

DESIGN OF SURFACE WATER DRAINAGE FOR ONION STORE
MOULTON BULB COMPANY, BROAD LANE, MOULTON PE12 6PP

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Introduction

Moulton Bulb Co have applied for planning permission (Reference No H13-0092-21) to construct a new Onion Store on their site at Long Lane, Moulton, near Spalding.

The lead Local Authority (Lincolnshire County Council) have requested a Drainage Strategy Report to show details of how the surface water will be disposed from the proposed building and hardstanding.

All new developments are now encouraged to include SuDS in the design of the surface water disposal. The CIRIA SuDS Manual 2015 explains the philosophy of SuDS in Chapter 1 of the manual as follows:

The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk, and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone.

The Technical Standards for Sustainable Drainage produced by the Local Authority SuDS Officer Organisation (LASOO) states that generally the aim for should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1) Into the ground (infiltration).
- 2) To a surface water body.
- 3) To a surface water sewer or highway drain.
- 4) To a combined sewer.

It is considered that to provide infiltration with either soakaways or a lagoon for this large building could lead to waterlogging or even some surface water flooding in the area between the buildings and the Moulton Mere Drain.

Therefore the proposed method of disposal is to discharge the surface water from the development to the nearest surface water body which is the Moulton Mere Drain, which is a watercourse under the jurisdiction of the South Holland Internal Drainage Board. The roof drainage will discharge through new drainage pipes into a storage lagoon located on the western side of the building. Water from the lagoon will flow through a flow control device into the Moulton Mere Drain limiting the flow to 4.5 litres/second.

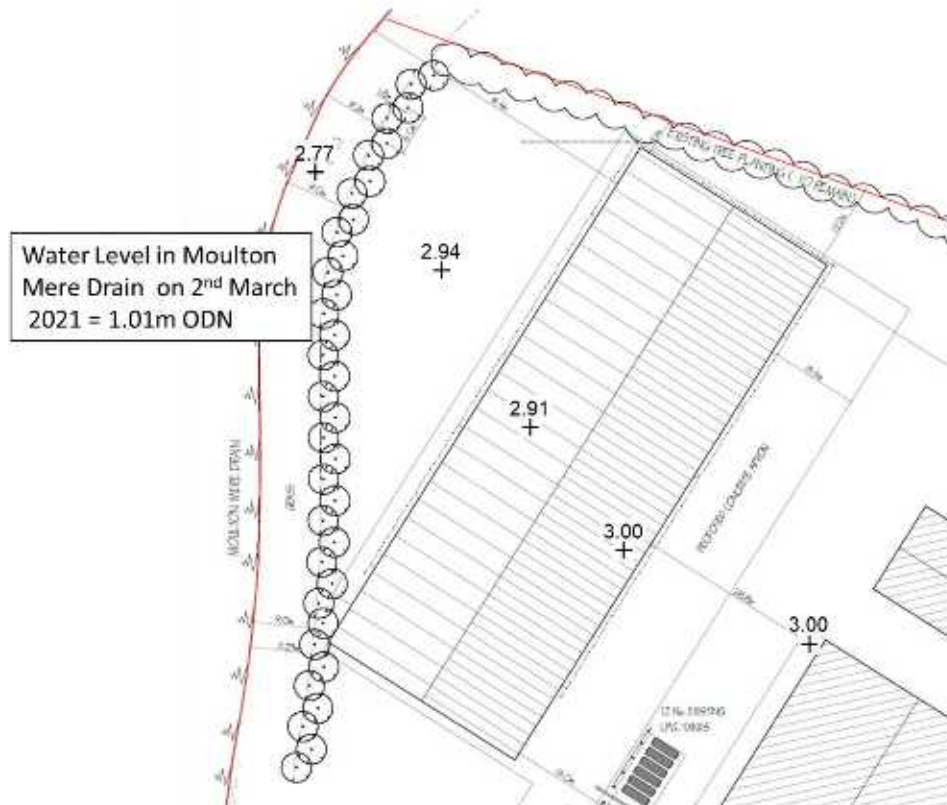
The proposed concrete apron will slope away from the building and the water will drain into french drain constructed on the edge of the apron. The French drain will provide some infiltration, especially in events such as 1 in 10 years, and excess water will flow into a new length of dyke which flows into the storage lagoon in higher rainfall events.

Consent will be required from the South Holland Internal Drainage Board for any discharge into the Moulton Mere Drain on the west side of the building.

The Site

There are already a number of large industrial buildings on the site some of which have roof outfalls which discharge rainwater into an existing surface water system. This system most likely discharges into the Moulton Mere Drain through one or more separate outfalls. It has been decided to design a separate surface water system for the proposed new building.

Levels have been taken on the site which are referenced to levels taken on the culvert in West Cob Gate north of the site, and are shown below.



It is assumed at the present time that the floor level of the building will be the same as or higher than the existing building, the floor level of which is 3.00m ODN.

Information from South Holland Internal Drainage Board.

South Holland IDB have stated that modelling by the Board has predicted the following levels in Moulton Mere Drain in the events as shown:

1 in 10 years	1.81m ODN
1 in 30 years	2.08m ODN
1 in 100 year plus climate change	2.53m ODN

The levels of the proposed surface water sewers, the dyke, and the storage lagoon will be set to limit the surcharging of the drainage system in a 1 in 30 year event. However it will be difficult to design a system which would not be surcharged in a 1 in 100 year event with 30% increase in flow.

Proposed New Building.

The proposed new building will be located on the western side of the site adjacent to the Moulton Mere Drain.

The proposed new building is 84.735 metres long and 31.927 metres wide. Therefore the area of roofing is 2705 square metres

There is a proposed concrete hardstanding on the eastern side of the building which is 85 metres long x 13.5 metres wide. Therefore the area of new hardstanding is 1148 square metres.

Flow Limiting Device.

Information on the most suitable flow limiting device suitable for this site has been provided by Hydro International, although similar devices may be available from other companies. The details supplied by Hydro International are shown on pages 9 and 10 of this report. The recommended device will reduce the flow to a nominal 5.0 litres/second, but reference to the graph shows the actual flow will be around 4.5 litres/second.

Proposed Surface Water Disposal System.

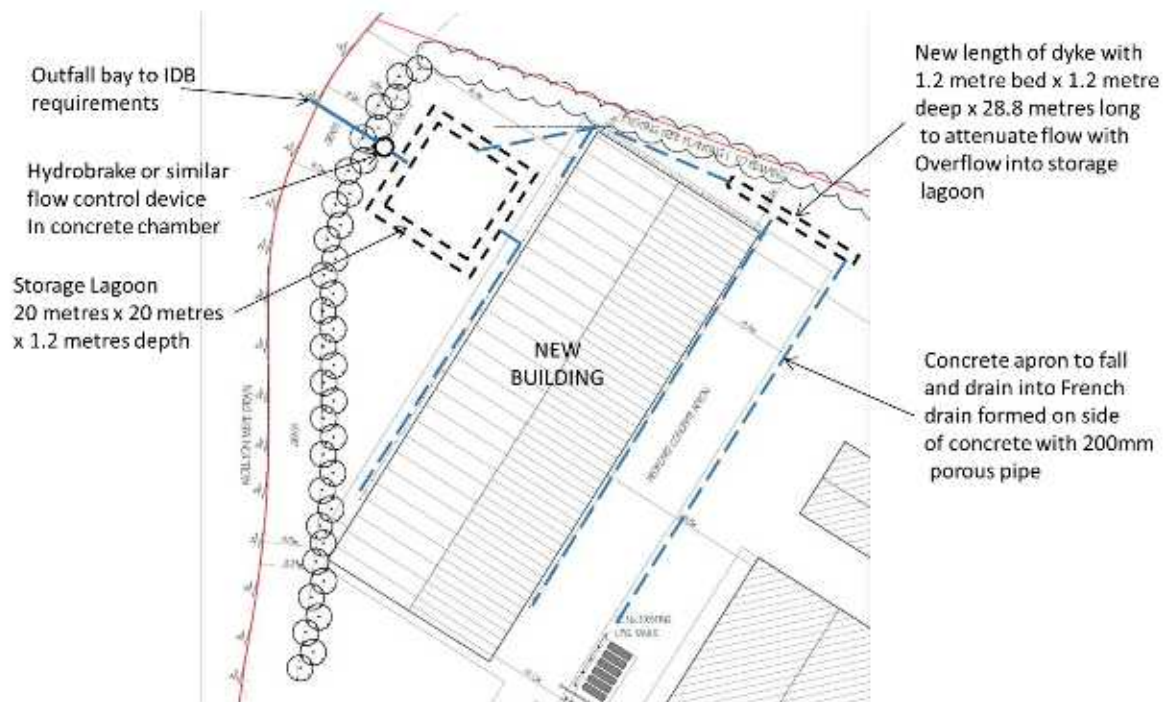
The first method of surface water disposal that needs to be considered is infiltration. No soakaway tests have been carried out but assuming the soil conditions are silt typical of this area a soil infiltration rate of approximately 5.0×10^{-6} m/sec could be expected.

With a large roof area the size of soakaways would also be large and cost prohibitive, and therefore drainage into soakaways or a storage pond without an outlet has been discounted.

The next disposal method of surface water disposal that will be considered is disposal to a surface water body. The Moulton Mere Drain, which is maintained by South Holland Internal Drainage Board, is located on the west side of the building and therefore it is considered that disposal of the surface water at a low rate into this watercourse should be the preferred method. There will however be some infiltration into the subsoil from the base and the sides of the proposed storage lagoon and dyke, and from the French drain that will drain the hardstanding.

It is recommended that the roof drainage should discharge into an underground system of pipes which will discharge into a storage lagoon sited between the building and the IDB drain. The rainwater from the eastern side of the building and the hardstanding will flow into a new section of dyke on the northern side of the building which will connect to the storage lagoon. During heavy rainfall the lagoon will fill with water and the excess water will flow out at a controlled volume through a flow limiter into the IDB drain. The water in the lagoon will also soakaway through the subsoil at the base of the lagoon.

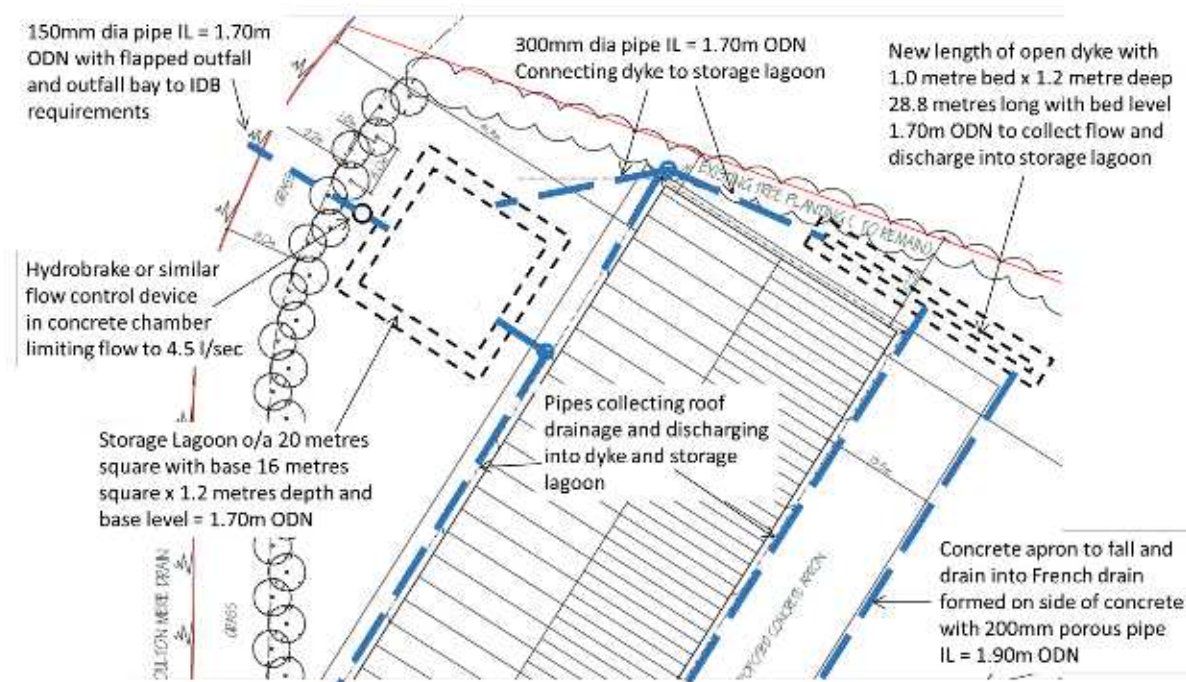
A discharge volume of 4.5 litres/second is suggested and the overall size of the storage lagoon should be 20.0 metres x 20.0 metres with a maximum depth of water of 600mm. To enable a fall through the drains from the downpipes to the lagoon a total depth of the lagoon will need to be around 1.2 metres. Details of the proposed drainage system is shown on the plan on the next page.



It is suggested that the new concrete apron should fall away from the building and a french drain should be constructed on the side of this concrete apron. Surface water would flow from the apron into the drain which would flow northwards and discharge into a new open section of dyke on the north side of the building. This French drain would possibly soakaway a normal rainfall but larger storms would discharge into the new dyke. A higher pipe could be constructed to discharge excess surface water into the larger storage lagoon.

Design of Surface Water System

Details of the proposed levels and sizes of the proposed system is shown below.



The system will firstly be designed with flows in a 1 in 30 year event, and then flows in a 1 in 100 year event with 30% allowance for climate change will be considered.

1 in 30 year event:

A spreadsheet has been drawn up showing the storage required for this event.

Impermeable area to be drained				3853	sm		
Discharge Rate into IDB drain				4.5	litres/second		
Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	30 Year Rainfall	Inflow	Outflow	Storage Required
5	0.37	7.4	1.48	11.0	42.20	1.35	40.85
10	0.52	10.4	1.51	15.7	60.51	2.70	57.81
15	0.63	12.6	1.53	19.3	74.28	4.05	70.23
30	0.8	16.0	1.54	24.6	94.94	8.10	86.84
60	1	20.0	1.53	30.6	117.90	16.20	101.70
120	1.21	24.2	1.51	36.5	140.80	32.40	108.40
240	1.45	29.0	1.49	43.2	166.49	64.80	101.69
360	1.6	32.0	1.47	47.0	181.25	97.20	84.05
600	1.79	35.8	1.45	51.9	200.01	162.00	38.01
1440	2.24	44.8	1.4	62.7	241.66	388.80	-147.14
Time to empty =		6.69 hours		SATISFACTORY			

It can be seen that a volume of 104.8 cu metres of storage is required. This will produce a depth of water of 370mm. Therefore the water level in the lagoon will be 2.07m ODN.

The South Holland IDB has advised that the predicted level in the Moulton Mere Drain in a 1 in 30 year event would be 2.08m ODN. It is unlikely that the maximum level in the Drain would occur within 24 hours.

In this event the water level in Moulton Mere Drain will rise to the maximum predicted level of 2.08m ODN. When the maximum water level is reached there may still be water held within the lagoon and the dyke. This water will be retained for a longer period of time than is predicted above and the pipework from the downpipes to the storage chamber and dyke will remain surcharged during this period.

1 in 100 year event with 30% increase for climate change:

The spreadsheet shown below has been drawn up showing the storage required for the 1 in 100 year event with climate change.

Impermeable area to be drained				3853	sm		
Discharge Rate into IDB drain				4.5	litres/second		
Duration	Growth Factor Z1	M5 rainfall	Growth Factor Z2	100 Year Rainfall + 30%	Inflow	Outflow	Storage Required
5	0.37	7.4	1.98	19.0	73.39	1.35	72.04
10	0.52	10.4	1.98	26.8	103.14	2.70	100.44
15	0.63	12.6	1.98	32.4	124.96	4.05	120.91
30	0.8	16.0	1.97	41.0	157.88	8.10	149.78
60	1	20.0	1.93	50.2	193.34	16.20	177.14
120	1.21	24.2	1.89	59.5	229.10	32.40	196.70
240	1.45	29.0	1.86	70.1	270.18	64.80	205.38
360	1.6	32.0	1.83	76.1	293.32	97.20	196.12
600	1.79	35.8	1.81	84.2	324.57	162.00	162.57
1440	2.24	44.8	1.81	105.4	406.16	388.80	17.36
Time to empty =		12.68	hours		SATISFACTORY		

It can be seen that a volume of 205.4 cu metres of storage is required. This will produce a depth of water of 720mm. Therefore the water level in the lagoon will be 2.42m ODN.

The South Holland IDB has advised that the predicted level in the Moulton Mere Drain in a 1 in 100 year event with 30% allowance for climate change would be 2.53m ODN. It is unlikely that the maximum level in the Drain would occur within 24 hours.

If and when an event of this magnitude occurs there is still adequate storage volume available in the lagoon and dyke to contain any excess volume that may occur in this event.

Summary and Conclusions

- 1) The system will work satisfactorily without surcharging in events up to the 1 in 10 year event.
- 2) In events greater than 1 in 10 years the drainage system could become surcharged. However the storage lagoon and dyke will together have sufficient capacity to store storms in a 1 in 100 year event with 30% allowance for climate change.
- 3) The design does not take into account the infiltration that will take place in the french drain, dyke and storage chamber. Therefore the system is likely to perform much better than is demonstrated in the above calculations.

26th February 2021

Revision A 9th March 2021 Additional information added.

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Technical Specification

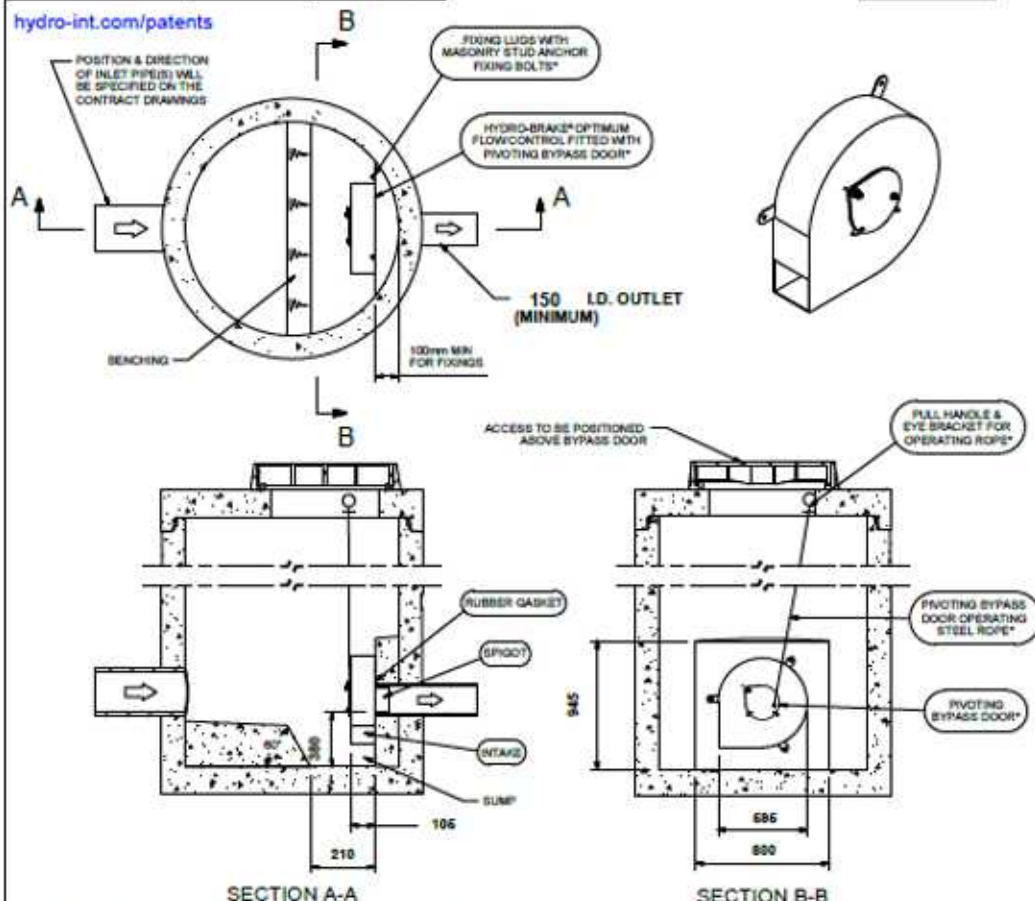
Control Point	Head (m)	Flow (l/s)
Primary Design	1.500	5.000
Flush-Flo™	0.432	4.890
Kick-Flo®	0.879	3.910
Mean Flow		4.331

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



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IMPORTANT: ○ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDLED 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.

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Hydro
International

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

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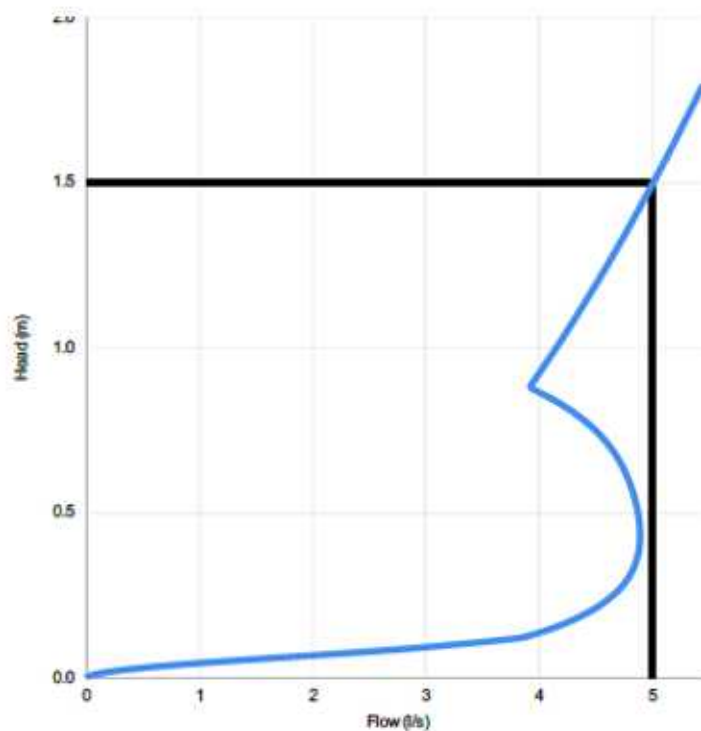
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Control Point	Head (m)	Flow (l/s)
Primary Design	1.500	5.000
Flush-Flo	0.432	4.890
Kick-Flo®	0.879	3.910
Mean Flow		4.331



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Head (m)	Flow (l/s)
0.000	0.000
0.052	1.260
0.103	3.321
0.155	4.149
0.207	4.473
0.259	4.677
0.310	4.799
0.362	4.864
0.414	4.889
0.466	4.886
0.517	4.862
0.569	4.821
0.621	4.763
0.672	4.681
0.724	4.568
0.776	4.412
0.828	4.200
0.879	3.926
0.931	4.015
0.983	4.116
1.034	4.215
1.086	4.311
1.138	4.404
1.190	4.496
1.241	4.585
1.293	4.673
1.345	4.759
1.397	4.843
1.448	4.925
1.500	5.006

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Site

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Ref

SHE-0098-5000-1500-5000

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