

**Project: 6239 – Shell Eastfield, Rustington
Bypass, Littlehampton, West Sussex.**

Client: Bayliss Design Ltd

Report Reference: 6239 - CIV_C001

Date: April 2019

REVISION RECORD Report Ref: 6239 - CIV-C001

Rev	Description	Date	Originator	Checked
-	Initial issue	04/04/19	AD	BK

Disclaimers

This report has been prepared for the sole use of the named client and, consequently, is confidential to the client and his professional advisors. The Contracts (Rights of Third Parties) Act 1999 does not apply, nothing in this report confers or purports to confer on any third party any benefit or right. No responsibility whatsoever is accepted to any other person than the named client and, consequently, the contents of this report should not be relied upon by third parties for the whole or any part of its contents.

This report is made on behalf of BCAL, no individual is personally liable, and by receiving this report and acting upon it, the client - or any third party relying on it - accepts that no individual is personally liable in contract, tort, or breach of statutory duty (including negligence).

Table of Contents

1.0	Introduction	3
	Background	3
	Aim	4
	Objective	4
2.0	Site Characteristics	4
3.0	Surface Water Management and Drainage Design	8
4.0	Water Quality & Construction Surface Water Management	Error! Bookmark not defined.
5.0	Overland Flood Routes	12
6.0	Conclusions and Recommendations	12
	APPENDIX A	13
	NETWORK CALCULATIONS	13
	(Including Micro-Drainage Calculations)	13
	APPENDIX B	14
	BROWNFIELD CONDITIONS	14
	(Including Micro-Drainage Calculations)	14
	APPENDIX C	15
	LAYOUT PLANS & CONSTRUCTION DETAILS	15

1.0 Introduction

Background

- 1.1 Bayliss Design Ltd commissioned BCAL Consulting Ltd to undertake a review of the proposed Drainage Design Strategy carried by others, with a view to produce a Surface Water Management Plan (SWMP) for the proposed development site. The project particulars are as follows:

Aspect	
Site Address:	Shell Eastfield, Worthing Road, BN17 6LE
Site Location:	Ordinance Survey Grid Reference [E503845 N103340]
Local Planning Authority:	Arun District Council
Planning Application Reference:	LU/314/18/PL
Description of Development:	The Development works entail the demolition of sales building & plant room, LPG compound/ dispenser & canopy link removed, erection of new sales building, plant room, bin store, delivery bay, front-of store customer parking & Adblue facility to the HGV forecourt, block pavements to car forecourt replaced with liquid tight concrete & fuel dispensers replaced to main forecourt & HGV. The gross impermeable areas of the existing and proposed are 0.2612ha and 0.2921ha respectively, whereas the net impermeable areas are 0.2612ha and 0.2826ha respectively.

- 1.2 The SWMP, the subject of this report, is to facilitate with the discharge of the following Pre-commencement Planning Conditions:

3. SURFACE WATER DRAINAGE: *Development shall not commence until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority.*

The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SUDS Manual produced by CIRIA.

Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage.

Reason: To ensure that the proposed development is satisfactorily drained in accordance with policies W SP1, W DM1, W DM2 and W DM3 of the Arun Local Plan. This is required to be a pre-commencement condition because it is necessary to implement the surface water drainage system prior to commencing any building works.

Aim

- 1.3 The aim of this SWMP Technical Report is to adopt a holistic strategy for the proposed development site, implementing a Sustainable Urban Drainage System (SUDS) concept using the best management practices (BMP's) as suggested in the CIRIA and EA publications.

Objective

- 1.4 The objective of the design requirement of this report is to:-
- a) Retain / reduce the quantity of surface water run-off leaving the development area to equal that, or less, of the Brownfield Run-off rate pre-development (i.e. site extension works) for all storms up to and including the in 100 year + 40% climate change event by source and site control measures.
 - b) Improve the quality of surface water run-off by filtration methods (via use of existing Fuel Separators).
 - c) Separate the Non-contaminated Surface Water (NCSW) from the Contaminated Surface Water flows.

2.0 Site Characteristics

- 2.1 **Topography** –The development site is located to the east of The Body Shop Roundabout and west of the Littlehampton Rustington Travel lodge. The north end of the site is the A259 dual carriageway and the along the south end is the B2187 single carriageway, Worthing Road.

The site is approximately 70m by 60m and is relatively steep with a gradient of 1:70 and generally comprises a combination of concrete hard standing, block pavements, and tarmac surfacing. The site is located approximately 5m AOD (Above Ordinance Datum).

- 2.2 **Geology and Soils –**

Bedrock Geology Description:

Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) – chalk.

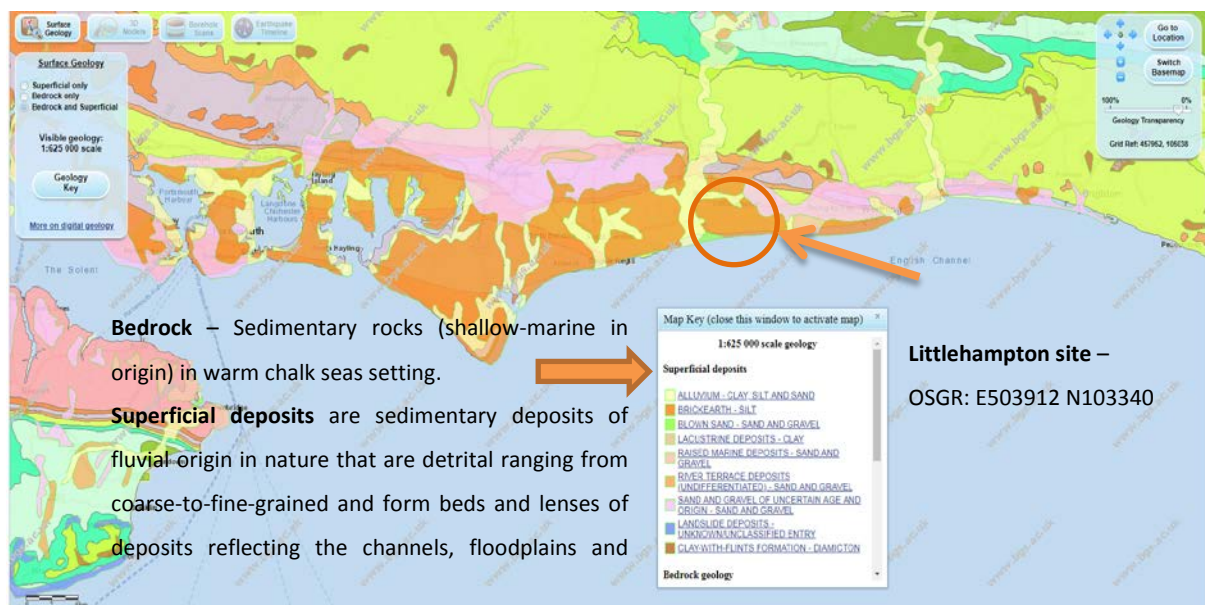
Sedimentary Bedrock formed approximately 72 to 94 million years ago in the Cretaceous Period. Local environment previously dominated by warm chalk seas.

Setting: Warm Chalk seas. These Sedimentary Rocks are shallow-marine in origin. They are biogenic and detrital, generally comprising carbonate material (coccoliths), forming distinctive beds of chalk.

Superficial deposits description:

River Terrace Deposits (undifferentiated) - Sand, Silt & Clay. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).

Setting: rivers (U). These sedimentary deposits are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).



2.3 **Percolation Tests** – This is not required, as no infiltration methods are being implemented. Piped network connecting to the existing network will be utilised.

2.4 **Impermeable Areas** – An Impermeable Area, Drainage Strategy and Catchment Plans are included in Appendix C for reference. The plans highlight impermeable areas derived from Roof Areas (Buildings, Canopy and Carwash facility), Patios, Bin Storage and Petrol Station Forecourt areas for light vehicle and heavy goods vehicles.

To model the network correctly, one must first determine the existing surface water network areas. The existing catchment comprises two independent areas of collecting and conveying surface water runoff to the Outfall.

The First Area being referred to herein as the 'Non-contaminated' Surface Water Areas (NCSW) as they only collect, retain and convey water from non-trafficked areas, namely Roofs (Main & Rear and Car Wash Buildings), Main & Link Canopy and walkways around the immediate vicinity of the Main & Rear Buildings.

The trafficked areas with the potential to carry pollutants shall be referred to as Contaminated Surface Water Areas (CSW). These areas include forecourt and car wash areas.

The various Impermeable areas are deduced as follows:

Non-contaminated Surface Water (NCSW) - Existing		Non-contaminated Surface Water (NCSW) - Proposed	
Description	Area (m ²)	Description	Area (m ²)
Existing Roof of Main Building	113.459	Proposed Roof of Main Building	296.103
Existing Roof of Rear Building	23.952	Canopy - Main	218.106
Canopy - Main & Link (218.106+73.014 = 291.120m ²)	291.120	Patios	118.743
Car wash roof	67.489	Carwash Roof area	67.489
Walkway Patios (137.448-113.459 =23.989 m2)	23.989		
Total Existing Impermeable Catchment Area (m²) =	520.009	Total Proposed Impermeable Catchment Area (m²) =	700.441
Difference in area between existing and proposed (m ²) NCSW zones	180.432		
Percentage difference between existing and proposed (+value represents an increase and a -ve value a decrease)	35.0%		
Contaminated Surface Water (CSW) - Existing		Contaminated Surface Water (CSW) - Proposed	
Description	Area (m ²)	Description	Area (m ²)
Total Existing catchment area at Grade Level	2,611.811	Total Existing catchment area at Grade Level	2,921.233
Existing Roof of Car Wash facility	-67.489	Existing Floor & nearby area of Car Wash taken up by the Foul Network	-95.315
Existing Roof of Main & Rear Building	-137.411	Proposed Roofs of Main Building & car wash	-363.592
Existing Roof of Canopy (Main & Link)	-291.120	Canopy - Main	-218.106
Walkway Patios (137.448-113.459 =23.989)	-23.989	Patios	-118.743
Total Effective Existing Impermeable Catchment Area (m²) =	2,091.802	Total Effective Proposed Impermeable Catchment Area (m²) =	2,125.477
Difference in area between existing and proposed (m ²) CSW zones	33.675		
Percentage difference (+value represents an increase and a -ve value a decrease)	1.6%		
Net Impermeable Area	2,611.811	Net Impermeable Area	2,825.918
Gross Impermeable Area	2,611.811	Gross Impermeable Area	2,921.233

2.5 Catchment Areas – The Storm Water Network comprises two independent sub-networks (NCSW & CSW) that converge at the outfall at the northeast corner of the site.

Pipe flows for both the NCSW and CSW of the existing system are unrestricted. However, as the NCSW network represents a 35 % increase in the surface area of the existing development our design strategy for the proposed would be to mimic the existing brownfield conditions without putting extra load on the existing drainage system.

To achieve this intent we have provided the use of cellular storage crates [3m wide by 6m long and 0.8m high and allowing for 95% porosity yields a storage volume of 13.68m³, which is in touch with the initial storage estimate of 16m³ and 29m³ obtained from Micro-Drainage (Source Control)]. See Appendix B.

In addition, a hydro-brake is provided at the location Manhole no. S10 (upstream of pipe 3.001) to ensure flows are limited to no more than 5l/s as the y reach the outfall.

Since the surface area of the CSW network represents a 1.6 % increase on the existing which is not restricted, we feel, there is no need for any online control measures.

The various catchment contributing areas per manhole and annotation of the control type are highlighted in the table overleaf and also detailed in the catchment area plan in Appendix C.

Pipe No.	U/S MN	D/S MN	Comment	Contributing Catchment Areas (CA) in m ²			Sub-Total	CA Hectares (ha)
				sub-catchment	sub-catchment	sub-catchment		
1.000	S01	S02		0.000	0.000	153.785	153.785	0.015
1.001	S02	S04		0.000	0.000	381.093	381.093	0.038
1.002	S04	S05		0.000	0.000	188.616	188.616	0.019
1.003	S05	S06		108.064	95.816	0.000	203.880	0.020
1.004	S06	S07		0.000	0.000	0.000	0.000	0.000
1.005	S07	Outfall		0.000	0.000	0.000	0.000	0.000
2.000	S03	S04		0.000	891.998	306.126	1,198.124	0.120
3.000	S08	S10		148.053	118.743	0.000	266.796	0.027
3.001	S10	Outfall	Hydrobrake & Cellular crates	0.000	0.000	0.000	0.000	0.000
4.000	S09	S10		148.050	218.106	67.489	433.645	0.043
							2,825.939	0.283

There is the opportunity to re-direct the flows from the sub-catchment (see highlighted cell) into the proposed Foul Network capacity permitting. The design of the Foul Network is outside the scope of this report. Re-directing the above catchment to the foul would ameliorate to some extent flooding experienced for some storm periods.

3.0 Surface Water Management and Drainage Design

3.1 MANAGEMENT OF SURFACE WATER

- (a) Current Conditions: The site is largely comprised of impermeable areas with the fringes made of grass and earth bunds around the perimeter.



Picture 1: Showing an Aerial view of the site.

It is proposed that Surface water captured from the Main Building and Canopy together the patio areas would drain directly into the pipe networks 3.000 and 4.000 prior to discharging to the outfall via pipe 3.001. This represents the Non-contaminated Surface water (NCSW) sub-network and has a storage volume (i.e. cellular crates) and a vortex control device (i.e. Hydro-brake) attached to it to restrict flows to no more than 5l/s..

Surface water from the trafficked areas shall drain via the CSW sub-network.

Surface water from the carwash building including the roof, floor and immediate vicinity shall drain to the proposed Foul Network. This catchment area would be deducted from the total surface water catchment area as the foul network will be computed separately by others.

- (b) Surface Water Drainage Outfalls: It is a requirement of the Building Regulations (2015), Drainage and Waste Disposal, Approved Document H, to dispose of surface water collected within a development in the following list of priorities:-
- First Option – Infiltration systems where ground condition permit *[Not viable in our case]*
 - Second Option – To watercourses *[there are no watercourses nearby]*
 - Third Option – To sewers *[the nearest adopted surface water sewer is located within northeast end of the site. This will require a vortex control device (i.e. NCSW network) to throttle flows to no more than 5 l/s.*

3.4 PROPOSED DRAINAGE STRATEGY and DESIGN

- (a) The Surface water discharge rates will be restricted to Brownfield equivalent runoff rates to ensure that the rate of surface water runoff from the site does not increase as a result of the proposed development.
- (b) A 35% increase in the surface area of the proposed NCSW sub-network would warrant the use of underground storage (cellular crates) system and an online control (Hydro-brake) to limit flows to 5 L/s. An increase of 1.6% of the CSW sub-network means there is negligible impact on the existing condition and no online or storage volumes are required.
- (c) The DESIGN Criteria has been based upon the following publications and computer software.
- The SUDS Manual C753 by CIRIA
 - Sustainable Drainage Systems C609 by CIRIA
 - Design Guide - Permeable Pavements by Interpave
 - MicroDrainage Software
- (d) Hydraulic Calculations shall be considered for the following storm events:
- 1 in 1 year return *(i.e. for site slopes greater than 1% – No surcharging above pipe soffit under pipe full condition)*
 - 1 in 30 years return *(No Flooding but surcharge permissible)*
 - 1 in 100 years return *(No internal Flooding)*
 - 1 in 100 years return plus 40 % climate change
- (e) Existing Brownfield Conditions

As the gross area of the site (0.2612ha) is less than 50ha the most appropriate hydraulic calculation technique is the ICP SuDS method, which was used to establish the existing greenfield runoff characteristics. The calculation results are in Appendices A and B.

- The brownfield runoff rate for the development site is as shown below:

Soil type	0.400
Standard Average Annual Rainfall (SAAR)	742 mm – obtained from FSR Parameters
Urban	0.50
Region number	6 & 7
Proposed Impermeable Area	0.283
Q_1	1.7 l/s
Q_{bar} (Mean Annual Flow from a rural catchment in l/s)	2.0 l/s
Q_{30}	3.7 l/s
Q_{100}	4.5 l/s

The Q_{bar} equivalent rate for the proposed development is 2.0 l/s. A restriction of 2.0 l/s could potentially result in a small aperture at the outfall, which could increase the risk of blockage. The minimum recommended discharge rate recommended by the Environment Agency is **5.0 l/s**.

(f) Attenuation Requirements

The NCSW network will be attenuated at a rate of 5l/s prior at the penultimate manhole prior to being discharge at the outfall at the same rate.

The attenuation (via pipes and geo-cellular storage crates) has been designed to accommodate a 1 in 100 year event plus allowance of 40% for climate change. The proposed net impermeable area of the development is 0.3095 ha, of which is 0.0633ha is from the NCSW sub-network.

Based on the proposed impermeable area and allowable discharge rate of 5.0 l/s, the storage requirement for the 1 in 100 year plus climate change event has been calculated utilising the following parameters. Full calculations are enclosed in Appendix B.

Rainfall Profile	Flood Studies Report (FSR)
Return Period	100 years
Climate Change	40% plus
Durations	15 to 10,080 minutes
Drained Area	0.07ha
Limit Flow to Outfall	5.0 l/s
Control	Hydro-brake
Total Storage Required	Between 16m ³ and 29m ³

(g) SUDs Methods

Piped Network: The Private surface water drainage within the site boundary is to be designed in accordance with Part H of the Building Regulations. All surface water sewers within the road network/communal open spaces will be designed in accordance with the Sewers for Adoption - 7th Edition publication using the Micro-Drainage software and offered for adoption under a Section 104 Agreement. The civil infrastructure in respects of roads will be owned and maintained privately and shall not be the subject of an adoption under a Section 38 Agreement.

4 Overland Flood Routes

- 4.1 The intent of the Drainage Strategy is to design the surface water drainage to accommodate the 1 in 100 year storm event, taking into account the predicted future effects of climate change (40% increase in intensity) .

There is a risk of this storm event being exceeded, albeit the risk is considered very low. In such an event, the proposed drainage systems will become overwhelmed and overland flows could occur.

Overland flows will be directed to follow the path that overland flows currently flow and away from the proposed new dwellings. Refer to Appendix C for details of the overland flow route plan.

5.0 Conclusions and Recommendations

- 5.1 This report details a proposed Surface Water Management and Drainage Design Strategy which meets the requirements of Planning Condition 3 as it;

- (a) Provides a sustainable drainage solution that disposes of surface water responsibly. This is achieved through a combination of SuDs techniques including oversized pipes, Cellular Storage. The said surface water management approach is the third option under the hierarchy of drainage outlined within the National Planning Policy Framework;
- (b) Is based on the 1 in 100 years return period plus climate change (i.e. 40%) rainfall event, results of which confirmed Flooding of 17m³ to the existing manhole S3, which is only of diameter 100mm. This flooding is to be expected as the original pipe was not designed for a 100 year plus 40% storm event.
- (c) Prevents pollution by providing water quality treatment via the use of existing Fuel & Oil separators / interceptors;
- (d) Includes infiltration substantive Micro-Drainage calculations as well as other construction detailing.
- (e) Incorporates flood protection measures in case of extreme weather conditions by ensuring overland flow paths move away from main proposed building. The Finished Floor Levels (FFL) of the main building should be set such that it is 150mm above the surrounding grade.

APPENDIX A

NETWORK CALCULATIONS

(Including Micro-Drainage Calculations)

BCAL Consulting		Page 0
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.346	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	99	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Network 1 at outfall Outfall (pipe 1.005)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.146	4-8	0.064

Total Area Contributing (ha) = 0.210

Total Pipe Volume (m³) = 2.121

Time Area Diagram at outfall S6 (pipe 3.001)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.046	4-8	0.023

Total Area Contributing (ha) = 0.069

Total Pipe Volume (m³) = 1.336

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto
(m)	(m)	(1:X)	(ha)	(mins)	Flow	(l/s)	(mm)	SECT	(mm)			Design

Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	Σ Base	Foul	Add Flow	Vel	Cap	Flow
(mm/hr)	(mins)	(m)	(ha)	Flow	(l/s)	(l/s)	(l/s)	(m/s)	(l/s)	(l/s)

BCAL Consulting		Page 1
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	15.595	0.267	58.4	0.015	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	40.502	0.692	58.5	0.038	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	26.439	0.580	45.6	0.119	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	7.893	0.047	167.9	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	5.464	0.033	165.6	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	3.162	0.019	166.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	8.916	0.053	168.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	21.232	0.573	37.1	0.026	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	20.635	0.353	58.5	0.043	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	33.748	0.577	58.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	47.84	5.20	4.500	0.015	0.0	0.0	0.0	1.32	23.3	1.9
1.001	45.95	5.71	4.233	0.053	0.0	0.0	0.0	1.32	23.3	6.6
2.000	47.13	5.38	4.400	0.119	0.0	0.0	0.0	1.14	9.0«	15.2
1.002	45.35	5.88	3.466	0.190	0.0	0.0	0.0	0.77	13.7«	23.3
1.003	44.96	6.00	3.269	0.210	0.0	0.0	0.0	0.78	13.8«	25.6
1.004	44.73	6.06	3.086	0.210	0.0	0.0	0.0	0.78	13.7«	25.6
1.005	44.33	6.19	2.917	0.210	0.0	0.0	0.0	1.21	85.5	25.6
3.000	47.78	5.21	4.500	0.026	0.0	0.0	0.0	1.66	29.3	3.4
4.000	47.60	5.26	4.280	0.043	0.0	0.0	0.0	1.32	23.3	5.5
3.001	46.02	5.69	3.927	0.069	0.0	0.0	0.0	1.32	23.3	8.6

BCAL Consulting		Page 2
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Manhole Schedules for Surface Network 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	5.800	1.300	Open Manhole	1200	1.000	4.500	150				
S2	5.550	1.317	Open Manhole	1200	1.001	4.233	150	1.000	4.233	150	
S3	5.750	1.350	Open Manhole	1200	2.000	4.400	100				
S4	5.170	1.704	Open Manhole	1200	1.002	3.466	150	1.001	3.541	150	75
								2.000	3.820	100	304
S5	5.340	2.071	Open Manhole	1200	1.003	3.269	150	1.002	3.419	150	150
S6	5.300	2.214	Open Manhole	1200	1.004	3.086	150	1.003	3.236	150	150
S7	5.230	2.313	Open Manhole	1200	1.005	2.917	300	1.004	3.067	150	
Outfall	5.130	2.266	Open Manhole	1200		OUTFALL		1.005	2.864	300	
S8	5.800	1.300	Open Manhole	1200	3.000	4.500	150				
S9	5.580	1.300	Open Manhole	1200	4.000	4.280	150				
S10	5.410	1.483	Open Manhole	1200	3.001	3.927	150	3.000	3.927	150	
								4.000	3.927	150	
S6	5.130	1.780	Open Manhole	1200		OUTFALL		3.001	3.350	150	

BCAL Consulting		Page 3
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

PIPELINE SCHEDULES for Surface Network 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S1	5.800	4.500	1.150	Open Manhole	1200
1.001	o	150	S2	5.550	4.233	1.167	Open Manhole	1200
2.000	o	100	S3	5.750	4.400	1.250	Open Manhole	1200
1.002	o	150	S4	5.170	3.466	1.554	Open Manhole	1200
1.003	o	150	S5	5.340	3.269	1.921	Open Manhole	1200
1.004	o	150	S6	5.300	3.086	2.064	Open Manhole	1200
1.005	o	300	S7	5.230	2.917	2.013	Open Manhole	1200
3.000	o	150	S8	5.800	4.500	1.150	Open Manhole	1200
4.000	o	150	S9	5.580	4.280	1.150	Open Manhole	1200
3.001	o	150	S10	5.410	3.927	1.333	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	15.595	58.4	S2	5.550	4.233	1.167	Open Manhole	1200
1.001	40.502	58.5	S4	5.170	3.541	1.479	Open Manhole	1200
2.000	26.439	45.6	S4	5.170	3.820	1.250	Open Manhole	1200
1.002	7.893	167.9	S5	5.340	3.419	1.771	Open Manhole	1200
1.003	5.464	165.6	S6	5.300	3.236	1.914	Open Manhole	1200
1.004	3.162	166.4	S7	5.230	3.067	2.013	Open Manhole	1200
1.005	8.916	168.2	Outfall	5.130	2.864	1.966	Open Manhole	1200
3.000	21.232	37.1	S10	5.410	3.927	1.333	Open Manhole	1200
4.000	20.635	58.5	S10	5.410	3.927	1.333	Open Manhole	1200
3.001	33.748	58.5	S6	5.130	3.350	1.630	Open Manhole	1200

BCAL Consulting		Page 4
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Area Summary for Surface Network 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.015	0.015	0.015
1.001	-	-	100	0.038	0.038	0.038
2.000	-	-	100	0.119	0.119	0.119
1.002	-	-	100	0.018	0.018	0.018
1.003	-	-	100	0.020	0.020	0.020
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.026	0.026	0.026
4.000	-	-	100	0.043	0.043	0.043
3.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.279	0.279	0.279

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

1.005	Outfall	5.130	2.864	0.000	1200	0
-------	---------	-------	-------	-------	------	---

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

3.001	S6	5.130	3.350	0.000	1200	0
-------	----	-------	-------	-------	------	---

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha	Storage 2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.346		

BCAL Consulting		Page 5
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S10, DS/PN: 3.001, Volume (m³): 2.4

Unit Reference	MD-SHE-0109-5000-0800-5000
Design Head (m)	0.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	3.927
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	5.0	Kick-Flo®	0.537	4.2
Flush-Flo™	0.241	5.0	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.800	5.0	2.000	7.7	4.000	10.6	7.000	13.9
0.200	5.0	1.000	5.5	2.200	8.0	4.500	11.3	7.500	14.4
0.300	5.0	1.200	6.0	2.400	8.4	5.000	11.8	8.000	14.8
0.400	4.8	1.400	6.5	2.600	8.7	5.500	12.4	8.500	15.2
0.500	4.5	1.600	6.9	3.000	9.3	6.000	12.9	9.000	15.7
0.600	4.4	1.800	7.3	3.500	10.0	6.500	13.4	9.500	16.1

BCAL Consulting		Page 6
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Storage Structures for Surface Network 1

Cellular Storage Manhole: S10, DS/PN: 3.001

Invert Level (m) 3.927 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	18.0	18.0	0.800	18.0	32.4	0.801	0.0	32.4

Manhole Headloss for Surface Network 1

PN	US/MH Name	US/MH Headloss
1.000	S1	0.500
1.001	S2	0.500
2.000	S3	0.500
1.002	S4	0.500
1.003	S5	0.500
1.004	S6	0.500
1.005	S7	0.500
3.000	S8	0.500
4.000	S9	0.500
3.001	S10	0.500

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
1.000	S1	1.470	0.254	0.000	1.725
1.001	S2	1.489	0.695	0.000	2.184
2.000	S3	1.527	0.198	0.000	1.725
1.002	S4	1.927	0.118	0.000	2.045
1.003	S5	2.342	0.075	0.000	2.418
1.004	S6	2.504	0.035	0.000	2.539
1.005	S7	2.616	0.545	0.000	3.161
3.000	S8	1.470	0.354	0.000	1.824
4.000	S9	1.470	0.343	0.000	1.814
3.001	S10	1.677	0.575	13.686	15.938
Total		18.494	3.193	13.686	35.373

BCAL Consulting		Page 7
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.100 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.346 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

									Water	Surcharged
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)
1.000	S1 15 Winter		100	+40%	100/15 Summer				5.297	0.647
1.001	S2 15 Winter		100	+40%	30/15 Summer				5.274	0.891
2.000	S3 30 Winter		100	+40%	1/15 Summer	30/15 Summer			5.768	1.268
1.002	S4 15 Winter		100	+40%	1/15 Summer				4.756	1.140
1.003	S5 15 Winter		100	+40%	1/15 Summer				4.288	0.869
1.004	S6 15 Winter		100	+40%	1/15 Summer				3.738	0.502
1.005	S7 15 Winter		100	+40%					3.110	-0.107
3.000	S8 60 Winter		100	+40%	100/30 Summer				5.038	0.388
4.000	S9 60 Winter		100	+40%	100/15 Summer				5.045	0.615
3.001	S10 60 Winter		100	+40%	30/15 Summer				5.028	0.951

Flooded				Pipe		Level	
PN	US/MH Name	Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Flow (l/s)	Status	Exceeded
1.000	S1	0.000	0.34		7.3	SURCHARGED	
1.001	S2	0.000	0.87		19.5	FLOOD RISK	
2.000	S3	17.956	1.79		15.6	FLOOD	16
1.002	S4	0.000	3.18		37.7	SURCHARGED	
1.003	S5	0.000	4.03		45.6	SURCHARGED	

BCAL Consulting		Page 8
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Flooded		Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)		
1.004	S6	0.000	4.38	45.6	SURCHARGED	
1.005	S7	0.000	0.74	45.4	OK	
3.000	S8	0.000	0.29	8.0	SURCHARGED	
4.000	S9	0.000	0.53	11.7	SURCHARGED	
3.001	S10	0.000	0.26	5.8	SURCHARGED	

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.000 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.001 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

BCAL Consulting		Page 11
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Rainfall Hyetograph for 30 minute 100 year Winter I+40%
for Pipe 2.000 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	11.583	6	38.663	11	112.669	16	208.549	21	88.287	26	37.439
2	28.458	7	43.441	12	139.622	17	191.531	22	67.646	27	37.424
3	35.643	8	52.895	13	167.548	18	167.548	23	52.895	28	35.643
4	37.424	9	67.646	14	191.531	19	139.622	24	43.441	29	28.458
5	37.439	10	88.287	15	208.549	20	112.669	25	38.662	30	11.582

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.002 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.003 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.004 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

Rainfall Hyetograph for 15 minute 100 year Winter I+40%
for Pipe 1.005 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	29.723	4	71.513	7	266.556	10	187.283	13	56.493
2	54.240	5	115.754	8	309.625	11	115.754	14	54.240
3	56.493	6	187.283	9	266.556	12	71.513	15	29.723

BCAL Consulting		Page 16
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Rainfall Hyetograph for 60 minute 100 year Winter I+40%
for Pipe 3.000 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	3.844	10	24.101	19	53.256	28	126.893	37	94.077	46	31.898	55	23.510
2	11.052	11	24.468	20	60.285	29	132.191	38	85.482	47	29.017	56	22.329
3	16.344	12	25.254	21	67.881	30	136.011	39	77.016	48	26.849	57	20.254
4	20.254	13	26.849	22	77.016	31	136.011	40	67.881	49	25.254	58	16.344
5	22.329	14	29.017	23	85.482	32	132.191	41	60.285	50	24.468	59	11.052
6	23.510	15	31.898	24	94.077	33	126.893	42	53.256	51	24.102	60	3.844
7	24.032	16	36.128	25	103.657	34	119.423	43	46.208	52	24.047		
8	24.097	17	40.787	26	111.817	35	111.817	44	40.787	53	24.097		
9	24.046	18	46.208	27	119.423	36	103.657	45	36.128	54	24.032		

BCAL Consulting		Page 17
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Rainfall Hyetograph for 60 minute 100 year Winter I+40%
for Pipe 4.000 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	3.844	10	24.101	19	53.256	28	126.893	37	94.077	46	31.898	55	23.510
2	11.052	11	24.468	20	60.285	29	132.191	38	85.482	47	29.017	56	22.329
3	16.344	12	25.254	21	67.881	30	136.011	39	77.016	48	26.849	57	20.254
4	20.254	13	26.849	22	77.016	31	136.011	40	67.881	49	25.254	58	16.344
5	22.329	14	29.017	23	85.482	32	132.191	41	60.285	50	24.468	59	11.052
6	23.510	15	31.898	24	94.077	33	126.893	42	53.256	51	24.102	60	3.844
7	24.032	16	36.128	25	103.657	34	119.423	43	46.208	52	24.047		
8	24.097	17	40.787	26	111.817	35	111.817	44	40.787	53	24.097		
9	24.046	18	46.208	27	119.423	36	103.657	45	36.128	54	24.032		

BCAL Consulting		Page 18
Orient House Church Way Wellingborough NN8 4HJ		
Date 04/04/2019 23:26	Designed by Amadou Dampha	
File FINAL SIMULATION OUTPUT_AD3.mdx	Checked by Barry King	
Micro Drainage		Network 2017.1.2

Rainfall Hyetograph for 60 minute 100 year Winter I+40%
for Pipe 3.001 (Surface Network 1)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	3.844	10	24.101	19	53.256	28	126.893	37	94.077	46	31.898	55	23.510
2	11.052	11	24.468	20	60.285	29	132.191	38	85.482	47	29.017	56	22.329
3	16.344	12	25.254	21	67.881	30	136.011	39	77.016	48	26.849	57	20.254
4	20.254	13	26.849	22	77.016	31	136.011	40	67.881	49	25.254	58	16.344
5	22.329	14	29.017	23	85.482	32	132.191	41	60.285	50	24.468	59	11.052
6	23.510	15	31.898	24	94.077	33	126.893	42	53.256	51	24.102	60	3.844
7	24.032	16	36.128	25	103.657	34	119.423	43	46.208	52	24.047		
8	24.097	17	40.787	26	111.817	35	111.817	44	40.787	53	24.097		
9	24.046	18	46.208	27	119.423	36	103.657	45	36.128	54	24.032		

APPENDIX B

BROWNFIELD CONDITIONS

(Including Micro-Drainage Calculations)

6239 Drainage Storage Calculations: FSR 100 Year Return Plus 40% Climate Change

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

FSR Rainfall

Return Period (years)

100

Region

England and Wales

Map

M5-60 (mm)

19.100

Ratio R

0.346

Cv (Summer)

0.750

Cv (Winter)

0.840

Impermeable Area (ha)

0.070

Maximum Allowable Discharge (l/s)

5.0

Infiltration Coefficient (m/hr)

0.00000

Safety Factor

2.0

Climate Change (%)

40

Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

Global Variables require approximate storage of between 16 m³ and 29 m³.

These values are estimates only and should not be used for design purposes.

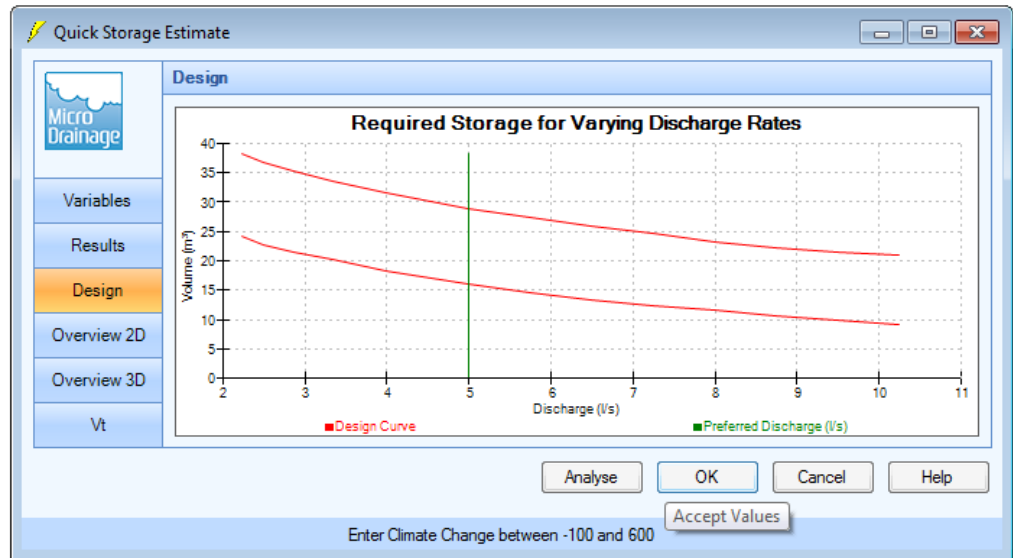
Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600



6119 Drainage Storage Calculations: FEH 30 Year Return Plus 0% Climate Change

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

Variables

FSR Rainfall

Return Period (years)30

RegionEngland and Wales

Map

M5-60 (mm)19.100

Ratio R0.346

Cv (Summer)0.750

Cv (Winter)0.840

Impermeable Area (ha)0.070

Maximum Allowable Discharge (l/s)5.0

Infiltration Coefficient (m/hr)0.00000

Safety Factor2.0

Climate Change (%)0

Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600

Micro Drainage

Variables

Results

Design

Overview 2D

Overview 3D

Vt

Results

Global Variables require approximate storage of between 5.6 m³ and 12 m³.

These values are estimates only and should not be used for design purposes.

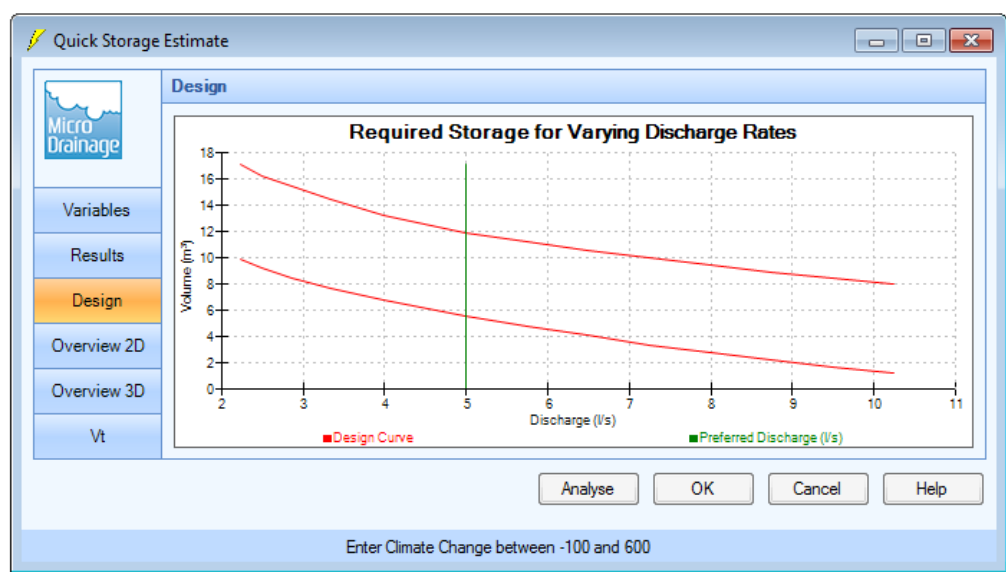
Analyse

OK

Cancel

Help

Enter Climate Change between -100 and 600



6239 Existing Brownfield Runoff Rates

Rural Runoff Calculator

Micro Drainage

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years)

Area (ha)

SAAR (mm)

Soil

Growth Curve

Partly Urbanised Catchment (QBAR)

Urban

Region

Results

QBAR rural (l/s)

QBAR urban (l/s)

Return Period Flood

Region	QBAR (l/s)	Q (30yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	2.0	3.2	1.7	3.2	3.7
Region 2	2.0	3.2	1.7	3.2	3.8
Region 3	2.0	3.1	1.7	3.1	3.4
Region 4	2.0	3.3	1.6	3.3	3.9
Region 5	2.0	3.8	1.7	3.8	4.8
Region 6/Region 7	2.0	3.7	1.7	3.7	4.5
Region 8	2.0	3.3	1.5	3.3	3.7
Region 9	2.0	3.1	1.7	3.1	3.5
Region 10	2.0	3.0	1.7	3.0	3.3
Ireland National	2.0	2.9	1.7	2.9	3.1
Ireland East	2.0	2.9	1.7	2.9	3.2
Ireland South	2.0	2.9	1.7	2.9	3.1
Ireland West	2.0	2.8	1.7	2.8	3.0
Ireland Greater Dublin	2.0	3.7	1.7	3.7	4.1

OK Cancel Help

Enter Return Period between 1 and 1000

6239 SIMULATION RESULTS

Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S1	15 minute 100 year Winter I+40%	5.800	5.297	0.647	0.000	0.34		7.3	SURCHARGED
1.001	S2	15 minute 100 year Winter I+40%	5.550	5.274	0.891	0.000	0.87		19.5	FLOOD RISK
2.000	S3	30 minute 100 year Winter I+40%	5.750	5.768	1.268	17.956	1.79		15.6	FLOOD
1.002	S4	15 minute 100 year Winter I+40%	5.170	4.756	1.140	0.000	3.18		37.7	SURCHARGED
1.003	S5	15 minute 100 year Winter I+40%	5.340	4.288	0.869	0.000	4.03		45.6	SURCHARGED
1.004	S6	15 minute 100 year Winter I+40%	5.300	3.738	0.502	0.000	4.38		45.6	SURCHARGED
1.005	S7	15 minute 100 year Winter I+40%	5.230	3.110	-0.107	0.000	0.74		45.4	OK
3.000	S8	60 minute 100 year Winter I+40%	5.800	5.038	0.388	0.000	0.29		8.0	SURCHARGED
4.000	S9	60 minute 100 year Winter I+40%	5.580	5.045	0.615	0.000	0.53		11.7	SURCHARGED
3.001	S10	60 minute 100 year Winter I+40%	5.410	5.028	0.951	0.000	0.26		5.8	SURCHARGED

APPENDIX C

LAYOUT PLANS & CONSTRUCTION DETAILS

DRAINAGE STRATEGY

IMPERMEABLE AREAS

CATCHMENT AREAS

STANDARD CONSTRUCTION DETAILS

This drawing is Copyright, is the property of BCAL and cannot be copied or used without the written consent of this company.

This drawing to be read in conjunction with all relevant BCAL, Architects, M & E, Specialist Consultants and Contractors project specific drawings and specifications.

Current British Standards apply.

All dimensions are in millimetres. (U.N.O)

All levels are in metres. (U.N.O)

Written dimensions only shall be used.

Do Not Scale.

Any discrepancies shall be brought to the attention of BCAL immediately.

IF IN DOUBT ASK.

NOTES

- Drawing based on:
 - Topographical Survey by URS dated May 2011;
 - Architects layout ref 10019507 - (Drainage & Levels) Drain 19 dated February 2019
- All drains to have Class S granular bed and surround, except where a, cover beneath roads or hardstanding is less than 0.9m b, cover beneath soft landscaping is less than 0.6m in which case class Z concrete bed and surround is required.
- Where pipes pass through the manhole wall a joint must be formed within 150mm of the wall.
- All pipes to enter manhole with soffits level.
- All chambers to have ductile iron, single seal lock down covers to grade D400 BS EN 124 in road or car park areas and B125 BS EN 124 in all other areas. Recessed covers to be used in areas of block paving. Covers are to be aligned parallel to kerbs, paving orientation or structures unless otherwise shown.

Refer also to Drawings

No	Description	Date	By	Chk
Revisions to this Drawing				
Saved: 0:\projects\6200\6239\Drawings\BCAL DWG\6239-20-DRAINAGE STRATEGY_02.04.19.dwg				
Dm By:	AD	Date:	29.03.19	Chkd: MB



BCAL CONSULTING, Orient House,
Church Way, Wellingborough, Northamptonshire, NN8 4HJ.
Tel: 01933 440024 Fax: 01933 440041 Web: www.bcal.co.uk

Client

BAYLISS DESIGN LTD

Project
**SHELL EASTFIELD
RUSTINGTON**
Littlehampton, West Sussex

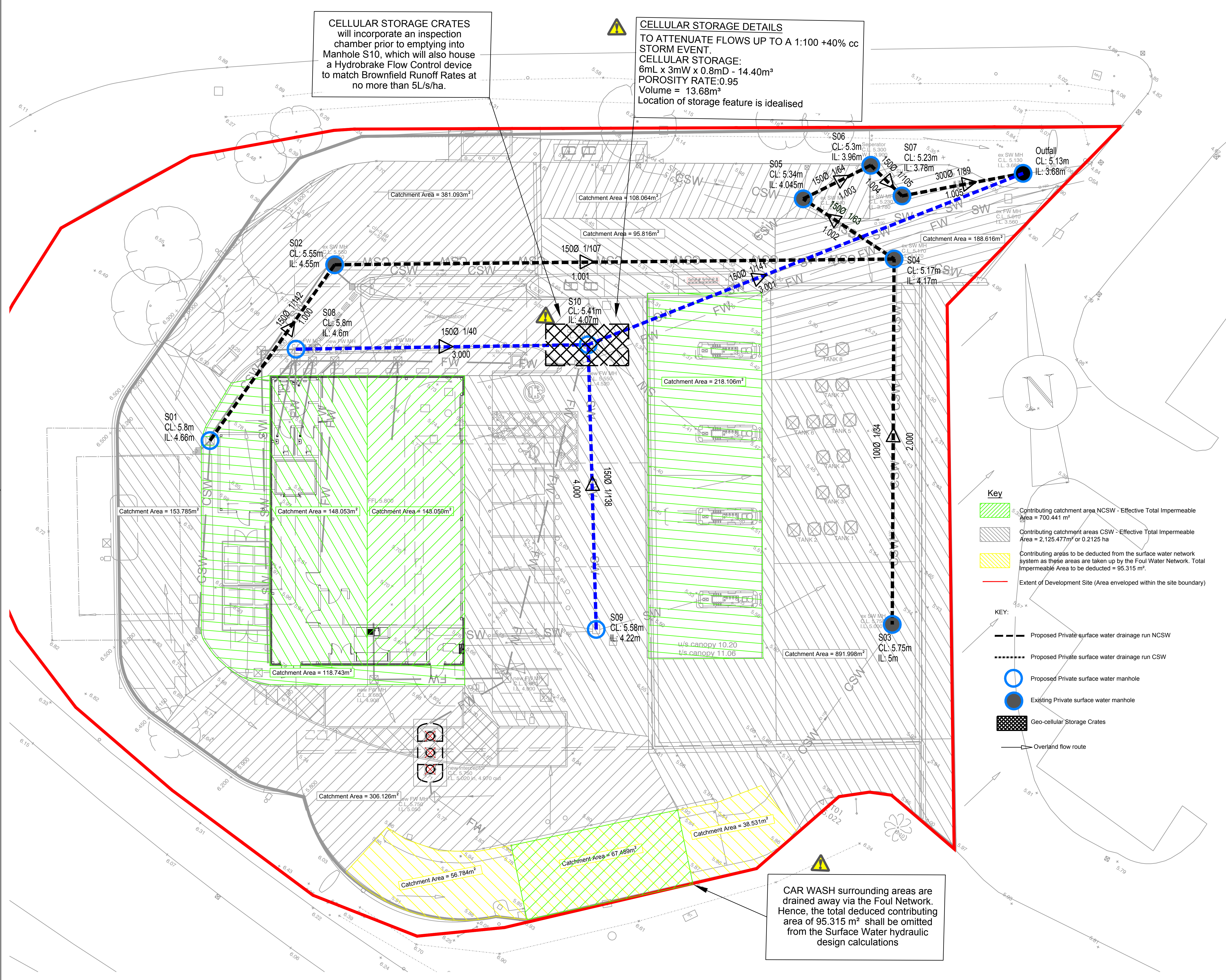
Drg. Title
DRAINAGE STRATEGY

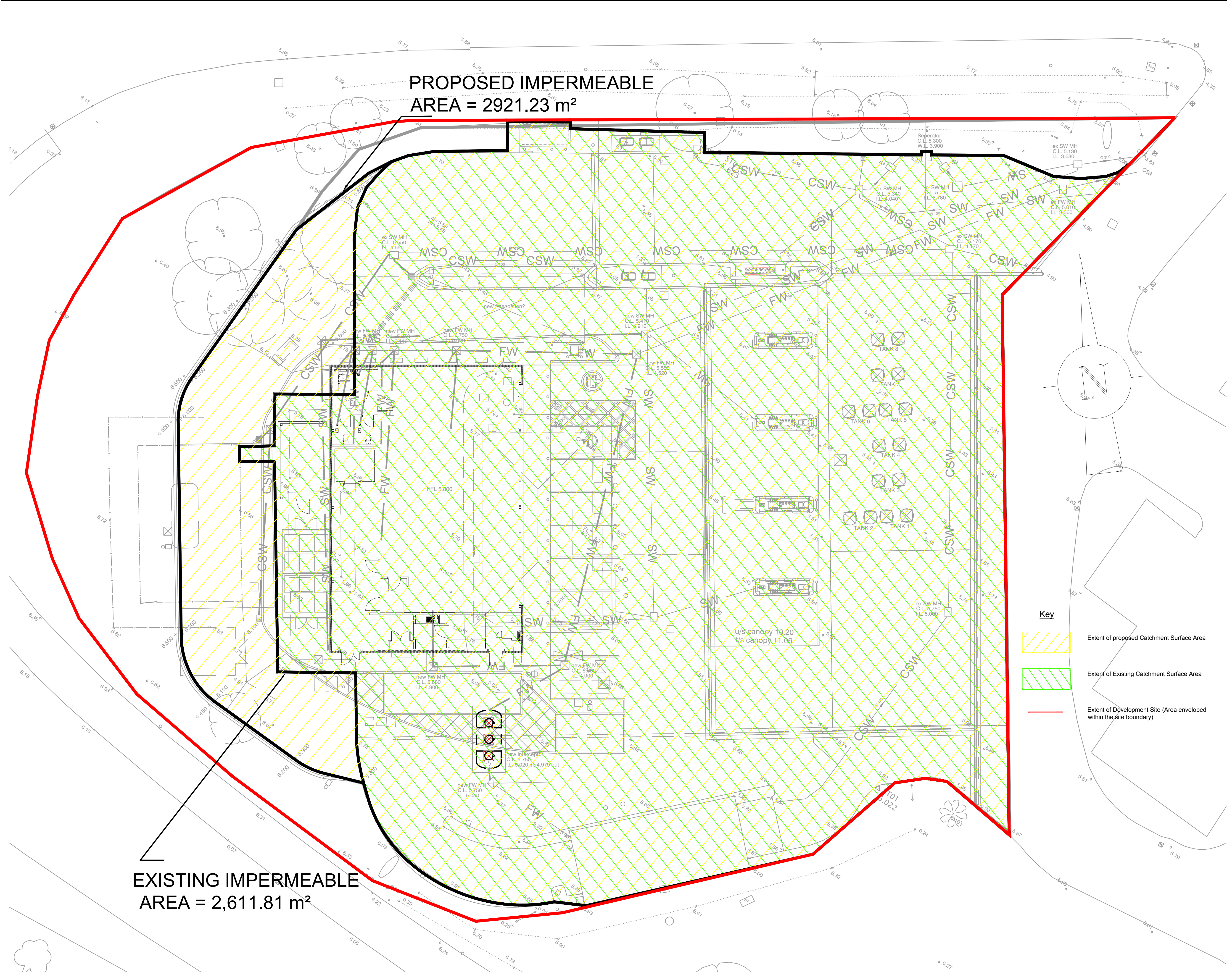
Scales @ A1
1:125

Drawing No.
6239-20

Rev
-

Status: **INFORMATION**





0:\PROJECTS\AUTOCAD STANDARDS\BCAL DRAWING FRAMES\BCAL A1 Frame Rev A.DWG

This drawing is Copyright, is the property of BCAL and cannot be copied or used without the written consent of this company.

This drawing to be read in conjunction with all relevant BCAL, Architects, M & E, Specialist Consultants and Contractors project specific drawings and specifications.

Current British Standards apply.

All dimensions are in millimetres. (U.N.O)

All levels are in metres. (U.N.O)

Written dimensions only shall be used.

Do Not Scale.

Any discrepancies shall be brought to the attention of BCAL immediately.

IF IN DOUBT ASK.

NOTES

1. Drawing based on:
- Topographical Survey by URS dated May 2011;
Architects layout ref 10019507 - (Drainage & Levels)
Drain 19 dated February 2019

2. All drains to have Class S granular bed and surround, except where a, cover beneath roads or hardstanding is less than 0.9m b, cover beneath soft landscaping is less than 0.6m in which case class Z concrete bed and surround is required.

3. Where pipes pass through the manhole wall a joint must be formed within 150mm of the wall.

4. All pipes to enter manhole with soffits level.

5. All chambers to have ductile iron, single seal lock down covers to grade D400 BS EN 124 in road or car park areas and B125 BS EN 124 in all other areas.
Recessed covers to be used in areas of block paving.
Covers are to be aligned parallel to kerbs, paving orientation or structures unless otherwise shown.

Refer also to Drawings

No	Description	Date	By	Chk
Revisions to this Drawing				
Saved: 0:\projects\6200\6239\Drawings\BCAL DWG\6239-20-DRAINAGE STRATEGY_02.04.19.dwg				
Dm By:	AD	Date:	29.03.19	Chkd: MB

BCAL

CONSULTING

BCAL CONSULTING, Orient House,
Church Way, Wellingborough, Northamptonshire. NN8 4HJ.
Tel: 01933 440024 Fax: 01933 440041 Web: www.bcal.co.uk

Client

BAYLISS DESIGN LTD

Project

SHELL EASTFIELD
RUSTINGTON
Littlehampton, West Sussex

Drg. Title

IMPERMEABLE AREAS

Scales @ A1

1:125

Drawing No.

6239-21

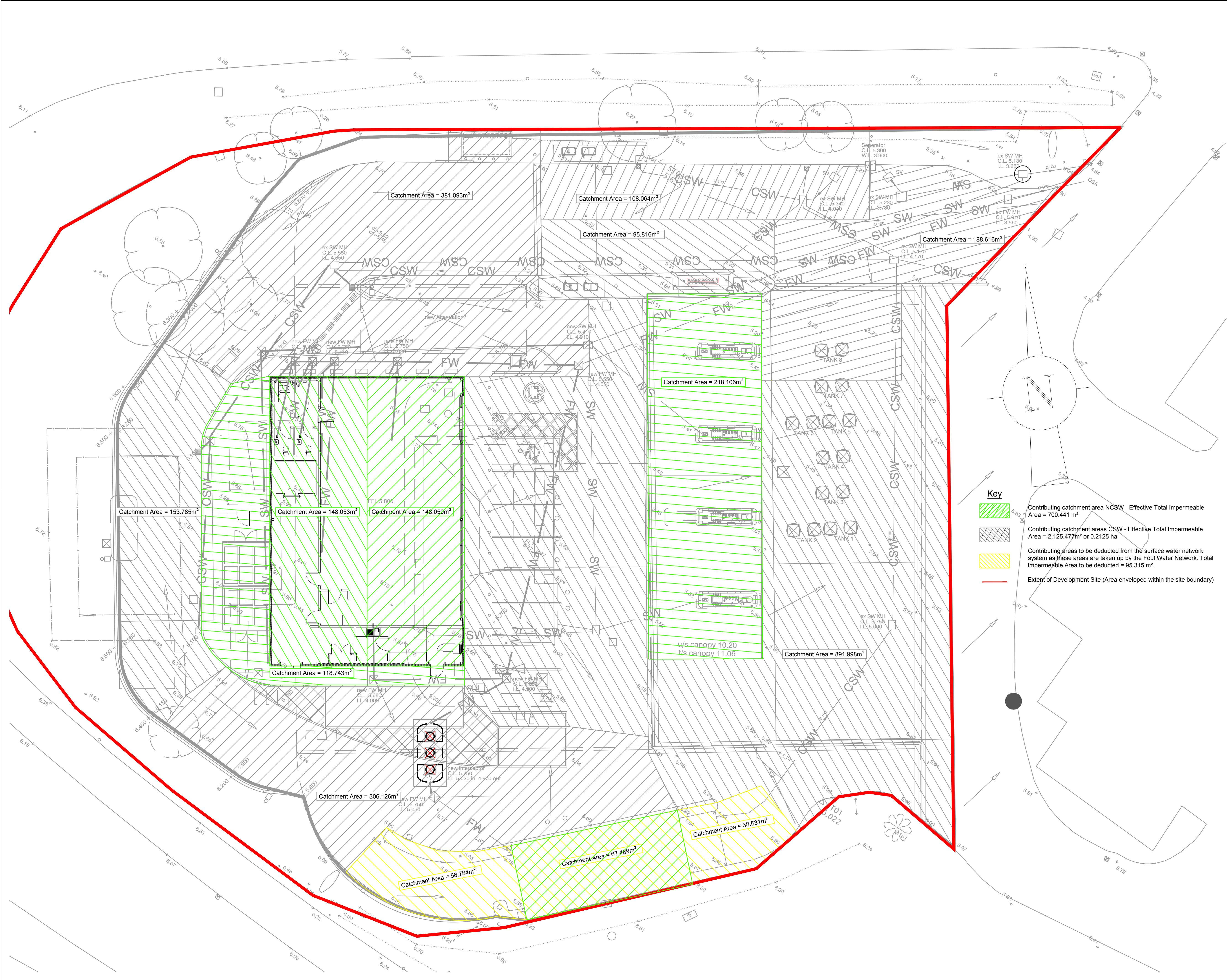
Rev

-

Status:

INFORMATION

ARUN DISTRICT COUNCIL LU109138DOC



0:\PROJECTS\AUTOCAD STANDARDS\BCAL DRAWING FRAMES\BCAL A1 Frame Rev A.DWG

This drawing is Copyright, is the property of BCAL and cannot be copied or used without the written consent of this company.

This drawing to be read in conjunction with all relevant BCAL, Architects, M & E, Specialist Consultants and Contractors project specific drawings and specifications.

Current British Standards apply.

All dimensions are in millimetres. (U.N.O)

All levels are in metres. (U.N.O)

Written dimensions only shall be used.

Do Not Scale.

Any discrepancies shall be brought to the attention of BCAL immediately.

IF IN DOUBT ASK.

NOTES

1. Drawing based on:
- Topographical Survey by URS dated May 2011;
Architects layout ref 10019507 - (Drainage & Levels)
Drain 19 dated February 2019

2. All drains to have Class S granular bed and surround, except where a, cover beneath roads or hardstanding is less than 0.9m b, cover beneath soft landscaping is less than 0.6m in which case class Z concrete bed and surround is required.

3. Where pipes pass through the manhole wall a joint must be formed within 150mm of the wall.

4. All pipes to enter manhole with soffits level.

5. All chambers to have ductile iron, single seal lock down covers to grade D400 BS EN 124 in road or car park areas and B125 BS EN 124 in all other areas. Recased covers to be used in areas of block paving. Covers are to be aligned parallel to kerbs, paving orientation or structures unless otherwise shown.

Refer also to Drawings

No	Description	Date	By	Chk
Revisions to this Drawing				
Saved: 0:\projects\6200\6239\Drawings\BCAL DWG\6239-20-DRAINAGE STRATEGY_02.04.19.dwg				
Dm By:	AD	Date:	29.03.19	Chkd: MB

BCAL

CONSULTING

BCAL CONSULTING, Orient House,
Church Way, Wellingborough, Northamptonshire. NN8 4HJ.
Tel: 01933 440024 Fax: 01933 440041 Web: www.bcal.co.uk

Client

BAYLISS DESIGN LTD

Project

SHELL EASTFIELD
RUSTINGTON
Littlehampton, West Sussex

Drg. Title

DRAINAGE CATCHMENT
AREAS PLAN

Scales @ A1	Drawing No.	Rev
1:125	6239-22	-

Status:	INFORMATION
---------	-------------

This drawing is Copyright, is the property of BCAL and cannot be copied or used without the written consent of this company.

This drawing to be read in conjunction with all relevant BCAL, Architects, M & E, Specialist Consultants and Contractors project specific drawings and specifications.

Current British Standards apply.

All dimensions are in millimetres. (U.N.O)

All levels are in metres. (U.N.O)

Written dimensions only shall be used.

Do Not Scale.

Any discrepancies shall be brought to the attention of BCAL immediately.

IF IN DOUBT ASK.

NOTES

Refer also to Drawings

No	Description	Date	By	Chk
----	-------------	------	----	-----

Revisions to this Drawing

Saved:	O:\projects\
Dm By:	AD
Date:	29/03/2019
Chkd:	BK



BCAL CONSULTING, Orient House,
Church Way, Wellingborough, Northamptonshire. NN8 4HJ.
Tel: 01933 440024 Fax: 01933 440041 Web: www.bcal.co.uk
Client

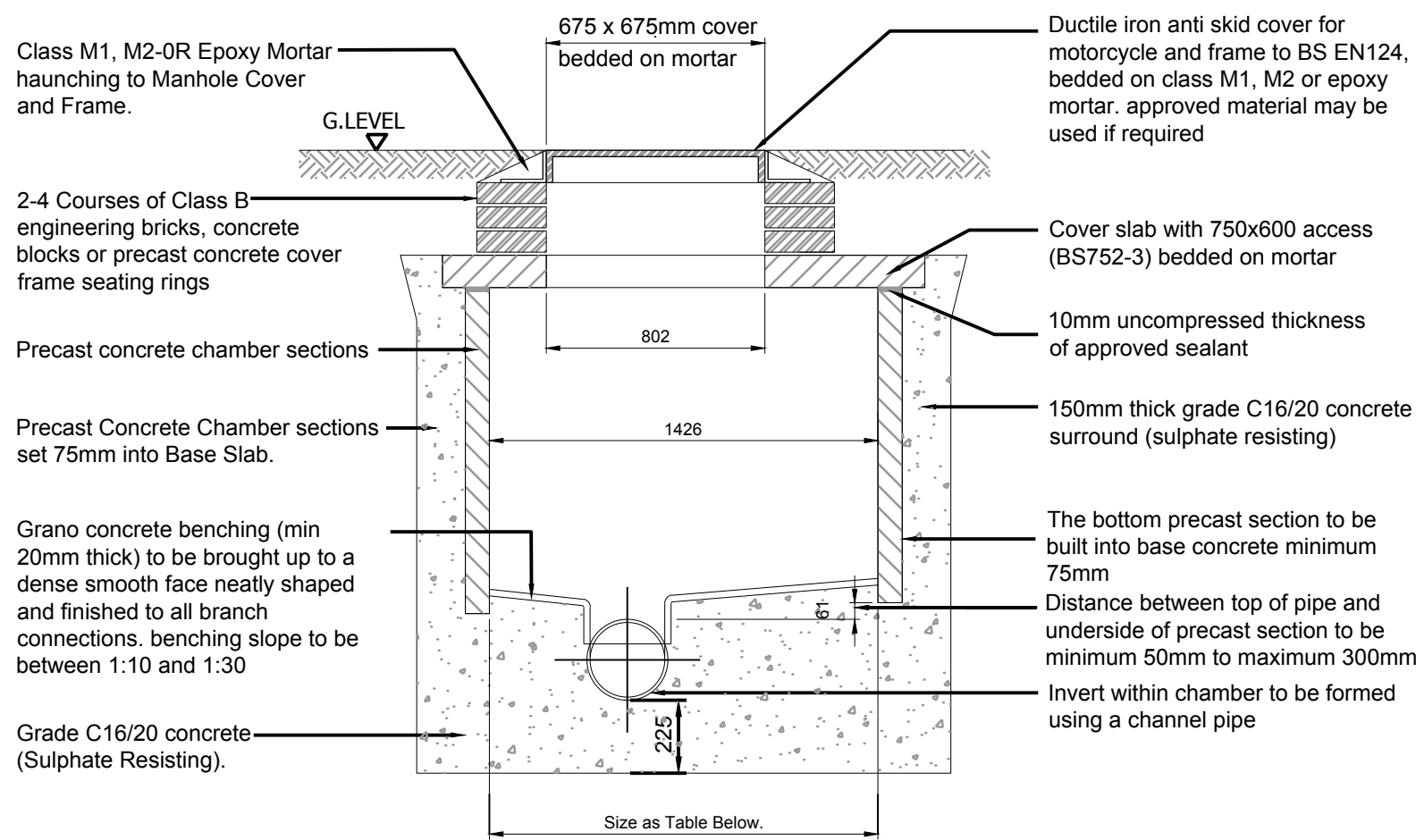
BAYLISS DESIGN LTD

Project
**SHELL EASTFIELD
RUSTINGTON**
Littlehampton, West Sussex

Drg. Title
**PROPOSED STANDARD
CONSTRUCTION DETAILS**

Scales @ A1 1:125	Drawing No. 6239_23	Rev -
----------------------	------------------------	----------

Status: **FOR APPROVAL**

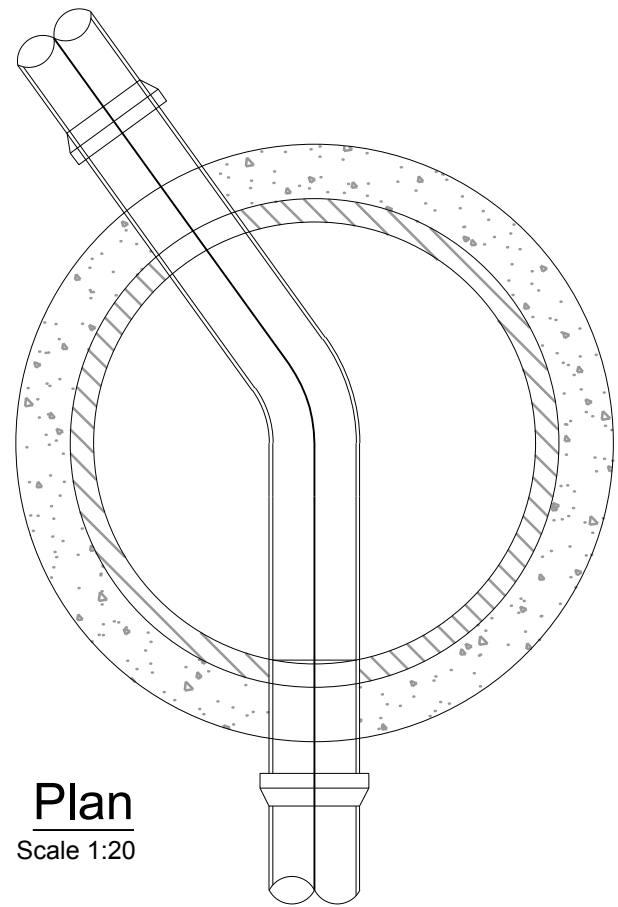


Shaft Diameters.

Diameter of largest pipe in MH (mm)	Internal diameter of MH (mm) NB:-
UP TO 375MM	1200MM

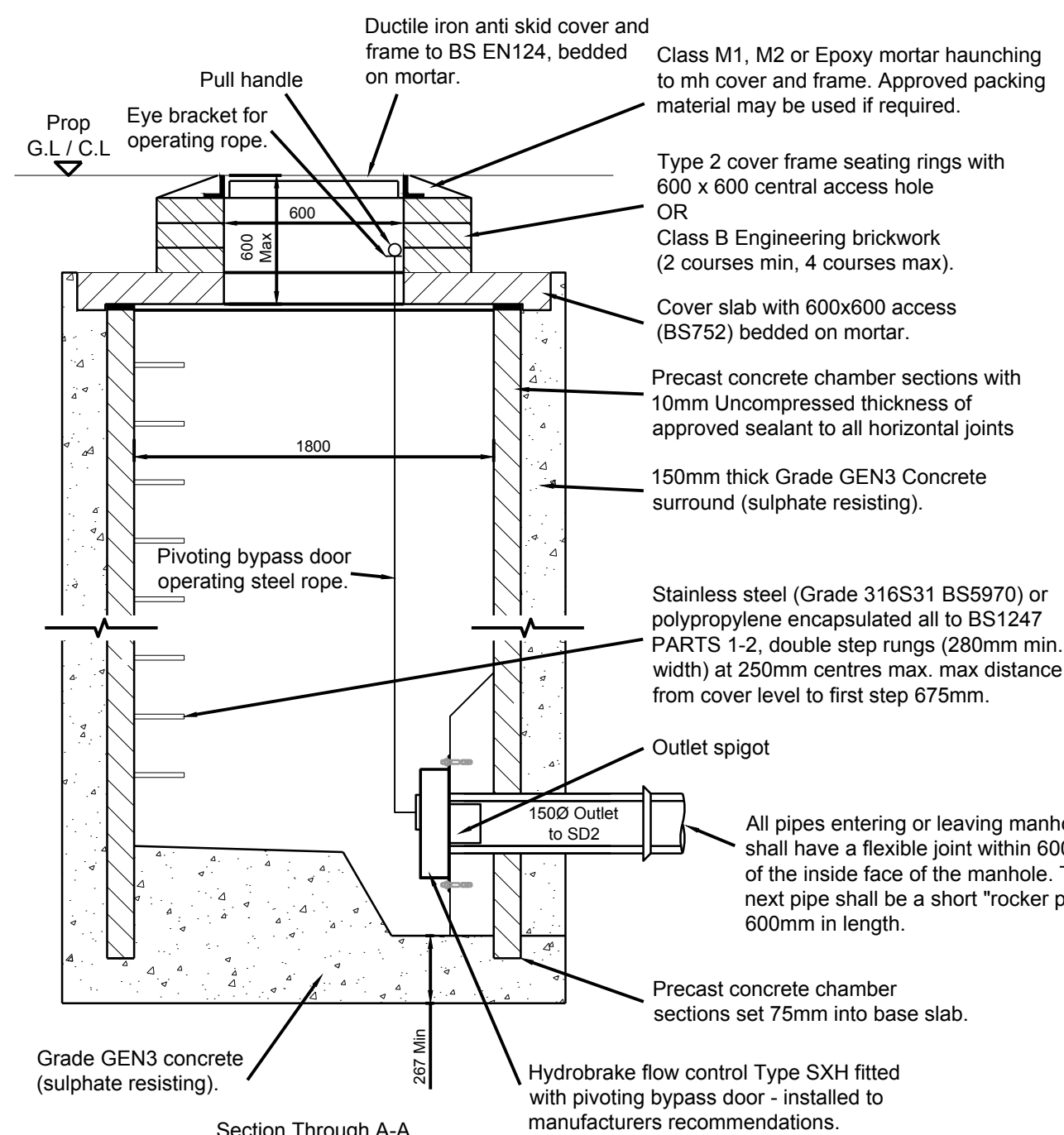
NB:-
If Pipe Diameter exceeds 375mm use Manhole Type B.

All pipes entering or leaving manholes shall have a flexible joint within 600mm of the inside face of the manhole. The next pipe shall be a short "Rocker Pipe" 600mm Long.

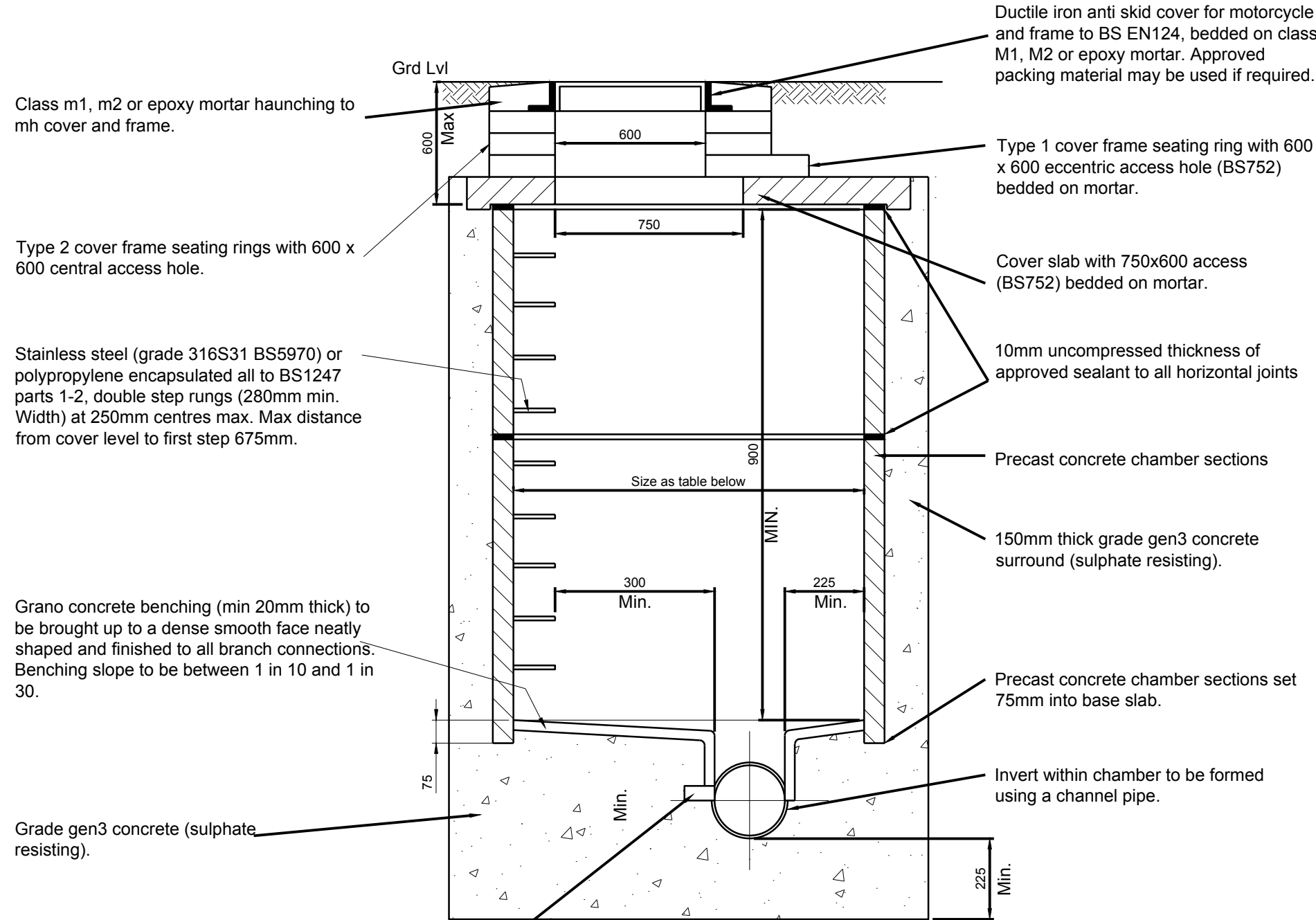


Typical Manhole Detail Type E (ADOPTABLE)

(depth to soffit 1.0m to 1.5m)

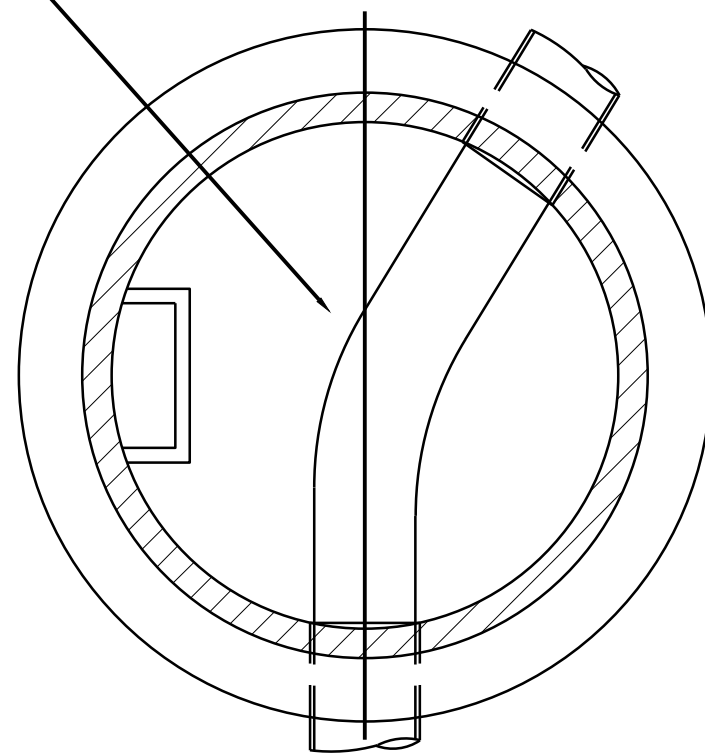


Flow Control Device Chamber MH S14 (ADOPTABLE)



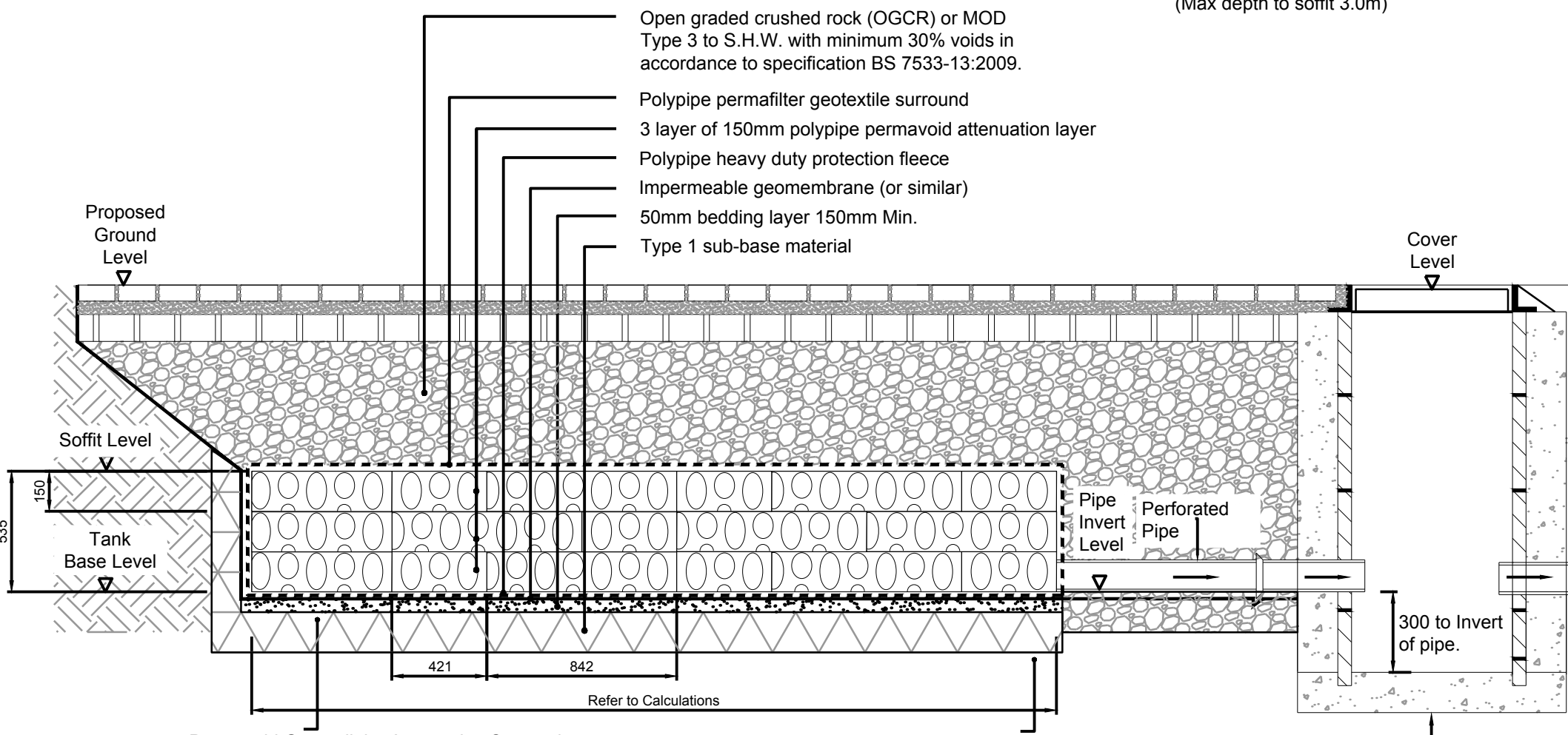
Shaft diameters	
Dia of largest pipe in MH (mm)	Internal dia of MH (mm)
Less than 375	1200
375 TO 450	1500 (1350 not available)
500 TO 700	1500

Chambers with outgoing pipes greater than 600mm dia. Shall be fitted with removable stainless steel (grade 316) safety chains or polypropylene rope.



Typical Manhole Detail Type B (ADOPTABLE)

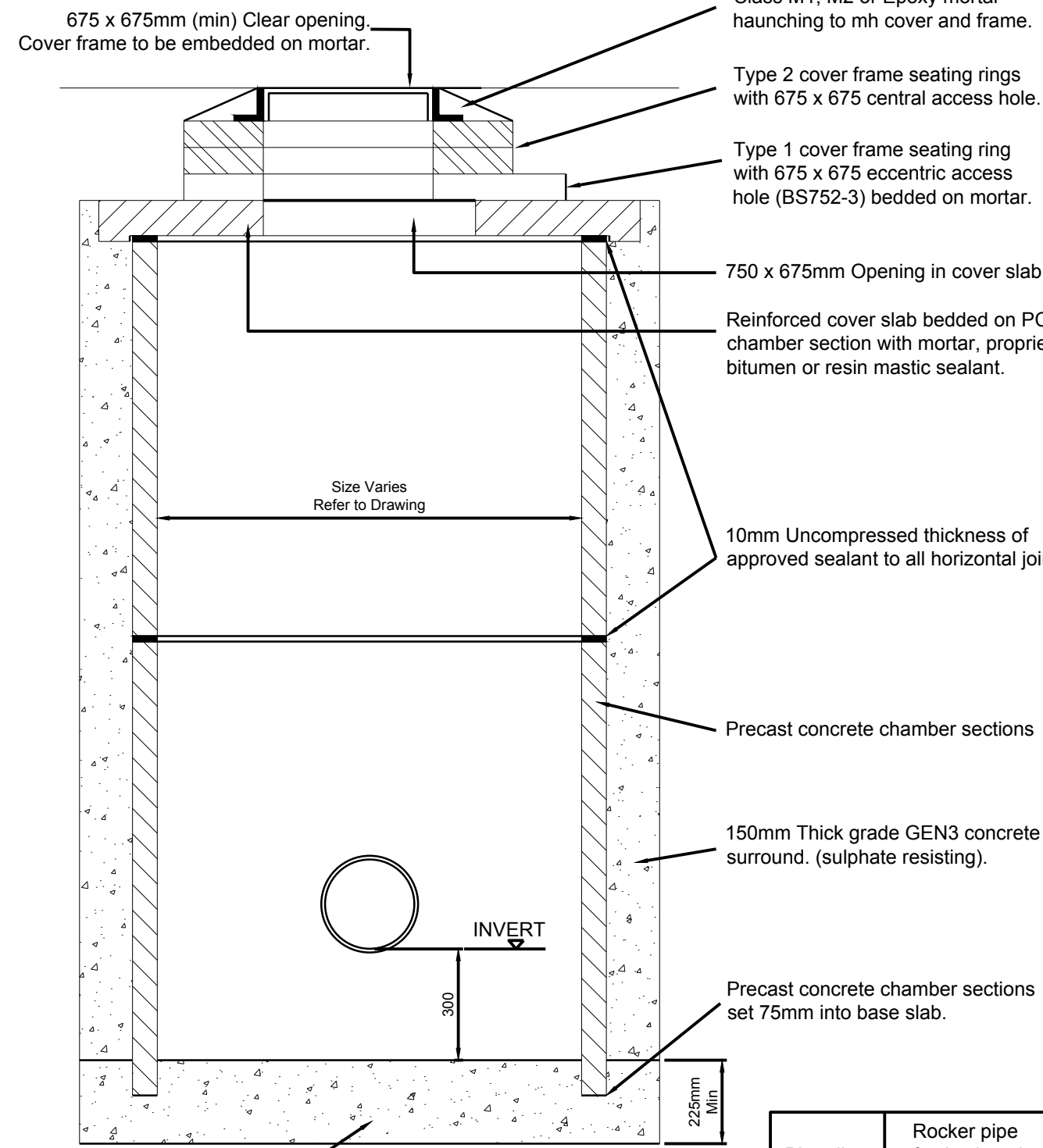
(depth to soffit 1.5m to 3.0m)



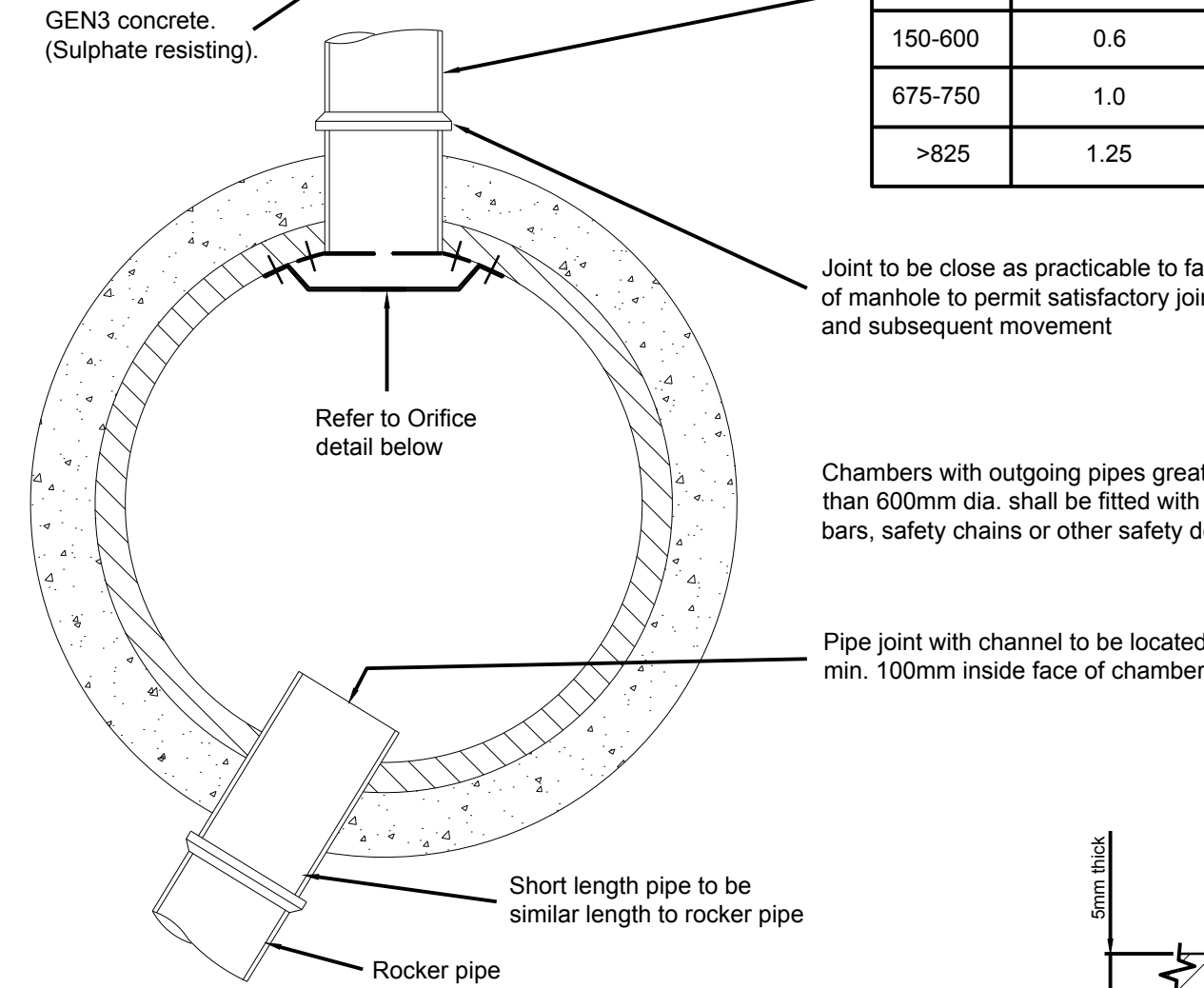
Permavoid Geo-cellular Attenuation System by Polypipe™
Unit dimension 708 x 354 x 150mm Dp
Note: For surface area and overall height of the crate system see drawing no: 5901-80

- Notes
- Minimum cover depth are accordance with crate suppliers recommendations.
 - Refer to manufacturers recommendations for installation.

Typical Permavoid Geo-cellular Attenuation System with Permeable Paving and Granular sub-base Detail (Mh S12)

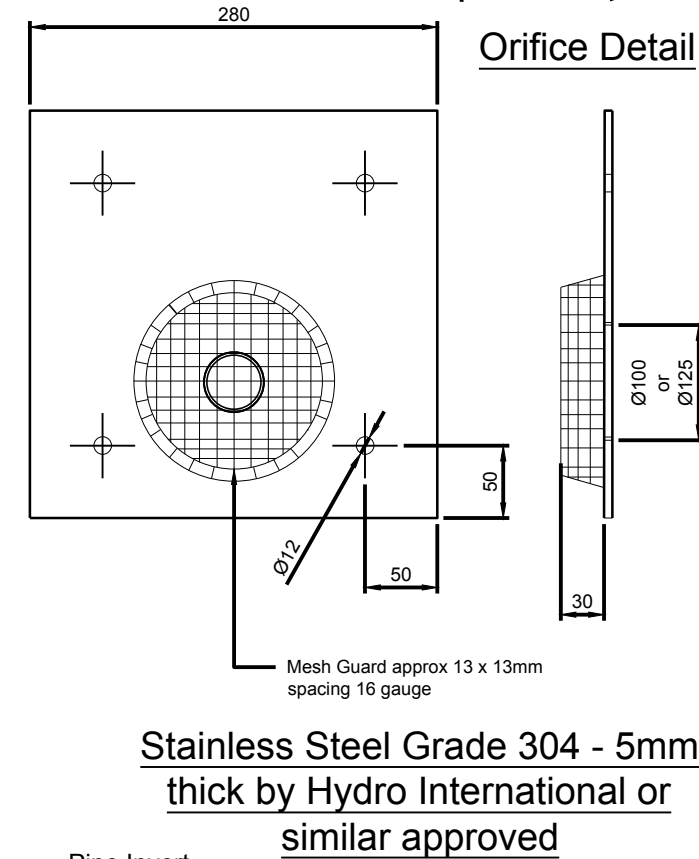


Pipe dia.	Rocker pipe effective length
150-600	0.6
675-750	1.0
>825	1.25

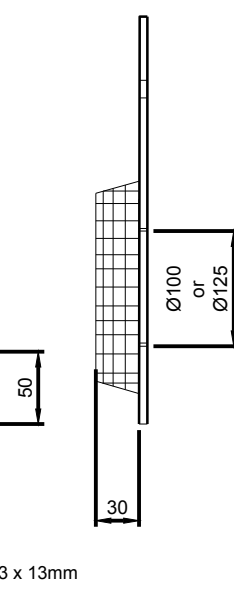


Typical Manhole Detail Type BR11 (Catchpit) with Orifice Manhole

(Max depth to soffit 3.0m)



Orifice Detail



Stainless Steel Grade 304 - 5mm thick by Hydro International or similar approved