007 into the knock-out incorporated in each cell. The capacity of a 160 mm pipe is limited and may be insufficient for the anticipated design flow. The flow may be split amongst a number of 160 mm pipes connected to a manifold to provide increased hydraulic capacity (see Figure 3). The system designer should ensure that the pipework connecting the units to the drainage system has sufficient capacity to cope with the design flow.

Figure 3 Typical inlet connection design



Flow control

6.9 When the system is used for attenuation purposes, the outflow from the system must be controlled to comply with the discharge rate consent of the site. The main methods to achieve outflow control are: orifice plate, vortex valve or small pipe. Comparative features and benefits of these various control flow devices should be considered prior to selection.

Outflow positioning and head calculations

6.10 The invert level of the outflow pipe should be flush with the bottom of the lowest unit to allow the system to drain. As the system fills, a depth of water develops on the upstream side of the outflow control. For a system with two layers of units, this depth is 0.8 m when the units are full, creating a driving head to push the flow through the control device. For design purposes, the head used in calculations is taken as that at the invert line of the outflow device.

7 Structural design

7.1 The structural design of each installation incorporating the system should be carried out by a suitably-qualified and experienced engineer.

7.2 Guidance on the design and installation of systems incorporating the units can be found in CIRIA Report C680 *Structural design of modular geocellular drainage tanks*. Consideration should be given to the effects of cumulative deflection in systems comprising several layers of units.

7.3 The system can be placed under a wide variety of landscaped or pedestrian areas were ground water is not present. Design procedures for trafficked applications are outside the scope of this Certificate.

7.4 The engineer responsible for the design of the installation must confirm that the ground-bearing capacity at the formation level is sufficient for the proposed operational loads. In areas of weak or compressible soils, advice should be sought from a geotechnical engineer.

Performance characteristics

7.5 Characteristic compressive strength at the yield point and elastic deflection values for the system have been determined from independent, short-term tests (see Table 5).

Table 5 Short-term performance values

Performance characteristic (unit)	Value
Characteristic compressive strength at the yield point ($kN \cdot m^{-2}$)	
vertical loading on top face	213
lateral loading on side face	52
Short-term elastic deflection (mm per $kN \cdot m^{-2}$) (applied load)	
vertical loading on top face	1 per 29
lateral loading on side face	1 per 9

7.6 Creep tests indicate that the long-term vertical deflection may be estimated from the equations shown in Table 6. This is valid for loads up to 52 $kN \cdot m^{-2}$ for durations of up to 10 years at 20°C. In locations where settlement is not a concern, designs of up to 50 years can be considered.

Table 6 Equations for estimation of long-term deflection

For loads up to ($kN \cdot m^{-2}$):	Equations for estimation of long-term deflection (mm)
52	Vertical deflection = 0.1069 Ln [time (days)] + 1.2561
13	Lateral deflection = 0.9344 Ln [time (days)] + 1.3841

7.7 The partial load and material factors given in Table 7, as defined in CIRIA Report C680, should be used for design.

Table 7 Partial factors for loads and materials

Description	Ultimate limit state	Serviceability limit state
Partial factors for loads		
vertical dead-load (F_{dl})	1.40	1.00
earth pressure (horizontal) + hydrostatic (horizontal) load (F_{ep})	1.35	1.00
imposed live-load (F_{ll})	1.60	1.00
Partial safety factors for materials (F_m)	2.75	1.50

Note: Where applicable, additional factors should be considered for dynamic factor and material factors for creep/fatigue.

7.8 Example maximum installation depths and minimum depths of cover, calculated as described in this Certificate and in accordance with CIRIA Report C680, are shown in Tables 8, 9 and 10. For soakaways serving an individual house, the system is located below a garden a minimum of 5 m from the building, inaccessible to motor vehicles. Table 8 indicates the maximum installation depth and minimum depths of cover.

Table 8 Design criteria for use of the system as a soakaway for an individual house(1)

Criterion (unit)	Value
Maximum depth to base of units (m)	2.68
Minimum cover depth (m)	0.50

(1) The following assumptions apply:
- soakaway constructed in sandy gravels with a soil weight not exceeding 20 $kg \cdot m^{-3}$ and angle of shearing resistance for surrounding soil not less than 30°
- groundwater at least one metre below the base of the units
- soakaway located beneath small gardens or landscaped areas inaccessible to motor vehicles, in accordance with Table 4.2 of CIRIA Report C680.

7.9 For installations below landscaped or pedestrian areas the information given in Tables 9 and 10 is only applicable in temperate climate conditions such as those in the UK. Site-specific calculations should be carried out for configurations and prevailing ground conditions other than those shown.

Table 9 Maximum installation depths (to base of units)

Soil description	Maximum installation depth (from invert of structure) (m)		
	Soil weight ($kN \cdot m^{-3}$)	Angle of internal friction (degrees)	No groundwater present: landscaped areas[1]
Over consolidated stiff clay	20	24	1.53
Silty sandy clay	19	26	1.68
Loose sand and gravel	18	30	2.08
Medium dense sand and gravel	19	34	2.35
Dense sand and gravel	20	38	2.68

(1) Landscaped area where drive-on mowers are used in accordance with Table 4.2 of CIRIA Report C680.

Notes:

- these values relate to installations where the groundwater is a minimum of one metre below the base of the excavation. AquaCell Eco units should not be used where groundwater is present
- calculations based on systems constructed from two layers of AquaCell Eco units
- no account is taken of accidental loading
- ground surface in vicinity of system assumed to be level
- formation below system assumed to have adequate bearing capacity
- partial load and material factors are defined in Table 7.

Table 10 Minimum cover depth

	Landscaped areas[1]
Minimum cover depth required (m)	0.50

(1) Landscaped areas where drive-on mowers are used in accordance with Table 4.2 of CIRIA Report C680.

Notes:

- calculations based on systems constructed from two layers of AquaCell Eco units
- soil weight and angle of internal friction of the soil above the system taken as 20 $kN \cdot m^{-3}$ and 38° respectively
- calculations based on there being no groundwater present
- angle of spread for wheel loads taken as 27° in car parks with asphaltic surfacing and angle of internal friction of soil in landscaped areas
- no account is taken of accidental loading
- ground surface in vicinity of system assumed to be level
- formation below system assumed to have adequate bearing capacity
- partial load and material factors are defined in Table 7
- values for distributed and concentrated wheel loads/contact as defined in Table 4.1 of CIRIA Report C680.

8 Geotextiles and geomembranes

Infiltration

8.1 The system requires a geotextile wrapping when used as an infiltration system to prevent:

- silt that may be contained in the surface water run-off contaminating the surrounding soil, in addition to reducing its permeability
- surrounding soil from entering the units.

8.2 The selection of an appropriate geotextile requires careful consideration (see section 8.6).

Attenuation

8.3 The system requires a sealed geomembrane wrapping to create an attenuation storage system, to prevent:

- the release of surface water into the surrounding ground
- inflow of groundwater that may overload downstream systems and contain pollutants on contaminated sites.

8.4 Site conditions may also require the use of an additional thick, protective geotextile fleece to prevent puncture or excessive strain in the geomembrane. Further advice should be sought from the geomembrane manufacturer.

8.5 Selection of an appropriate geomembrane requires careful consideration (see section 8.7).

Specification of geotextile

8.6 The selection of an appropriate geotextile for a specific AquaCell Eco Infiltration System should be considered carefully, particularly with reference to the surrounding soil properties and required performance. Points to consider are:

- pore size — this should be designed and specified to assist infiltration and prevent migration of fine soil particles
- permeability and breakthrough head — the geotextile should not limit flow of water in the system, and should have a similar or greater permeability than the surrounding ground
- puncture resistance — the geotextile must be able to resist piercing by potentially sharp objects, eg stones in the soil
- tensile strength — the geotextile should have sufficient strength to resist any imposed forces, eg from traffic
- specialist advice should be sought if surrounding soil characteristics exhibit a high degree of fines/low infiltration capacity and/or there is risk of damage from ground contaminants.

Specification of geomembrane

8.7 The specification and selection of the impermeable geomembrane must be correct for the proposed installation, to ensure that it performs to the level required. It is essential that the specified material:

- withstands the rigours of installation
- resists puncture
- resists multi-axial elongation stress and strains associated with settlement
- resists environmental stress cracking
- resists damage from ground contaminants
- remains intact for the full design life.

8.8 A geomembrane less than 1 mm thick is unlikely to meet these criteria (except in shallow, domestic installations), and is not recommended for use with AquaCell Eco. For further details the Certificate holder's advice should be sought.

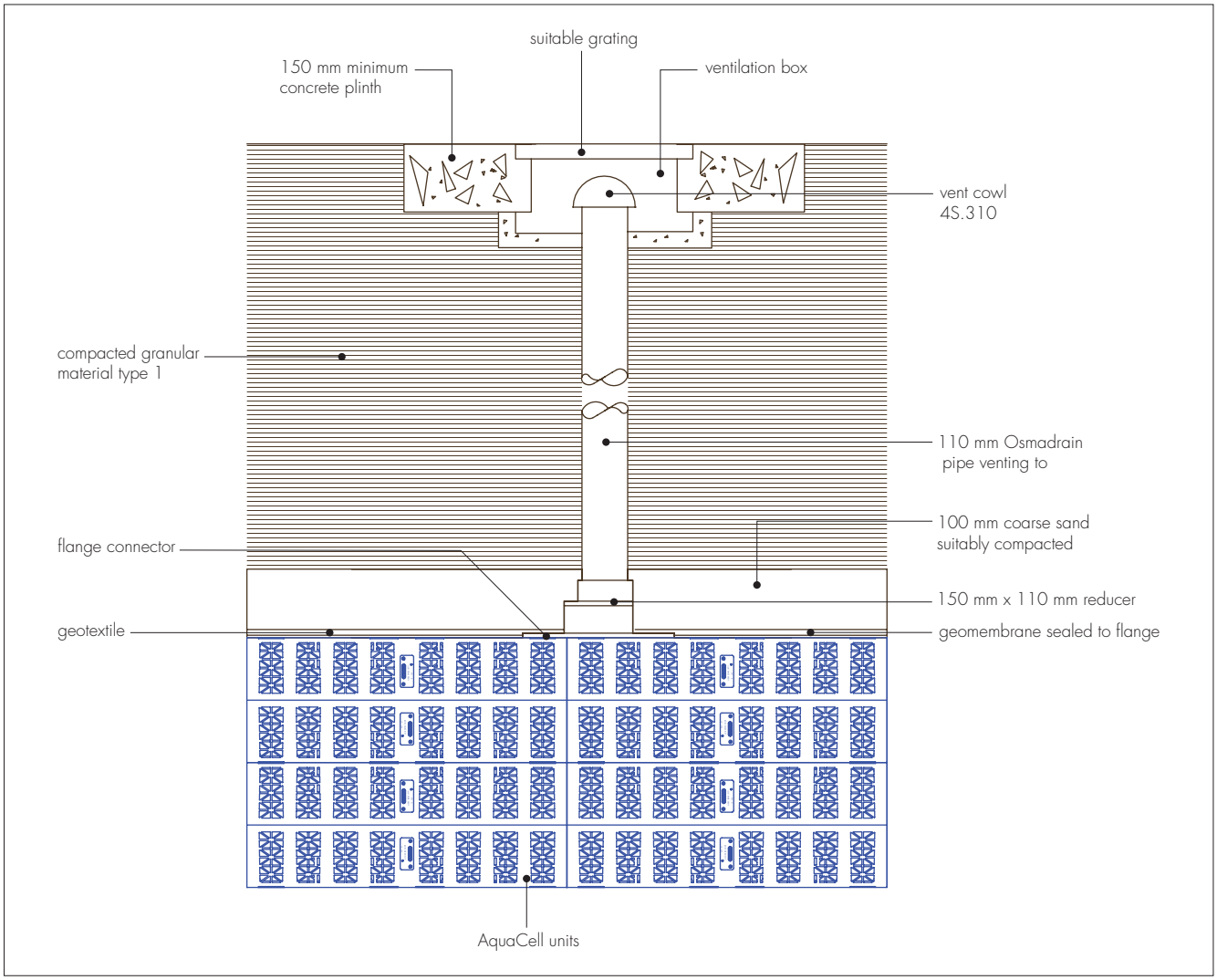
8.9 All joints must be sealed using proprietary techniques recommended by the manufacturer. Advice on seam testing procedures is given in CIRIA Report SP 124 : 1996 *Barriers, liners and cover systems for containment and control of land contamination*.

9 Venting

9.1 Adequate venting must be provided to the system. One 110 mm diameter air vent is required per 7500 m² of impermeable catchment area to be drained (see Figure 4).

9.2 Typical air vent connectors and pipework can be seen in the Certificate holder's *AquaCell Systems — Product and Installation Manual*. It is recommended that all air vent installations in attenuation/storage applications (using an impermeable geomembrane) are made using a flange adaptor. Adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

Figure 4 Typical air vent system



10 Resistance to chemicals

10.1 An assessment carried out by the BBA indicates that the system components are suitable for use in contact with the chemicals likely to be found in rainwater.

10.2 An assessment of the suitability for use of AquaCell Eco units on brownfield sites should be made, only after a suitable site investigation, to determine the possibility for chemical attack. Particular care must be taken where acids and organic solvents are present at high concentrations. Further information can be obtained from the Certificate holder.

11 Maintenance

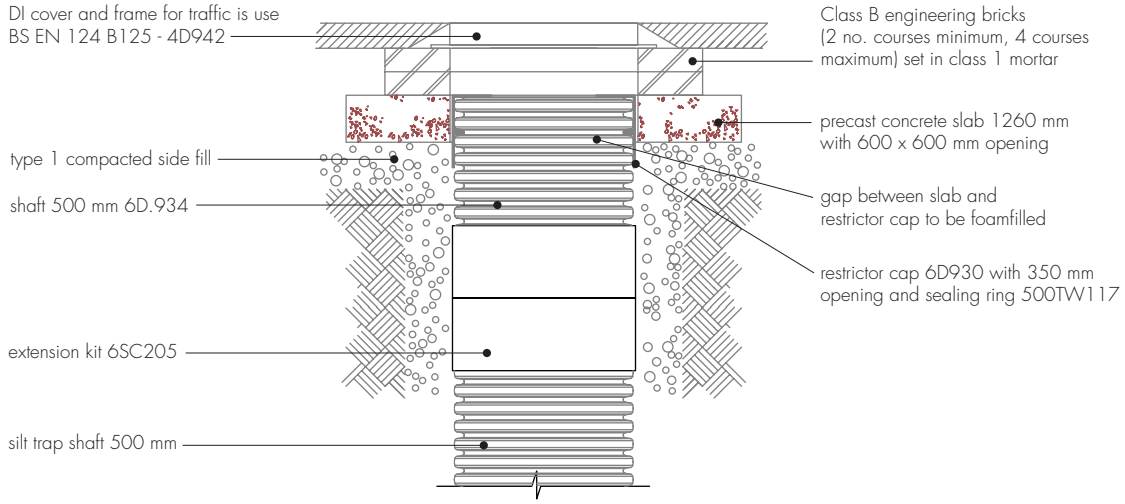
11.1 The owner of the structure is responsible for its maintenance.

11.2 For soakaways to individual houses, the only necessary maintenance of the system is to keep all gullies clear of debris, such as leaves.

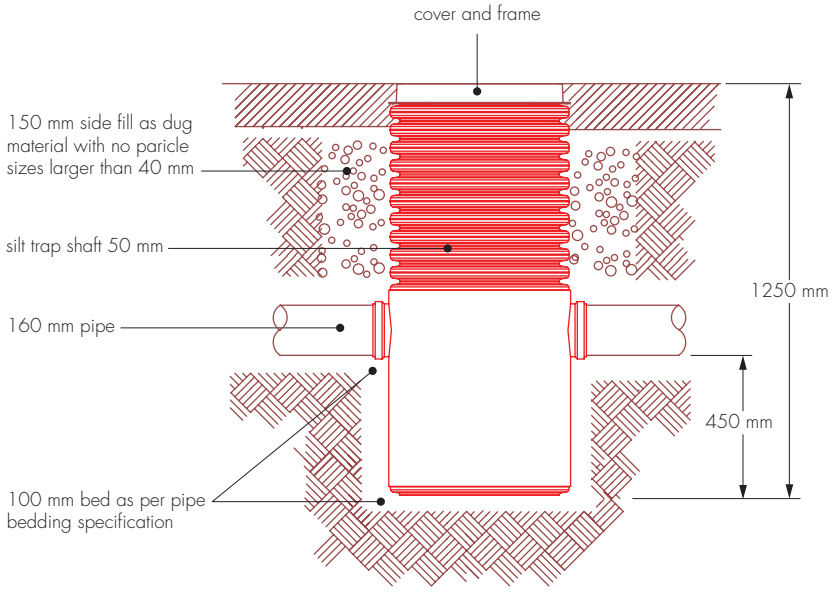
11.3 For large installations, or where the receiving waters are environmentally sensitive, a programme of regular inspections should be established to prevent siltation of the system which, if allowed to develop, would reduce its effectiveness. The system should also be inspected after every major storm event.

11.4 It is recommended that a silt trap or sediment removal separator be installed upstream of the inlet pipework to the system (see Figure 5). A maintenance plan must be in place for regular cleaning of all traps and sumps to ensure correct performance. Silt traps and sediment removal separators for use with the system are outside the scope of this Certificate.

Figure 5 Typical silt trap



cover detail for trafficked areas with extension option



typical detail for silt trap non trafficked areas

11.5 For all flow control devices it is sensible to incorporate access (via a manhole or similar) to the location of the pipe entry, orifice or vortex valve. This will enable easy removal of any blockage. The orifice itself may be protected by a debris screen.

11.6 Paved surface areas above an installation should be inspected at the same time as internal inspections, to ensure that the units continue to provide the required structural support.

12 Durability



The structural properties of polypropylene used in the system components will deteriorate with time, and this should be taken into account at the design stage by the application of suitable safety factors. In the opinion of the BBA, AquaCell Eco , when used in accordance with this Certificate, will have a life in excess of 50 years.

13 Reuse and recyclability

The units are made from polypropylene, which can be recycled.

Installation

14 General

The system should be installed in accordance with the Certificate holder's *AquaCell Systems — Product and Installation Manual*.

15 Procedure

15.1 The hole or trench is excavated to the required depth, dimensions and levels. It must be ensured that the plan area is sufficient to allow plant access around sides to compact backfill material (300 mm minimum). The base must be smooth and level without sharp drops or humps. Slopes must be cut to a safe angle or adequately supported, and safe access must be provided to allow personnel to enter the excavation.

15.2 The base must be inspected for soft spots in the formation; any present must be excavated and replaced with compacted granular fill material.

15.3 A 100 mm thick bedding layer of coarse sand is laid on the base and sides of the excavation. If required in attenuation systems, a layer of geotextile is laid to protect the impermeable geomembrane.

15.4 The impermeable geomembrane (or geotextile, if in an infiltration system) is laid over the sand bedding layer and up the sides of the excavation. The impermeable geomembrane is inspected for damage and all welds are tested as required. Joints between adjacent sheets of impermeable membrane should be sealed correctly using proprietary techniques with a minimum lap of 50 mm. Jointing with tape is not recommended as the system then becomes reliant on the mechanical properties of the tape to maintain its integrity.

15.5 The AquaCell Eco units are installed in accordance with the installation schedule for correct orientation. Wherever possible, continuous vertical joints should be avoided. The units are arranged so that preformed sockets are in the correct alignment for inlet and outlet pipes. For single-layer applications, AquaCell clips are used and, for multilayers, AquaCell clips and shear connectors.

15.6 The geotextile or impermeable geomembrane encapsulation to base, sides and top of installation, including protective geotextile (if required to protect the geomembrane), is completed. Impermeable geomembranes should be welded with double seams. All welds should be tested as required and the membrane inspected for damage.

15.7 Drainage connections are made to the installation using proprietary adaptors. Preformed socket positions for pipe connections must be located at the correct position for receiving pipework. Alternatively, flange adaptors are used attached to AquaCell Eco units with adhesive tape and self-tapping screws (flange adaptors cannot be used at the invert of AquaCell Eco units into the preformed socket). It is recommended that all connections and air vent installations, in attenuation/storage applications, are made with a flange adaptor, using adhesive or double-sided tape to form a seal. Alternatively, drainage connections are sealed into a preformed socket using proprietary seals approved by the geomembrane manufacturer.

15.8 A coarse sand protection layer, 100 mm thick, should be placed over the top of the units that have been wrapped. Backfilling is continued with selected as-dug material, with size of pieces less than 75 mm, compacted to 90% maximum dry density. Compaction plant over the top of the system must not exceed 2300 kg per metre width.

15.9 Pavement construction or landscaping over the system is completed.

Technical Investigations

16 Tests

Tests were carried out on the system and the results assessed to determine:

- long- and short-term resistance to loading
- performance and durability
- volumetric capacity and discharge rate.

17 Investigations

17.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

17.2 An assessment of the system was made in relation to material properties and design procedures.

17.3 A site visit was made to assess the practicability and ease of installation and connection.

Bibliography

BS EN 752 : 2008 *Drain and sewer systems outside buildings*

BS EN 13476-3 : 2007 +A1 : 2009 *Plastics piping systems for non-pressure underground drainage and sewerage — Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE) — Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B*

BS EN ISO 9001 : 2008 *Quality management systems — Requirements*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*

Conditions of Certification

18 Conditions

18.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

18.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

18.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

18.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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APPENDIX F: British Geological Survey Maps

