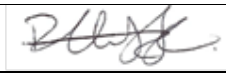
BMC

BELL MUNRO CONSULTING LTD.

786 Stockport Road
Manchester

Hydraulic Calculations
Rev. A
February 2025

	Initials	Signature	Date
Prepared by:	R.C		02/25
Checked by:	S.J.B		02/25
Approved by:	S.J.B		02/25

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Ref: J8683

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.361	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	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

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.044	0.044	0.044
2.000	User	-	100	0.009	0.009	0.009
	User	-	100	0.003	0.003	0.012
	User	-	100	0.015	0.015	0.027
3.000	User	-	100	0.018	0.018	0.018
3.001	User	-	100	0.006	0.006	0.006
1.001	User	-	100	0.007	0.007	0.007
	User	-	100	0.005	0.005	0.012
4.000	User	-	100	0.012	0.012	0.012
	User	-	100	0.003	0.003	0.015
5.000	User	-	100	0.007	0.007	0.007
6.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.009	0.009	0.012
5.001	User	-	100	0.007	0.007	0.007
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.013	0.013	0.013
				Total	Total	Total
				0.162	0.162	0.162

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		19.920	18.303	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	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	M5-60 (mm) 18.000
Return Period (years)		100	Ratio R 0.361
Region	England and Wales	Profile Type	Summer

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Synthetic Rainfall Details

Cv (Summer) 0.750 Storm Duration (mins) 30
Cv (Winter) 0.840

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S12, DS/PN: 1.003, Volume (m³): 4.1

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	18.449
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)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

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Storage Structures for Storm

Cellular Storage Manhole: S11, DS/PN: 1.002

Invert Level (m) 18.504 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	96.0	96.0	0.801	0.0	128.0
0.800	96.0	128.0			

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	Ratio R	0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S02	15 Winter	2	+0%	30/15 Summer				19.059
2.000	S03	15 Winter	2	+0%	100/15 Summer				19.902
3.000	S04	15 Winter	2	+0%	30/15 Summer				19.041
3.001	S05	15 Winter	2	+0%	30/15 Summer				18.847
1.001	S06	15 Winter	2	+0%	30/15 Summer				18.808
4.000	S07	15 Winter	2	+0%	100/15 Summer				19.744
5.000	S08	15 Winter	2	+0%					19.730
6.000	S09	15 Winter	2	+0%					19.733
5.001	S10	15 Winter	2	+0%					19.582
1.002	S11	60 Winter	2	+0%	30/30 Winter				18.626
1.003	S12	60 Winter	2	+0%	30/15 Winter				18.619

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S02	-0.091	0.000	0.33			7.4	OK	
2.000	S03	-0.098	0.000	0.26			4.5	OK	
3.000	S04	-0.109	0.000	0.17			3.1	OK	
3.001	S05	-0.102	0.000	0.22			3.9	OK	
1.001	S06	-0.030	0.000	0.99			17.3	OK	
4.000	S07	-0.056	0.000	0.40			2.5	OK	
5.000	S08	-0.070	0.000	0.20			1.2	OK	
6.000	S09	-0.117	0.000	0.11			2.0	OK	
5.001	S10	-0.095	0.000	0.29			4.2	OK	
1.002	S11	-0.103	0.000	0.15		37	3.9	OK	
1.003	S12	-0.056	0.000	0.09			4.2	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	Ratio R	0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S02	15 Winter	30	+0%	30/15 Summer				19.243
2.000	S03	15 Winter	30	+0%	100/15 Summer				19.924
3.000	S04	15 Winter	30	+0%	30/15 Summer				19.172
3.001	S05	15 Winter	30	+0%	30/15 Summer				19.147
1.001	S06	15 Winter	30	+0%	30/15 Summer				19.123
4.000	S07	15 Winter	30	+0%	100/15 Summer				19.765
5.000	S08	15 Winter	30	+0%					19.742
6.000	S09	15 Winter	30	+0%					19.746
5.001	S10	15 Winter	30	+0%					19.609
1.002	S11	60 Winter	30	+0%	30/30 Winter				18.775
1.003	S12	60 Winter	30	+0%	30/15 Winter				18.775

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S02	0.093	0.000	0.61			13.6	SURCHARGED	
2.000	S03	-0.076	0.000	0.49			8.5	OK	
3.000	S04	0.022	0.000	0.30			5.6	SURCHARGED	
3.001	S05	0.198	0.000	0.45			7.9	SURCHARGED	
1.001	S06	0.285	0.000	1.84			32.2	SURCHARGED	
4.000	S07	-0.035	0.000	0.76			4.8	OK	
5.000	S08	-0.058	0.000	0.37			2.3	OK	
6.000	S09	-0.104	0.000	0.21			3.9	OK	
5.001	S10	-0.068	0.000	0.58			8.4	OK	
1.002	S11	0.045	0.000	0.18		55	4.7	SURCHARGED	
1.003	S12	0.101	0.000	0.10			4.8	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	Ratio R	0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

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

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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S02	15 Winter	100	+40%	30/15 Summer				20.378
2.000	S03	15 Winter	100	+40%	100/15 Summer				20.065
3.000	S04	15 Winter	100	+40%	30/15 Summer				20.120
3.001	S05	15 Winter	100	+40%	30/15 Summer				20.058
1.001	S06	15 Winter	100	+40%	30/15 Summer				19.991
4.000	S07	15 Summer	100	+40%	100/15 Summer				19.904
5.000	S08	15 Winter	100	+40%					19.760
6.000	S09	15 Winter	100	+40%					19.764
5.001	S10	15 Summer	100	+40%					19.678
1.002	S11	120 Winter	100	+40%	30/30 Winter				19.123
1.003	S12	120 Winter	100	+40%	30/15 Winter				19.134

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S02	1.228	0.000	1.10			24.4	FLOOD RISK	
2.000	S03	0.065	0.000	0.87			14.9	SURCHARGED	
3.000	S04	0.970	0.000	0.54			10.0	SURCHARGED	
3.001	S05	1.109	0.000	0.76			13.3	SURCHARGED	
1.001	S06	1.153	0.000	3.33			58.1	SURCHARGED	
4.000	S07	0.104	0.000	1.37			8.6	SURCHARGED	
5.000	S08	-0.040	0.000	0.67			4.2	OK	
6.000	S09	-0.086	0.000	0.38			7.0	OK	
5.001	S10	0.000	0.000	1.02			14.8	OK	
1.002	S11	0.393	0.000	0.19		110	5.0	SURCHARGED	
1.003	S12	0.460	0.000	0.10			4.9	SURCHARGED	

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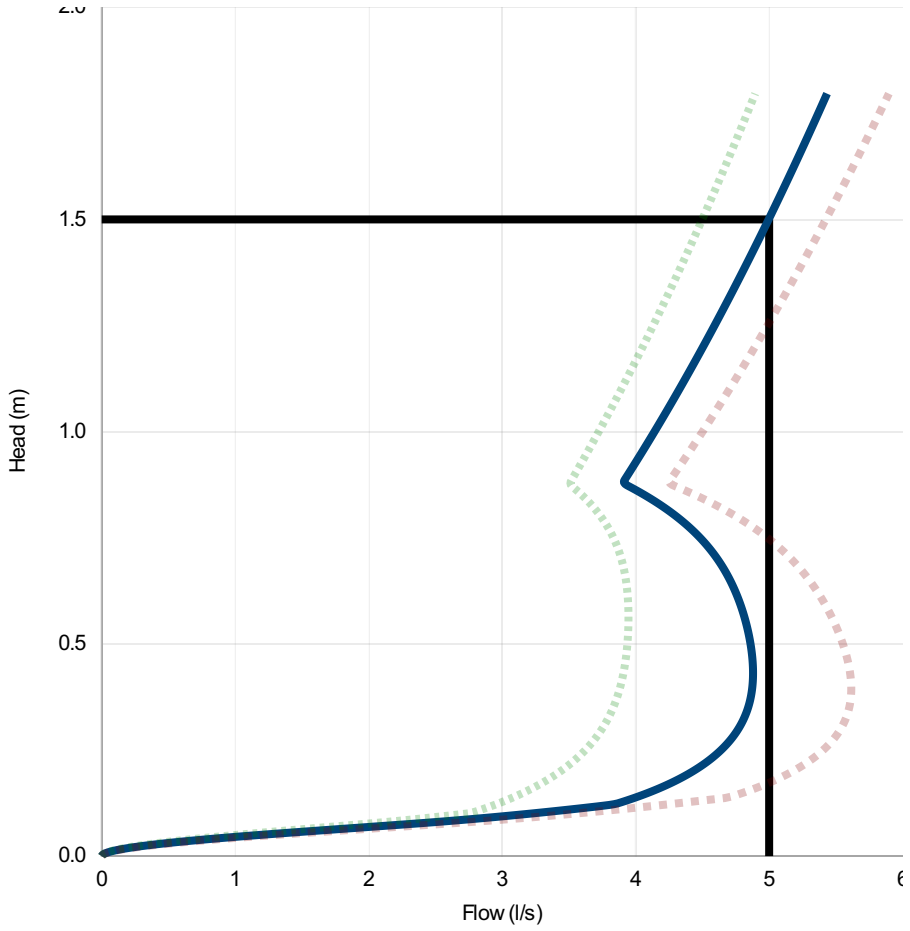
Technical Specification

	Original Setting		Minimum Setting		Maximum Setting	
Control Point	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**
Primary Design	1.500	5.000	1.500	4.499	1.500	5.425
Flush-Flo™	0.431	4.879	0.562	3.946	0.395	5.615
Kick-Flo®	0.878	3.900	0.875	3.500	0.877	4.240
Mean Flow		4.321		3.684		4.819

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

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

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.052	1.259
0.103	3.316
0.155	4.142
0.207	4.464
0.259	4.667
0.310	4.789
0.362	4.853
0.414	4.878
0.466	4.874
0.517	4.850
0.569	4.809
0.621	4.750
0.672	4.668
0.724	4.555
0.776	4.398
0.828	4.184
0.879	3.914
0.931	4.007
0.983	4.108
1.034	4.206
1.086	4.302
1.138	4.396
1.190	4.487
1.241	4.576
1.293	4.664
1.345	4.749
1.397	4.833
1.448	4.915
1.500	4.996

DESIGN ADVICE

The head/flow characteristics of this SHE-0098-5000-1500-5000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

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

Hydro International
A CRH COMPANY

DATE	20/02/2025 12:08
Site	786 Stockport Rd.
DESIGNER	Richard Cliffe
Ref	J8683

SHE-0098-5000-1500-5000

Hydro-Brake® Optimum

© 2024 Hydro International, Rivermead Court, Kenn Business Park, Windmill Road, Kenn, Clevedon, BS21 6FT. Tel 01275 878371 Fax 01275 874979 Web www.hydro-int.com Email designtools@hydro-int.com

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.500	5.000
Flush-Flo™	0.431	4.879
Kick-Flo®	0.878	3.900
Mean Flow		4.321

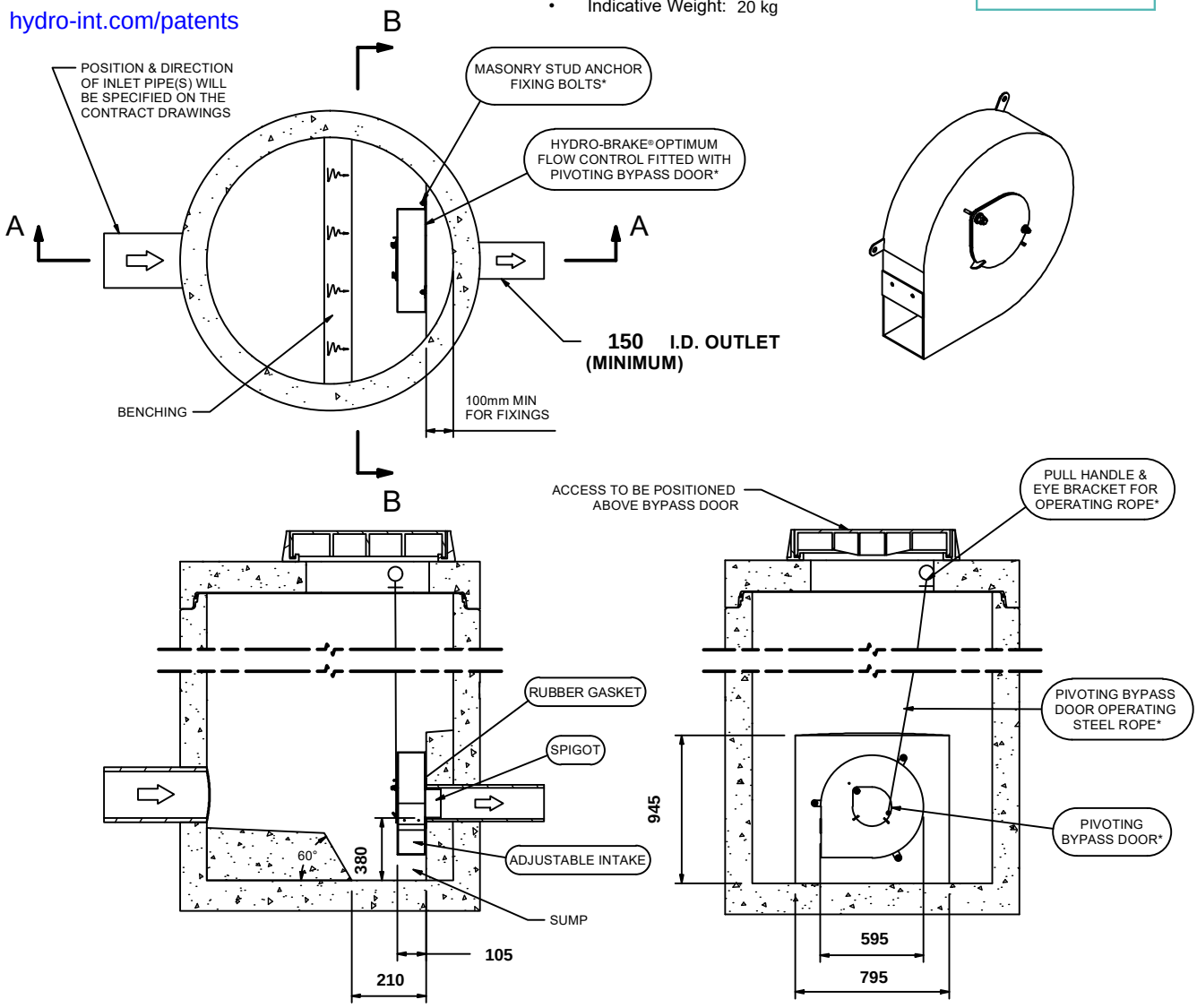
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Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Variable flow rate post installation via adjustable inlet
- Indicative Weight: 20 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

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



SECTION A-A SECTION B-B

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

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

DESIGN ADVICE

The head/flow characteristics of this SHE-0098-5000-1500-5000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International A CRH COMPANY

DATE	20/02/2025 12:08
SITE	786 Stockport Rd.
DESIGNER	Richard Cliffe
REF	J8683

SHE-0098-5000-1500-5000
Hydro-Brake® Optimum

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