Technical note

Project	7 The Forum`	**Date**	11 March 2024
Note	Drainage Technical Note	**Ref**	19-5771-D101
Author	Arwyn Norris		

This technical note is produced to accompany the Syntegra Drainage General Arrangement Drawing ref 6001 and Standard details 6010-6011 in support of discharge of the drainage condition.

The design has been based upon the submitted drainage strategy. Attenuation will be provided via a series of blue roof systems with outlets restricted utilising 40mm orifice systems a part of the proprietary manufacturer design.

Outlets shall be routed to ground floor and conveyed via gravity to the existing surface water sewer within the service yard.

The attenuation has been sized to accommodate the rainfall events up to and including the 1% AEP event inclusive of 40% climate change.

Storm	Proposed Runoff Rate l/s
1 in 1 year	0.9
1 in 30 year	2.6
1 in 100 year	3.6
1 in 100 year +40% CC	4.9

Table 1 Proposed vs Existing runoff rates

Foul drainage is to be separated from surface water and will discharge to the existing foul drainage system within the courtyard utilising existing connections where feasible during construction.

Management and Maintenance

All drainage will be required to be maintained by the contractor during construction, following which the post construction phase maintenance would apply as per manufacturer recommendations and as appended to this document.

The proposed drainage system for the site adopts a series of SuDS measures to control the rate of storm water discharge and the quality of the water in line with current practice. A site management company will be in place to maintain the drainage to ensure that SuDS elements operate effectively for their lifetime.

This document should be read in conjunction with the drainage system drawings. Responsibility of maintenance will lie with the client and an appropriate management company is to be appointed to oversee future maintenance.

Overview of Maintenance

All drainage systems, whether piped systems or SuDS systems require regular maintenance. The maintenance of the SuDS system should be included alongside other regular maintenance tasks. The table below gives an overview of typical maintenance tasks and the frequency with which they need to be undertaken.

Activity	Indicative frequency	Typical tasks
Routine/regular maintenance	Monthly to annually (for normal care of SuDS)	Litter picking Inspection of inlets, outlets and control structures
Occasional maintenance	Annually up to 25 years (dependent on the design)	Silt control around components Vegetation management around components Suction sweeping of permeable paving Silt removal from catchpits, soakaways and cellular storage
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	Inlet/outlet repair Erosion repairs Reinstatement of edgings Reinstatement following pollution Removal of silt build up

Typical maintenance tasks and frequency for SUDs drainage

The required maintenance for each of the elements that make up the SuDS systems, is scheduled below. The following guidance is based on CIRIA C753 – The SuDS Manual.

Pipes (Including Oversized) & Manholes

Pipes are intended to be the main conveyance across the development. They are intended to be dry except for during rainfall events. These have been designed to be self-cleansing where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers, manholes, rodding plates and rodding eyes.

Regular inspection and maintenance is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk. Maintenance responsibility for the pipes should be placed with Landowner.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols, as run-off is taken from potentially contaminated areas such as car parks/service yards.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection should be provided as post construction CCTV survey.	N/A
	Inspect for evidence of poor operation via water level in chambers. If required take remedial action.	3-monthly, 48 hours after large storms.
Occasional maintenance	Check and remove large vegetation growth near pipe runs.	6 monthly
Remedial actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

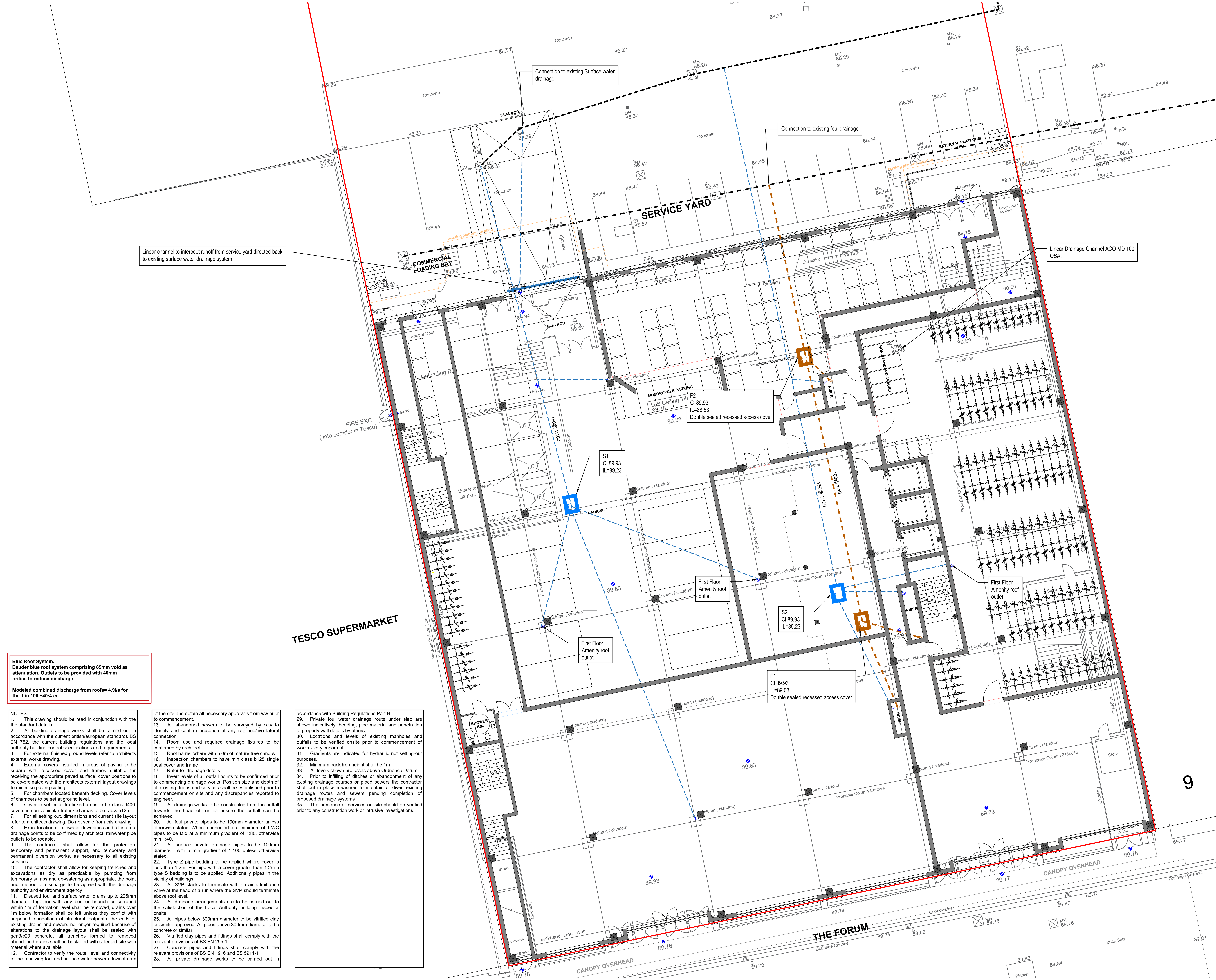
Flow Control Devices – Hydro Brake, Orifice Plates

Maintenance to be undertaken according to manufacturer's specification. As a general guide, this should include the following:

Maintenance Schedule	**Required Action**	**Typical Frequency**
Routine Maintenance	Inspection	Quarterly
	Litter / debris removal	Monthly or as required
Occasional Maintenance	Sediment removal	6 monthly

Remedial Maintenance	Repair (as a result of damage or vandalism)	As required

All drainage will be maintained as required. It is envisaged that minimal maintenance would be needed of the proposed system.



Blue Roof System.
Bauder blue roof system comprising 85mm void as attenuation. Outlets to be provided with 40mm orifice to reduce discharge,

Modeled combined discharge from roofs= 4.9l/s for the 1 in 100 +40% cc

NOTES:

1. This drawing should be read in conjunction with the the standard details
2. All building drainage works shall be carried out in accordance with the current british/european standards BS EN 752, the current building regulations and the local authority building control specifications and requirements.
3. For external finished ground levels refer to architects external works drawing.
4. External covers installed in areas of paving to be square with recessed cover and frames suitable for receiving the appropriate paved surface. cover positions to be co-ordinated with the architects external layout drawings to minimise paving cutting.
5. For chambers located beneath decking. Cover levels of chambers to be set at ground level.
6. Cover in vehicular trafficked areas to be class d400. covers in non-vehicular trafficked areas to be class b125.
7. For all setting out, dimensions and current site layout refer to architects drawing. Do not scale from this drawing
8. Exact location of rainwater downpipes and all internal drainage points to be confirmed by architect. rainwater pipe outlets to be rodable.
9. The contractor shall allow for the protection, temporary and permanent support, and temporary and permanent diversion works, as necessary to all existing services
10. The contractor shall allow for keeping trenches and excavations as dry as practicable by pumping from temporary sumps and de-watering as appropriate. the point and method of discharge to be agreed with the drainage authority and environment agency
11. Disused foul and surface water drains up to 225mm diameter, together with any bed or haunch or surround within 1m of formation level shall be removed, drains over 1m below formation shall be left unless they conflict with proposed foundations of structural footprints. the ends of existing drains and sewers no longer required because of alterations to the drainage layout shall be sealed with gen3/c20 concrete. all trenches formed to removed abandoned drains shall be backfilled with selected site won material where available
12. Contractor to verify the route, level and connectivity of the receiving foul and surface water sewers downstream of the site and obtain all necessary approvals from ww prior to commencement.
13. All abandoned sewers to be surveyed by cctv to identify and confirm presence of any retained/live lateral connection
14. Room use and required drainage fixtures to be confirmed by architect
15. Root barrier where with 5.0m of mature tree canopy
16. Inspection chambers to have min class b125 single seal cover and frame
17. Refer to drainage details.
18. Invert levels of all outfall points to be confirmed prior to commencing drainage works. Position size and depth of all existing drains and services shall be established prior to commencement on site and any discrepancies reported to engineer.
19. All drainage works to be constructed from the outfall towards the head of run to ensure the outfall can be achieved
20. All foul private pipes to be 100mm diameter unless otherwise stated. Where connected to a minimum of 1 WC pipes to be laid at a minimum gradient of 1:80, otherwise min 1:40.
21. All surface private drainage pipes to be 100mm diameter with a min gradient of 1:100 unless otherwise stated.
22. Type Z pipe bedding to be applied where cover is less than 1.2m. For pipe with a cover greater than 1.2m a type S bedding is to be applied. Additionally pipes in the vicinity of buildings.
23. All SVP stacks to terminate with an air admittance valve at the head of a run where the SVP should terminate above roof level.
24. All drainage arrangements are to be carried out to the satisfaction of the Local Authority building Inspector onsite.
25. All pipes below 300mm diameter to be vitrified clay or similar approved. All pipes above 300mm diameter to be concrete or similar.
26. Vitrified clay pipes and fittings shall comply with the relevant provisions of BS EN 295-1.
27. Concrete pipes and fittings shall comply with the relevant provisions of BS EN 1916 and BS 5911-1
28. All private drainage works to be carried out in accordance with Building Regulations Part H.
29. Private foul water drainage route under slab are shown indicatively; bedding, pipe material and penetration of property wall details by others.
30. Locations and levels of existing manholes and outfalls to be verified onsite prior to commencement of works - very important
31. Gradients are indicated for hydraulic not setting-out purposes.
32. Minimum backdrop height shall be 1m
33. All levels shown are levels above Ordnance Datum.
34. Prior to infilling of ditches or abandonment of any existing drainage courses or piped sewers the contractor shall put in place measures to maintain or divert existing drainage routes and sewers pending completion of proposed drainage systems
35. The presence of services on site should be verified prior to any construction work or intrusive investigations.

DO NOT SCALE DRAWING -
IF IN DOUBT, ASK

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CONSTRUCTION
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2. Filling of voids formed by site clearance operations shall be measured under Series 600 of the Specification.
3. Contractor is to ensure that all voids are to be filled with granular sub base material Type 1.
4. All hard material broken out under the Contract is to be disposed of to contractor's tip.

CDM (RISKS & HAZARDS)
1. Prior to commencement of construction the contractor is to liaise with all relevant statutory undertakers and protect / divert apparatus and to protect the workforce during the works. Any damage caused to the apparatus to be the responsibility of the contractor.
2. Contractor to undertake their own statutory plant checks on site prior to the commencement of excavation exercise.
3. The contractor is to make sure that any excavation should be adequately covered at night to protect both public and wildlife from becoming trapped.
4. Appropriate health and safety measures should be adhered to while working in close proximity to the existing overhead power lines.

DISCLAIMERS
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EXISTING DRAINAGE.
1. Where existing runs and chambers are to be reused, their condition and suitability is first to be assessed and levels checked and verified. any discrepancies or required alterations are to be reported to the engineer.

RWP locations shown indicatively. setting out to be confirmed by architect.

Linear channel grate to be specified by architect.

Rev	Drawn	App'd	Date	Revision Description
P1	AN	AK	04.03.24	DRAFT

Issue: PRELIMINARY

SYNTEGRA CONSULTING
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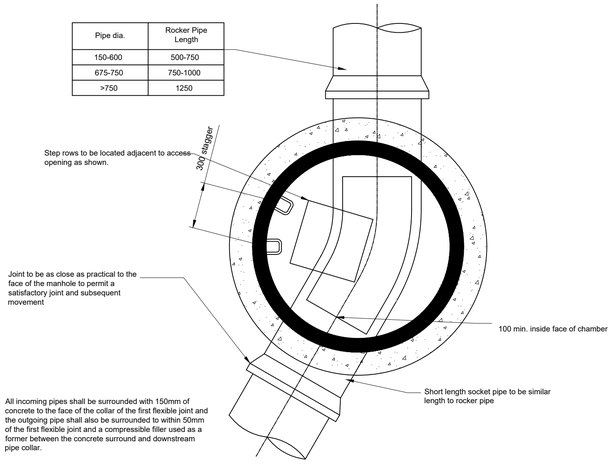
mail@syntegragroup.com www.syntegragroup.com

Client: -

Project: 7 The Forum

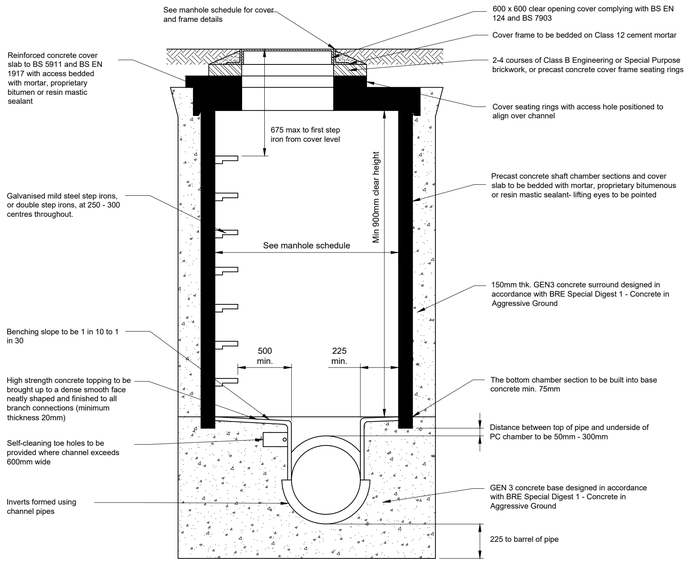
Title: DRAINAGE GA GROUND FLOOR

Scale: 1:50 @ A1	Drawn By: AN
Date: March 2024	Checked By: AK
Drg. No. 6001	Rev. P1



TYPICAL MANHOLE PLAN

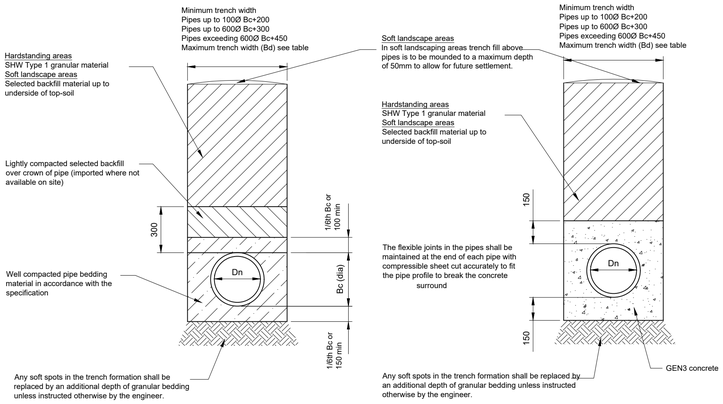
(SCALE 1:20)



TYPICAL TYPE 2 CONCRETE MANHOLE (PCC) DETAIL

MAX. DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE 3.0m

(SCALE 1:20)



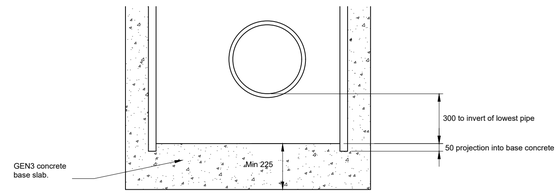
CLASS S - 360° GRANULAR SURROUND PIPE BEDDING DETAIL

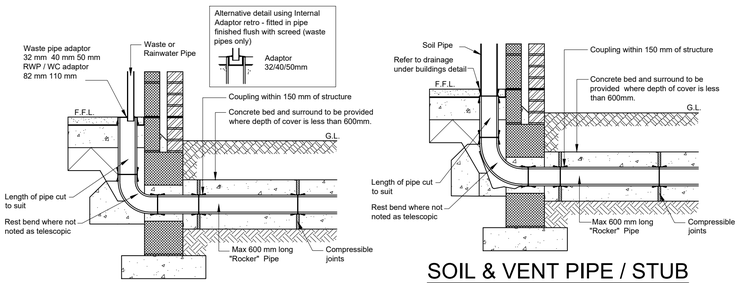
(SCALE 1:20)

CLASS Z - CONCRETE BED AND SURROUND PIPE BEDDING DETAIL

(COVER < 900mm IN VEHICULAR LOADING AND OPEN FIELD.
COVER <600mm ELSEWHERE EXCEPT UNDER BUILDINGS.)

(SCALE 1:20)



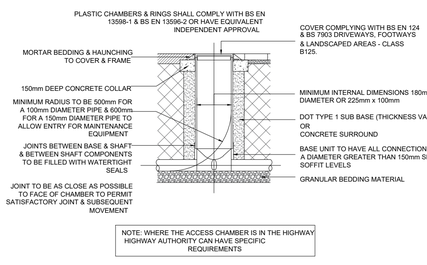


INTERNAL WASTE PIPE CONNECTION DETAIL

(SCALE 1:20)

SOIL & VENT PIPE / STUB STACK / W.C. CONNECTION DETAIL

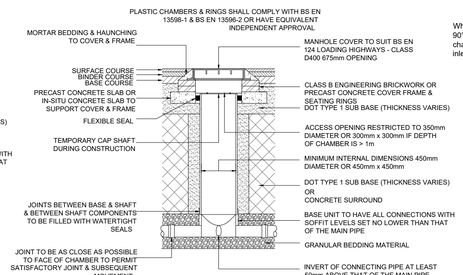
(SCALE 1:20)



TYPICAL INSPECTION CHAMBER DETAIL
4 (FLEXIBLE MATERIAL DETAIL)

MAXIMUM DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE 2m, NON ENTRY

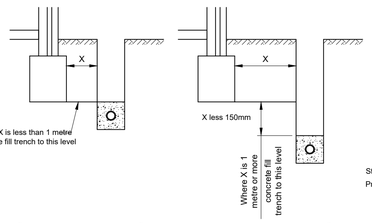
SCALE 1:25



TYPICAL INSPECTION CHAMBER DETAIL
3 (FLEXIBLE MATERIAL DETAIL)

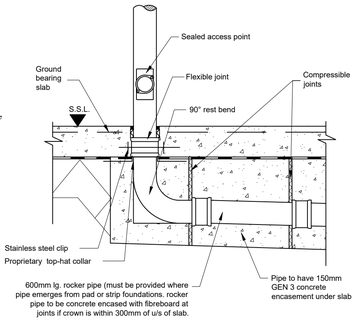
MAXIMUM DEPTH FROM COVER LEVEL TO SOFFIT OF PIPE IN AREAS SUBJECT TO VEHICLE LOADING 3m, NON ENTRY

SCALE 1:25



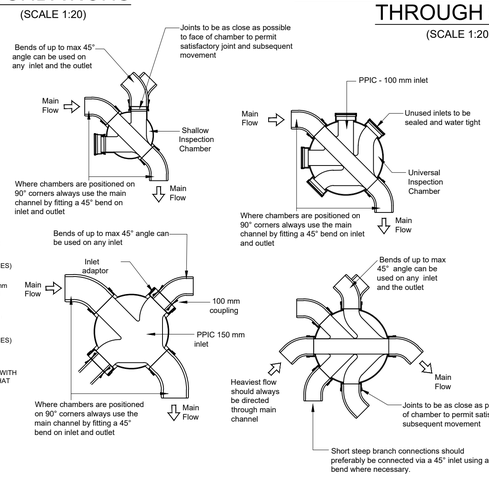
TYPICAL DETAILS WHERE DRAINAGE TRENCH IS DEEPER THAN FOUNDATIONS

(SCALE 1:20)



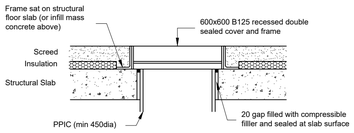
TYPICAL DETAIL SHOWING SVP THROUGH SLAB

(SCALE 1:20)



INSPECTION CHAMBER (PPIC) BASE DETAILS

(SCALE 1:20)



INTERNAL COVER DETAIL

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Rev	Drawn	App'd	Date	Revision Description

Issue: PRELIMINARY

SYNTEGRA CONSULTING

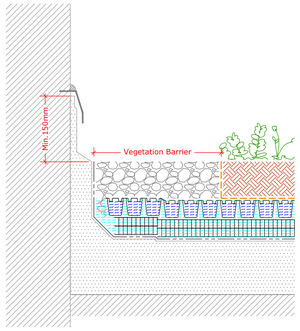
Client:

Project: 7 The Forum

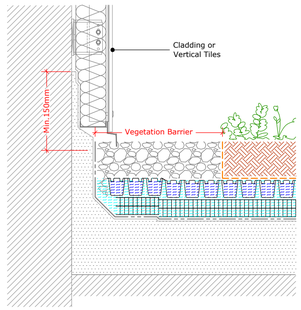
Title: Drainage Standard Details

Scale: 1:125 @ A1	Drawn By: A.Norris
Date: March 2024	Checked By: A.Norris

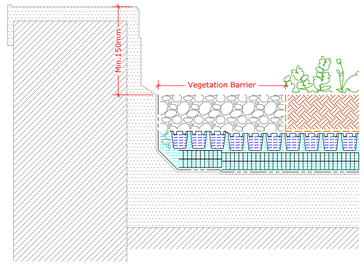
Drg. No. 6010 | Rev. P1



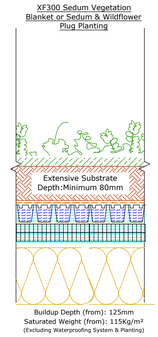
Upstand

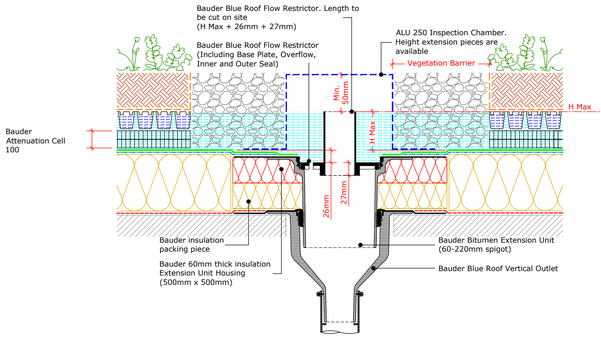


Upstand to Vertical Cladding or Slates/Tiles

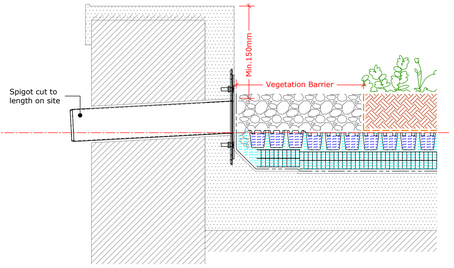


Parapet Upstand

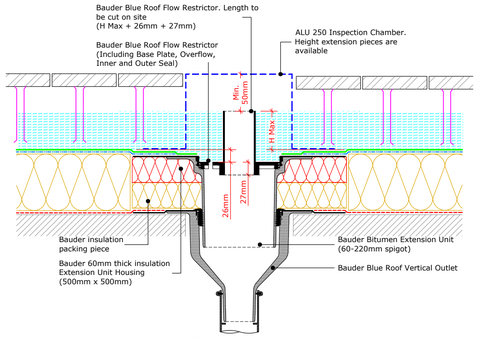




Bauder Blue Roof Vertical Outlet



Parapet Upstand With Overflow



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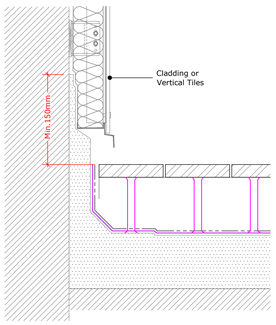
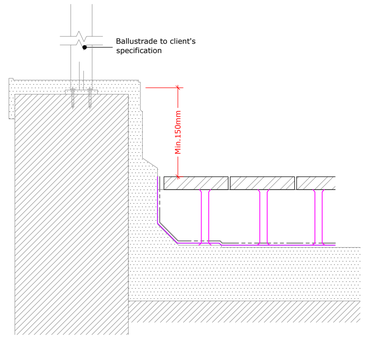
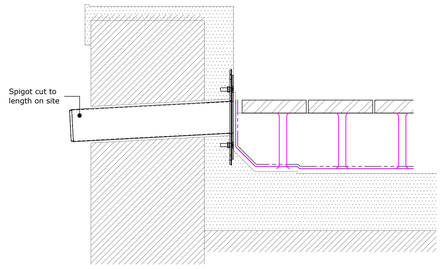


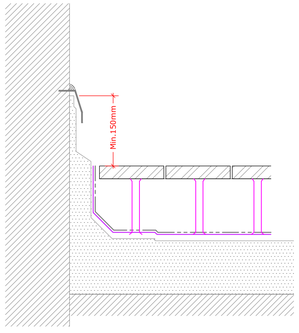
Upstand to Vertical Cladding or Slates/Tiles



Parapet Upstand



Parapet Upstand With Overflow



Upstand

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Key
Bauder Bituminous Systems
- Bauder Capping Sheet
- Bauder Underlayer
- Bauder Vapour Barrier / Control Layer/ Carrier Membrane
- Vegetation (By Others)
- Bauder Extensive Substrate
- Bauder Filter Fleece
- Drainage Board
- Bauder Protection Mat
- Layers of Bauder Versicell
- Bauder Waterproofing System. (Refer to Specific Bauder Waterproofing Details Drawings.)
- Deck / Substrate
- Vegetation Barrier **- Minimum 300mm wide But Must Be Increased to At Least 500mm When Positioned Adjacent to Opening Rooflights, Windows or Door Openings. In Accordance with both GRO Green and FLL Roof Codes.**

Rev	Drawn	App'd	Date	Revision Description

Issue: PRELIMINARY

SYNTEGRA CONSULTING

Client:

Project: 7 The Forum

Title: Blue Roof Standard Details

Scale: 1:125 @ A1	Drawn By: A.Norris
Date: March 2024	Checked By: A.Norris

Drg. No. 6011 | Rev. P1

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	15.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1			10.000	1200	-23.147	60.776	2.187
2			10.000	1200	-11.509	79.526	2.217
3			10.000	1200	55.948	79.957	2.586
4			10.000	1200	123.621	80.172	2.785
5	0.040	15.00	10.000	1200	-22.136	25.254	1.300
Depth/Area 1	0.021	15.00	10.000	1200	-5.901	25.254	1.300
Depth/Area 2	0.021	15.00	10.000	1200	11.905	25.429	1.300
Depth/Area 3	0.048	15.00	10.000	1200	-43.433	17.748	1.300
Depth/Area 4	0.018	15.00	10.000	1200	90.461	37.649	1.300
Depth/Area 5	0.040	15.00	10.000	1200	78.939	65.580	1.300
Depth/Area 6	0.040	15.00	10.000	1200	44.898	17.573	1.300
Depth/Area 7	0.016	15.00	10.000	1200	57.119	40.267	1.300

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node Depth/Area 3 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	2.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node 5 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	1.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 1 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	3.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 2 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	4.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 6 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	5.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 7 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	6.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 5 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	8.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node Depth/Area 4 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.040
Downstream Link	7.000	Invert Level (m)	8.700	Discharge Coefficient	0.600

Node 5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	0.100	400.0	0.0

Node Depth/Area 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	210.0	0.0	0.100	210.0	0.0

Node Depth/Area 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	210.0	0.0	0.100	210.0	0.0

Node Depth/Area 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	480.0	0.0	0.100	480.0	0.0

Node Depth/Area 4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	180.0	0.0	0.100	180.0	0.0

Node Depth/Area 5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	0.100	400.0	0.0

Node Depth/Area 6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	400.0	0.0	0.100	400.0	0.0

Node Depth/Area 7 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	160.0	0.0	0.100	160.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	1	465	7.831	0.018	0.5	0.0201	0.0000	OK
600 minute winter	2	465	7.797	0.014	0.5	0.0162	0.0000	OK
600 minute winter	3	465	7.435	0.021	0.9	0.0237	0.0000	OK
600 minute winter	4	465	7.236	0.021	0.9	0.0000	0.0000	OK
1440 minute winter	5	990	8.718	0.018	0.3	6.7871	0.0000	OK
600 minute winter	Depth/Area 1	420	8.715	0.015	0.3	3.0273	0.0000	OK
600 minute winter	Depth/Area 2	420	8.715	0.015	0.3	3.0273	0.0000	OK
1440 minute winter	Depth/Area 3	990	8.719	0.019	0.4	8.5862	0.0000	OK
600 minute winter	Depth/Area 4	405	8.714	0.014	0.3	2.4503	0.0000	OK
1440 minute winter	Depth/Area 5	990	8.718	0.018	0.3	6.7871	0.0000	OK
1440 minute winter	Depth/Area 6	990	8.718	0.018	0.3	6.7871	0.0000	OK
360 minute winter	Depth/Area 7	344	8.714	0.014	0.3	2.1027	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)
600 minute winter	1	1.001	2	0.5	0.473	0.027	0.0030	
600 minute winter	2	1.002	3	0.5	0.562	0.018	0.0118	
600 minute winter	3	1.003	4	0.9	0.500	0.018	0.0368	25.2
1440 minute winter	5	Orifice	1	0.1				
600 minute winter	Depth/Area 1	Orifice	1	0.1				
600 minute winter	Depth/Area 2	Orifice	1	0.1				
1440 minute winter	Depth/Area 3	Orifice	1	0.2				
600 minute winter	Depth/Area 4	Orifice	3	0.1				
1440 minute winter	Depth/Area 5	Orifice	3	0.1				
1440 minute winter	Depth/Area 6	Orifice	3	0.1				
360 minute winter	Depth/Area 7	Orifice	3	0.1				

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	360	7.842	0.029	1.3	0.0333	0.0000	OK
480 minute winter	2	360	7.806	0.023	1.3	0.0265	0.0000	OK
480 minute winter	3	360	7.448	0.034	2.6	0.0390	0.0000	OK
480 minute winter	4	360	7.249	0.034	2.6	0.0000	0.0000	OK
480 minute winter	5	368	8.734	0.034	1.5	12.8511	0.0000	OK
360 minute winter	Depth/Area 1	272	8.729	0.029	1.0	5.8554	0.0000	OK
360 minute winter	Depth/Area 2	272	8.729	0.029	1.0	5.8554	0.0000	OK
720 minute winter	Depth/Area 3	540	8.735	0.035	1.3	16.0082	0.0000	OK
180 minute winter	Depth/Area 4	168	8.729	0.029	1.4	4.9375	0.0000	OK
480 minute winter	Depth/Area 5	368	8.734	0.034	1.5	12.8511	0.0000	OK
480 minute winter	Depth/Area 6	368	8.734	0.034	1.5	12.8511	0.0000	OK
240 minute winter	Depth/Area 7	188	8.728	0.028	1.0	4.2546	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)
480 minute winter	1	1.001	2	1.3	0.633	0.074	0.0063	
480 minute winter	2	1.002	3	1.3	0.763	0.051	0.0242	
480 minute winter	3	1.003	4	2.6	0.678	0.049	0.0757	59.3
480 minute winter	5	Orifice	1	0.4				
360 minute winter	Depth/Area 1	Orifice	1	0.3				
360 minute winter	Depth/Area 2	Orifice	1	0.3				
720 minute winter	Depth/Area 3	Orifice	1	0.4				
180 minute winter	Depth/Area 4	Orifice	3	0.3				
480 minute winter	Depth/Area 5	Orifice	3	0.4				
480 minute winter	Depth/Area 6	Orifice	3	0.4				
240 minute winter	Depth/Area 7	Orifice	3	0.3				

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	1	200	7.848	0.035	1.8	0.0393	0.0000	OK
240 minute winter	2	200	7.810	0.027	1.8	0.0311	0.0000	OK
240 minute winter	3	196	7.455	0.041	3.6	0.0460	0.0000	OK
240 minute winter	4	200	7.255	0.040	3.6	0.0000	0.0000	OK
360 minute winter	5	296	8.742	0.042	2.4	16.1446	0.0000	OK
240 minute winter	Depth/Area 1	188	8.737	0.037	1.7	7.4498	0.0000	OK
240 minute winter	Depth/Area 2	188	8.737	0.037	1.7	7.4498	0.0000	OK
480 minute winter	Depth/Area 3	376	8.744	0.044	2.3	19.9499	0.0000	OK
240 minute winter	Depth/Area 4	184	8.736	0.036	1.5	6.2258	0.0000	OK
360 minute winter	Depth/Area 5	296	8.742	0.042	2.4	16.1446	0.0000	OK
360 minute winter	Depth/Area 6	296	8.742	0.042	2.4	16.1446	0.0000	OK
180 minute winter	Depth/Area 7	148	8.735	0.035	1.6	5.4019	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)
240 minute winter	1	1.001	2	1.8	0.691	0.103	0.0079	
240 minute winter	2	1.002	3	1.8	0.836	0.070	0.0305	
240 minute winter	3	1.003	4	3.6	0.745	0.069	0.0959	59.1
360 minute winter	5	Orifice	1	0.5				
240 minute winter	Depth/Area 1	Orifice	1	0.4				
240 minute winter	Depth/Area 2	Orifice	1	0.4				
480 minute winter	Depth/Area 3	Orifice	1	0.5				
240 minute winter	Depth/Area 4	Orifice	3	0.4				
360 minute winter	Depth/Area 5	Orifice	3	0.5				
360 minute winter	Depth/Area 6	Orifice	3	0.5				
180 minute winter	Depth/Area 7	Orifice	3	0.4				

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	1	280	7.854	0.041	2.5	0.0461	0.0000	OK
360 minute winter	2	280	7.815	0.032	2.5	0.0363	0.0000	OK
360 minute winter	3	272	7.462	0.048	4.9	0.0537	0.0000	OK
360 minute winter	4	272	7.261	0.046	4.9	0.0000	0.0000	OK
480 minute winter	5	368	8.759	0.059	2.7	22.5296	0.0000	OK
180 minute winter	Depth/Area 1	160	8.751	0.051	3.0	10.2432	0.0000	OK
180 minute winter	Depth/Area 2	160	8.751	0.051	3.0	10.2432	0.0000	OK
480 minute winter	Depth/Area 3	384	8.761	0.061	3.3	27.9467	0.0000	OK
180 minute winter	Depth/Area 4	148	8.750	0.050	2.6	8.5494	0.0000	OK
480 minute winter	Depth/Area 5	368	8.759	0.059	2.7	22.5296	0.0000	OK
480 minute winter	Depth/Area 6	368	8.759	0.059	2.7	22.5296	0.0000	OK
180 minute winter	Depth/Area 7	144	8.748	0.048	2.3	7.3811	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)
360 minute winter	1	1.001	2	2.5	0.752	0.140	0.0099	
360 minute winter	2	1.002	3	2.5	0.914	0.096	0.0380	
360 minute winter	3	1.003	4	4.9	0.815	0.094	0.1197	102.5
480 minute winter	5	Orifice	1	0.7				
180 minute winter	Depth/Area 1	Orifice	1	0.6				
180 minute winter	Depth/Area 2	Orifice	1	0.6				
480 minute winter	Depth/Area 3	Orifice	1	0.7				
180 minute winter	Depth/Area 4	Orifice	3	0.6				
480 minute winter	Depth/Area 5	Orifice	3	0.7				
480 minute winter	Depth/Area 6	Orifice	3	0.7				
180 minute winter	Depth/Area 7	Orifice	3	0.6				

Blue Roofs

The BauderBLUE Roof System is a sustainable drainage method designed to attenuate and manage stormwater on a flat roof over a 24-hour period via a restrictive flow outlet.

This rooftop solution is specified where construction is being carried out in urban areas and particularly within flood sensitive areas.

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BAUDER BLUE ROOF SYSTEM

Sustainable Urban Drainage

Development and expansion of towns and cities has seen exponential use of impervious surfaces causing artificially high rates of rainwater runoff. In measures to prevent flooding, planners are restricting the amount of rainwater leaving a site via the drainage system which can be limited to 5-10 litres per second per hectare, the same flow rates for regional greenfield sites.

A BauderBLUE Roof is a solution for urban areas where options for ground-based attenuation systems are limited, and in particular, where construction is being carried out within flood sensitive areas. This rooftop sustainable urban drainage system (SuDS) has weight load implications and the project's structural engineer will need to be engaged with the design process from an early stage.

Blue Roof for SuDS

The specifically engineered Bauder outlet restricts the discharge of stormwater to a calculated and predesigned flow rate to significantly slow down the volume of water leaving the site. As the storm passes, water continues to discharge from the roof at a controlled rate over a 24-hour period that helps to avoid downstream or localised flooding.

The BauderBLUE Roof System can be constructed at either rooftop or podium level. The designed void space between the flat roof waterproofing membrane and hard or soft landscaping finish allows the stormwater to attenuate.

Key Features

- Simple low maintenance design.
- Bespoke, project specific discharge rates to match the requirement of the SuDS report for the site.
- Can be created on zero falls or up to 1:40 pitch.
- Correct volume and weight of water storage with built in overflow to ensure the maximum water level (HMax) is never exceeded and a tell-tale parapet overflow is utilised to visibly identify if water levels rise close to the HMax.
- Designed to work in conjunction with the Bauder Total Green Roof System and Bauder Hot Melt System.

Specification Support

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

Telephone helpline:
0845 271 8800

BLUE ROOFS

BLUE ROOF DESIGN

System Configuration

The BauderBLUE Roof is designed for use with either the Bauder Total Green Roof System as a warm roof or the Bauder Hot Melt cold roof construction.

The design of the void space requires free-flowing water movement to the specifically engineered outlets.

The baseplate of the blue roof system sits within a standard Bauder outlet and slows water leaving the roof via a calculated number of restrictive flow holes. The number of flow holes, up to a maximum of 12, is calculated to reflect the SuDS calculation for permitted discharge rate for the site.

If, in the event of a storm of greater magnitude than 1:100 plus 40% for climate change, then water will evacuate the roof through the central overflow.

The design of every blue roof is individual to the project and geographical location. The roof should have minimal penetrations in the construction. We use details of the roof area and the drainage requirements for the site to produce a roof specific discharge report as part of our service.

Restrictor Flow Hole

Bauder Infograph Video

To view the entire animation: https://www.bauder.co.uk/blue-roofs

BLUE ROOF SURFACE FINISHES

BLUE ROOF DESIGN CONSIDERATIONS

Many local planning authorities (LPAs) are adopting early perspectives that encompass Schedule 3 of the Flood and Water Act 2010 to bring in measures that prevent flooding. Within construction and development, planners are restricting the amount of rainwater leaving a site via the drainage system, limiting water egress to 5-10 litres per second per hectare, the same flow rates for regional greenfield sites.

We have a comprehensive Blue Roof Design Considerations Guide available to download from, www.bauder.co.uk/technical-centre.

Design of a Blue Roof

A blue roof can be at rooftop or podium level and is designed to attenuate storm water within a void which sits directly above the waterproofing layer and beneath a surface finish such as a vegetated green roof or hard landscaping.

A blue roof should not be designed as a water storage facility but should allow all the water to evacuate the roof over a 24-hour period from the end of the projected maximum rainfall event.

Key Aspects

1. **Single Point Source and Guarantee.** Consider the waterproofing, blue roof and surface design finish as one element, to ensure compatibility and guarantee clarity.

2. **Void Space.** To have the correct capacity to accommodate the predicted stormwater levels during a 1:100 year storm and the permanent load of the required finish and any imposing loading.

3. **British Standards.** Standards and Systems Codes of Practice for waterproofing and roof detailing.

4. **Roof Penetrations.** must be minimal or eliminated in the area where water is to be attenuated, other than the rainwater outlets or emergency overflows that are required for drainage functionality.

5. **Emergency Overflow.** Unconnected to the blue roof outlet flow restrictor, to discharge the rainwater.

Drainage

The discharge rate for the site is set by the local planning authority. The blue roof may be included to supplement other methods, or designed as the sole solution. The blue roof may be designed to accept a higher or lower percentage of the controlled discharge depending on other attenuation or storage options available in other areas of the site or because the building will have loading restrictions or limited available height for the rooftop solution.

Deck Construction

The implementation of a blue roof will have considerable loading implication on the roof and its waterproofing. The roof deck construction will need to be designed not only to accept the dead and imposed loads*, but also the weight loading associated with the water to be attenuated on the roof.

A blue roof can be designed on zero falls providing the waterproofing system holds relevant certification and the roof is designed in accordance with British Standards.

Waterproofing

Consideration must be given to the appropriate form of waterproofing so that it can meet the demands placed on it by the blue roof.

If the blue roof construction has a finish where germination of any plant seedlings is possible the membrane should be tested and approved to the current FLL and GRO guidelines.

Our blue roof solutions utilise two robust waterproofing constructions; a bituminous warm or cold roof build-up with the Bauder Total Roof System (Green for soft landscaping) or a Bauder Hot Melt cold roof construction. Both systems carry BBA certification and are suitable to maintain the integrity required for blue and green roof applications.

Void-Forming Component

The void forming component must have the correct structural capacity to resist the permanent load of the required finish and any imposing loading.

The void-forming components must:

- Have the capacity to fully accommodate the predicted storm water for a 24-hour period.
- Be resistant to chemicals such as fertilisers, petro-based compounds and water bound pollutants carried in by rainfall typically from 4-9pH.
- Allow free-flowing movement of water to the flow restrictor outlets.
- Be designed beneath the surface finish and be able to prevent any ponding or flooding occurring on the surface finish.

Blue Roof Outlets

Restrictor Outlets

The design, manufacture and installation of a flow restrictor and outlet is critical to the success of a blue roof as the outlet will be subjected to greater water pressures than standard gravity-fed drainage and it could be immersed for long periods.

Emergency Overflows

Emergency drainage will be provided with the primary outlet and a secondary method of drainage to facilitate the removal of excess rainfall if the designed capacity is exceeded. The emergency overflow outlet will be specified and the base of the overflow pipe should be placed level with the top of the void height or H-Max.

Maintenance access is important to allow for clearing of any silt, debris, or leaf and plant matter which could block or restrict the flow of water through the emergency outlet. This is particularly important if trees are located nearby, as they can be a frequent source of material.

Surface Finishes

The surface finish will be able to freely drain in to the attenuating void space without submitting to ponding water or flooding.

Suitable permeable surface finishes are:

- Paving or decking on a pedestal support system.
- Extensive green roofs, such as sedum or wildflower systems.
- Intensive green roofs, such as lawns, planters and more substantial planting.
- BioSOLAR.

Impermeable surface finishes require approaches to ensure the water can drain or filter in to the blue roof void space so that attenuation of rainwater can occur.

Ensuring Success

Designing a blue roof requires specialist knowledge and a cohesive approach with full compatibility of the waterproofing void components, outlets and finish. We provide the complete design package and guarantees for every project to ensure success.

BREEAM

If you are working to BREEAM, please contact a member of our technical team, who can advise on best practice for your individual project

Pollution

This category addresses the prevention and control of pollution and surfce water run-off assosicated the building's location and use.

Pol 03 – Flood and surface water management

This section emphasises the importance to avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, thereby minimising the risk and impact of localised flooding on-site and off-site, watercourse pollution and other environmental damage.

A BauderBLUE roof system is a solution for urban areas where options for ground-based attenuation systems are limited. This rooftop sustainable urban drainage system (SuDS) has specifically engineered outlets to restrict the discharge of stormwater to a calculated and predesigned flow rate to significantly slow down the volume of water leaving the site.

BLUE ROOF FLOW RESTRICTORS

Bauder Bitumen Blue Roof Flow Restrictor

The Bauder Bitumen Blue Roof Flow Restrictor is designed to be used in conjunction with a standard Bauder Bitumen Blue Roof Vertical Outlet DN70. The Bauder Blue Roof Bitumen Flow Restrictor is comprised of four parts; Baseplate, overflow pipe, Baseplate inner and Baseplate outer seal. The polyamide Baseplate fits within the 70mm vertical outlet, with the EPDM outer seal creating a watertight fit. The HDPE Overflow slots into the central hole of the Baseplate with an inner EPDM seal preventing any leaks.

Baseplate has a number (1-12) of 10mm restrictive flow holes bespoke to the project.

Bauder Hot Melt Blue Roof Flow Restrictor

The Bauder Hot Melt Blue Roof Flow Restrictor is designed to be used in conjunction with a Bauder Hot Melt Compact Vertical Outlet DN70. The Bauder Hot Melt Blue Roof Flow Restrictor is comprised of four parts; Baseplate, Overflow pipe, inner and outer seal. The polyamide Baseplate fits within the 70mm vertical outlet, with the EPDM outer seal creating a watertight fit. The HDPE Overflow slots into the central hole of the Baseplate with an inner EPDM seal preventing any leaks.

The Baseplate has a number (1-12) of 10mm restrictive flow holes bespoke to the project.

DRAINAGE VOID FORMER

Attenuation Cell 100 - For Blue Roofs

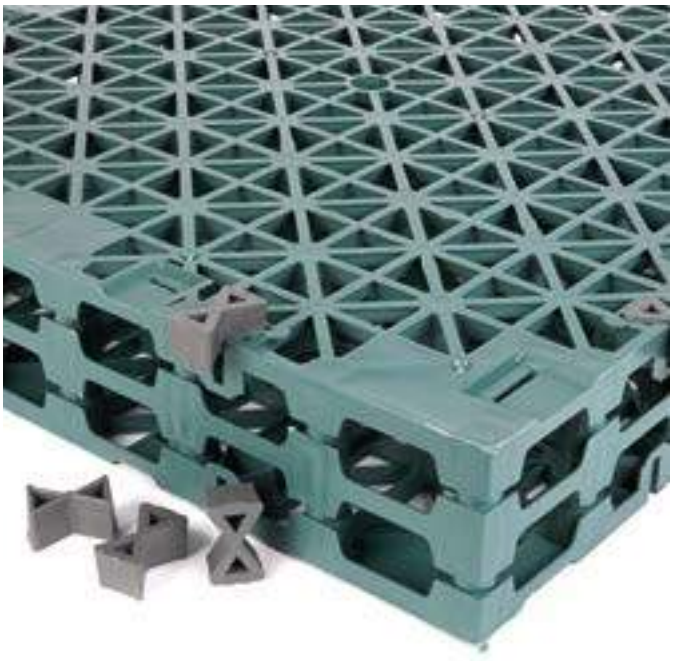
The Bauder Attenuation Cell 100 is a multi-directional drainage layer used primarily as a void former in our blue roof systems.

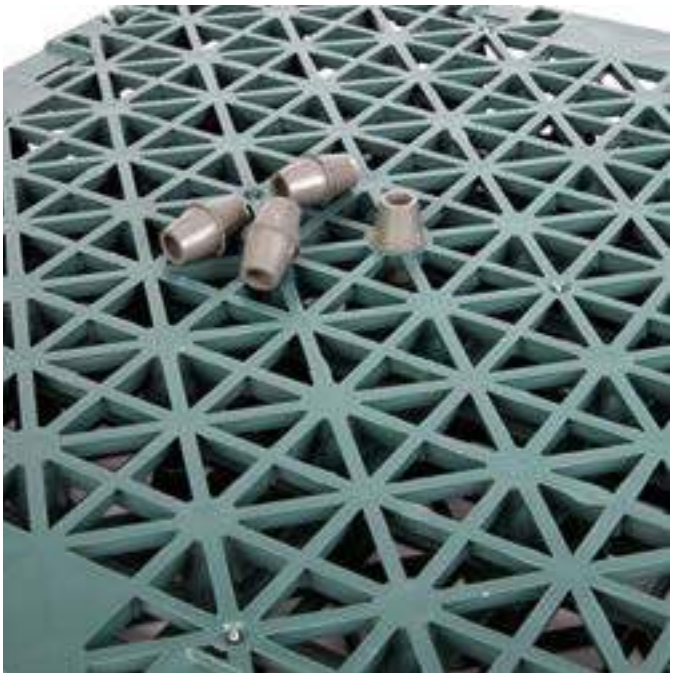
The boards are designed to create the void space required between the flat roof waterproofing and the hard or soft landscaping finish to allow the stormwater to attenuate. The product is over 95% void and has excellent compressive strength for use under green roofs and hard landscaping surfaces. Attenuation Cell 100 is laid on a protection layer above the completed waterproofing to provide continuous drainage.

Material	Recycled HDPE
Board size	0.6 x 0.6m
Thickness	100mm
Weight	2.9Kg/m^2
Water holding capacity	95 litres/m^2 (95% void space)
Compressive strength	≥400kN/m^2 vertically 100kN/m^2 laterally

Attenuation Cell Connectors

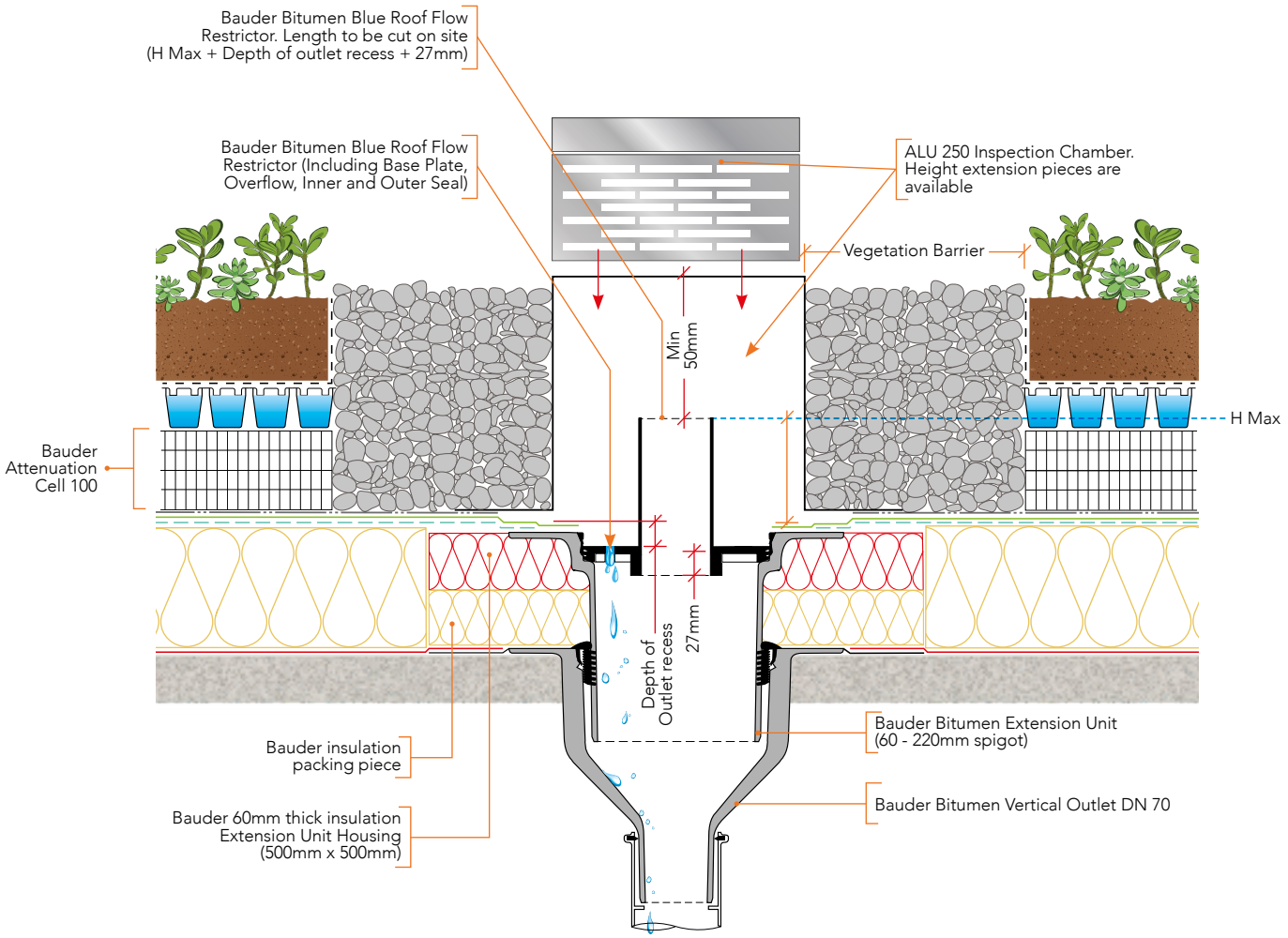
The Cross Connectors link the boards together horizontally, the Shear Connectors connect two layers of Attenuation Cell 100 should they be required.





GENERAL DETAILING

Blue roofs for SuDS

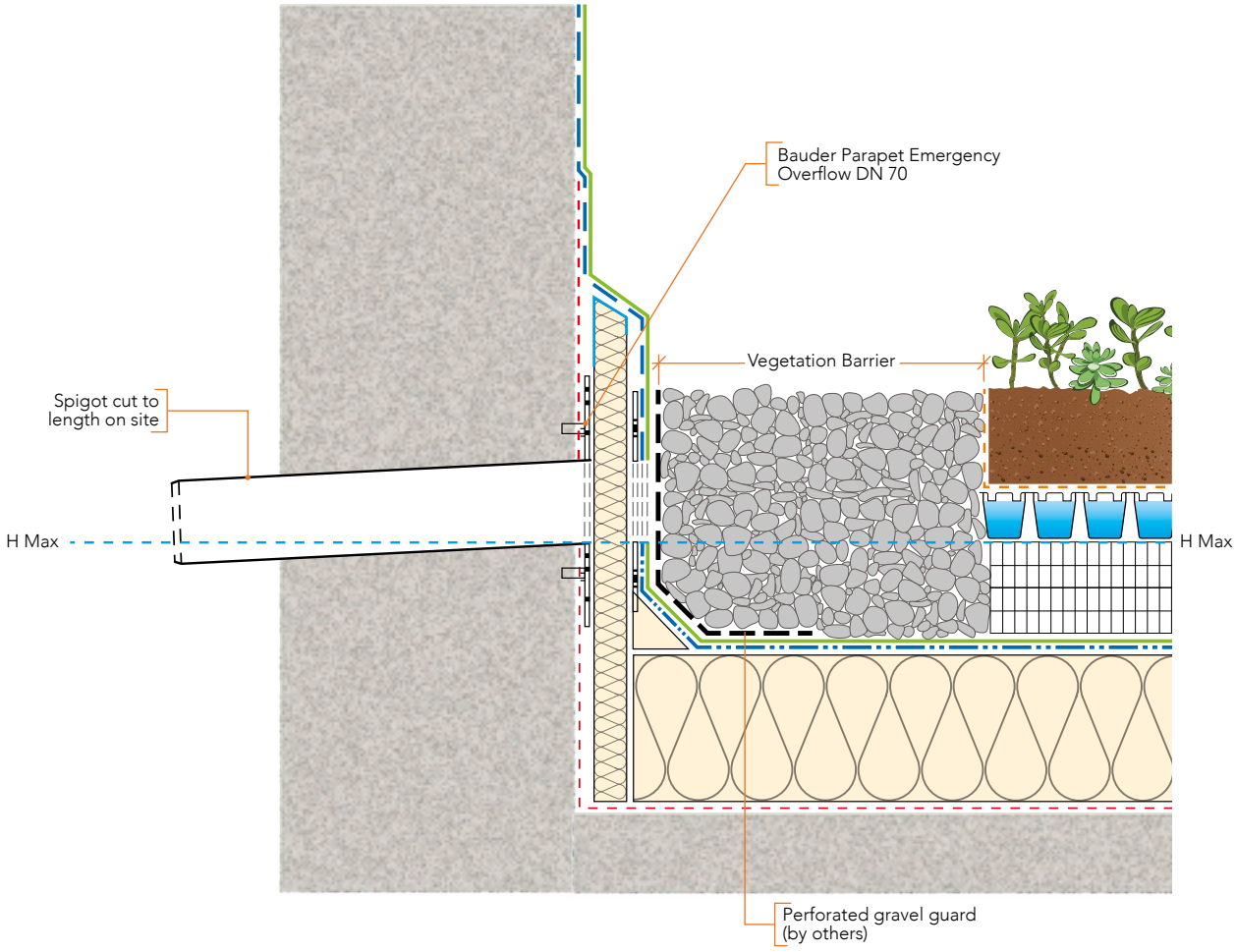


The cross section above shows the BauderBLUE Roof System. The Flow Restrictor sits securely within the outlet and precisely controls the flow rate of rainwater off the roof (each restrictor is bespoke to the roof requirements).

The Attenuation Cell 100 provides an open void for holding back rainwater in the short term. This will only start to fill in heavy storm conditions when the restricted flow is exceeded. During a heavy storm, the water builds up to a maximum (normally set at a 1:100 Yr storm event (+40% for global warming). In the event of this being exceeded the water is safely discharged through the overflow in the centre of the flow restrictor.

Prior to finalising the roof design Bauder carries out detailed calculations to establish the configuration of the restrictors and their individual flow rate plus the maximum depth of water allowed to build up on the roof (H-Max).

The layers above the Attenuation Cell 100 (DSE drainage board, substrate and vegetation) are the green roof elements, and whilst they greatly help with the attenuation of water on the roof they are separate to the blue roof elements.



NFRC guildelines for blue roofs recommend that a parapet overflow is always installed to enable excess water to drain off the roof.

The Bauder Emergency Overflow is designed to act as a highly visible 'tell-tale' of the level of water on the roof. It provides a useful indicator should water build up to the H-Max point. Bauder's Flow Restrictors have additional vertical overflows to prevent the H-Max ever being exceeded.

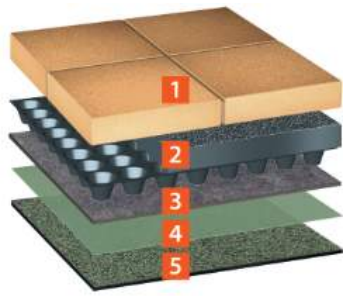
edded paving

reating low maintenance accessible areas such as walkways, access roads and terrace spaces with container planting set atop e paving or decking for an intensive green roof finish.

ard landscaping for moderate loadings

hen to specify...

his system is ideal for hard landscaping intensive green roof (https://www.bauder.co.uk/green-roofs/accessible-green-roofs-ardens) applications such as decking and paving where the anticipated loading is moderate.



1 Paving	
2 DSE 20 (/technical-centre/products/green-roof-landscaping/dse-20) infilled with sand cement screed bedding	Protection layer to prevent mechanical damage to the waterproofing system.
3 FSM 600 (/technical-centre/products/green-roof-landscaping/fsm-600) protection layer	Protection layer to prevent mechanical damage to the waterproofing system.
4 PE foil (/technical-centre/products/green-roof-landscaping/pe-foil) separation layer	Separation layer between the waterproofing and green roof components.
5 Bauder waterproofing (/roof-systems/waterproofing-systems)	Shown here with Plant E root resistant, SBS modified bitumen membrane reinforced with 250g/m² recycled spunbond polyester.

Key features

- Designed with a compressive strength of up to 1000kN/m^2
- Creates low maintenance accessible spaces
- Versatile visual finish
- Supports planter held vegetation

Benefits

- Assists in maximising the building's potential
- Planters can be relocated to suit visual design
- Low maintenance

Approvals, certification and guarantee

- Comprehensive range of guarantees for this system
- Landscaping elements manufactured to meet FLL guidelines

Environmental credentials

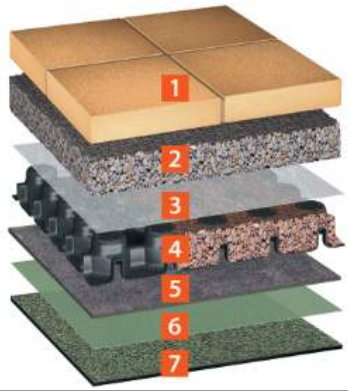
- DSE 20 is made from recyclable HDPE

Installation and maintenance

The quality and experience of the installing operative is paramount to ensuring a successful project. Bauder Approved Contractors are the only people fully trained and certified to install our products. They provide the necessary experience that our exceptional guarantee demands.

When to specify...

When the roof structure allows, hard landscaping can be designed to allow for vehicular access and the associated dynamic higher weight loading.



1 Paving, decking or road surface	
2 Crushed gravel base 30-50mm	
3 (/technical-centre/products/green-roof-landscaping/fsm-600)Filter fleece (/technical-centre/products/green-roof-landscaping/filter-fleece)	Polypropylene fleece to prevent substrate fines from entering the drainage element.
4 DSE 60 (/technical-centre/products/green-roof-landscaping/dse-60) water retention and drainage layer infilled with Bauder Mineral Drain	Multi-functional water storage and drainage layer, usually infilled with Mineral Drain.
5 FSM 1100 (/technical-centre/products/green-roof-landscaping/fsm-1100) protection layer	Protection layer to prevent mechanical damage to the waterproofing system.
6 (https://www.bauder.co.uk/cms/getdoc/d4f260e6-babd-4d04-bcca-428c8766c4dd/Heavily-trafficked-permeable-hard-landscaping.aspx?viewmode=3&showpanel=1&cmscontentchanged=true&lang=en-GB&langobjectlifetime=request#)**PE foil** (/technical-centre/products/green-roof-landscaping/pe-foil) separation layer	Separation layer between the waterproofing and green roof components.
5 Bauder waterproofing (/roof-systems/waterproofing-systems)	Shown here with Plant E root resistant, SBS modified bitumen membrane reinforced with 250g/m² recycled spunbond polyester.

Key features

- Withstands loads above 1000Kg/m^2
- Ideal construction base for permeable or bedded surfaces including roadways and paving
- Creates low maintenance accessible spaces
- Versatile visual finishes
- Planter held vegetation as well as full complement of landscaping

Benefits

- Assists in maximising the building's potential
- If planters are utilised this creates a moveable scheme
- Low maintenance

Approvals, certification and guarantee

- Comprehensive range of guarantees for this system
- Landscaping elements manufactured to meet FLL guidelines.

Environmental credentials

- DSE 60 is made from recyclable HPDE

Installation and maintenance

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Engineered design and specification

Fundamentally, a blue roof is designed to attenuate water and should not be considered as a water storage solution.

The Bauder Blue Roof is designed for use with either the Bauder Total Green Roof System as a warm roof construction or the Bauder Hot Melt cold roof construction. The design of the blue roof requires:

- Specific flow restrictor outlets to meet the requirements of planning for total allowable water discharge.
- Emergency overflows included in the design, unconnected to the blue roof outlets, to discharge the rainwater should the maximum height of rainwater attenuated be reached.
- Free-flowing multi-directional water movement within the void space to the specifically engineered outlets.
- Minimal or elimination of penetrations in the area where water is to be attenuated, other than the rainwater outlets or emergency overflows that are required for drainage functionality. In some instances, it may be possible to individually isolate the roof penetration from the blue roof SuDS to prevent any possible water ingress from contaminating the insulation.
- Roof design must adhere to the British Standards and Systems Codes of Practice for waterproofing and roof detailing.

Flow Restrictor Outlet Design and Specification

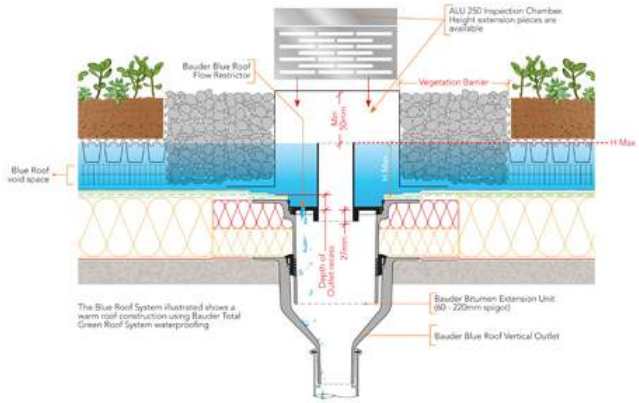
The baseplate of the blue roof system sits within a standard Bauder outlet and slows water from leaving the roof via a calculated number of restrictive flow holes. The number of flow holes, up to a maximum of 12, is calculated to reflect the SuDS calculation for permitted discharge rate for the site.

If, in the event of a storm of greater magnitude than 1 in 100 years plus 40% for climate change, then water will evacuate the roof through the central overflow.

The design of every Bauder blue roof is individual to the project and geographical location. We use details of the roof area and the drainage requirements for the site to produce a roof specific discharge report to show the following:

- Storm profile for the roof during a 1 in 100-year storm event + 40% for climate change.
- Maximum attenuation volume on the roof.
- Number of outlets required, complete with an assigned number of control holes, restricting the flow of water in line with the discharge rate for site.
- The depth of void required on the roof on to which any landscaping finish can be installed.

The report and series of calculations allows us to produce the most effective scheme for your project.



Installation of a BauderBLUE Roof

The Bauder blue roof outlet overflow is inserted into the baseplate and measured, marked and cut to the specified Hmax for the roof. The entire blue roof outlet is protected with the Bauder ALU250 Inspection Chamber which allows for ease of access during regular maintenance.

Maintenance

Blue roofs require regular maintenance and inspection of the outlets to ensure the drainage holes are free of debris or blockages. Inspections should take place following any significant storm event, any notable traffic or remedial works that take place on or around the roof, and following leaf fall during the autumn months to ensure leaf litter is not causing obstruction.