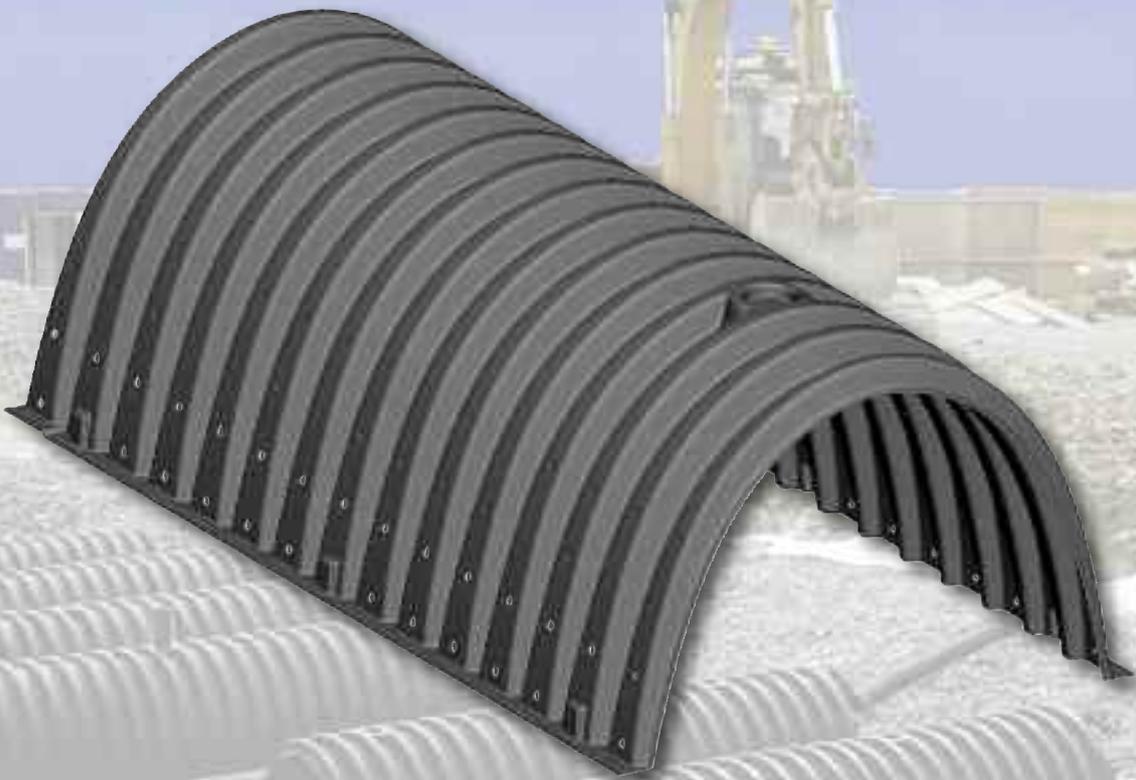




# HydroChamber Design Manual



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# HydroChamber Design Manual

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# HydroChamber Design Manual

## 1.0 Introduction

JFC's experience and expertise in the stormwater sector lead to the development of the HydroChamber, a thermoplastic culvert for stormwater management. It was developed to satisfy engineers, architects, local authorities and contractors. Other JFC products in the same sector include CorriPipe™ (corrugated twin wall H.D.P.E. drainage pipe) and the Hydro-Valve vortex flow control device.



Fig 1.0 - Flooding

## 1.1 Conventional Systems

Rainfall on green field sites is either absorbed into the ground or runs off slowly to the nearest watercourse. When these sites are built upon, much of the areas become impermeable increasing surface water runoff which is piped to the nearest outfall or storm drain. This increased run-off coupled with global climate change has caused large scale flooding in many areas, with conventional storm water drainage systems being over-loaded.

## 1.2 Application – Infiltration

Where possible it is recommended to dispose of the stormwater on site through infiltration. This helps the water to replenish the natural water table as would

have happened before the site was developed. Over time this allows a natural biomass to form on the walls and floor of the tank, this filters and helps break down pollutants and contaminants that may be found in stormwater runoff. Using this type of system the excavation is lined in a permeable non-woven geotextile (see table 12.1) which allows the water infiltrate vertically and laterally into the surrounding ground (see section 5).

A detailed site audit is required to determine if infiltration is suitable and should be carried out by the consultant engineer. The audit should include analysis of the following parameters: site topography, winter water table level, soil type, soil infiltration rate, soil contamination and local authority regulations. (see section 4)

## 1.3 Application – Attenuation

Attenuation tanks control the rate at which stormwater enters the local water course or storm drain. They can be impermeable or permeable systems depending on site conditions. The flow is controlled with a Hydro-Valve vortex flow control device.

A detailed site audit is required to determine if the tank should be impermeable or permeable and should be carried out by the consultant engineer. The audit should include analysis of the following parameters: site topography, winter water table level, soil type, soil infiltration rate and local authority regulations.

# HydroChamber Design Manual

## 2.0 Product Description

### HydroChamber HC-800

The HydroChamber is a thermoplastic culvert manufactured from high density polyethylene. The chambers hold a nominal capacity of 1.40m<sup>3</sup>, the system (chambers and backfill stone) holds a nominal storage capacity of between 2.1m<sup>3</sup> and 2.8m<sup>3</sup> per chamber when installed with 300mm of 35/50mm clean washed crushed stone in the foundation. A stone porosity of 40% is assumed and can change depending on compaction and aggregate size.

The arch shape of the chamber and the corrugated wall profile provides optimum structural strength (see section 3). There is an integrated inspection port in each chamber as detailed in section 14. This port may be used to lower a silt detection probe into the chamber to check the level of silt. Alternatively inspection can be carried out through the inlet and outlet manholes. See section 14 on maintenance and inspection for more details.

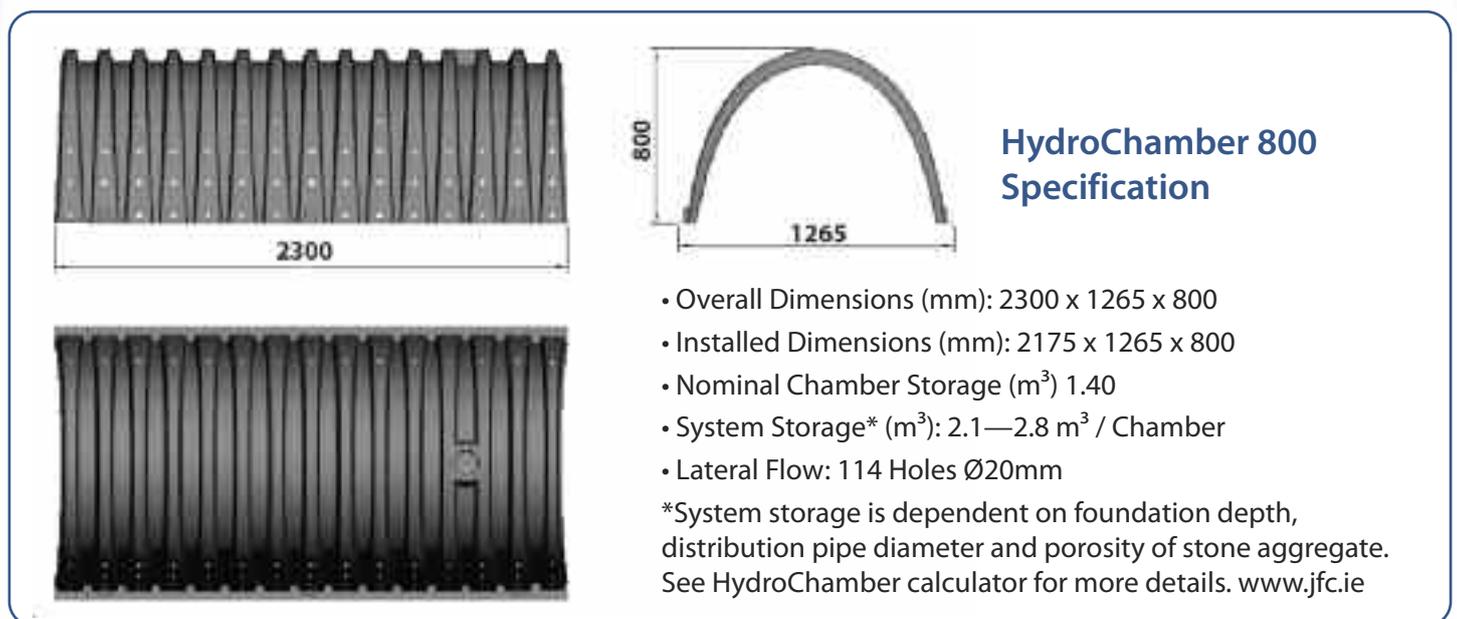


Fig 2.1 – HydroChamber Specification

The HydroChambers are assembled together with the last corrugation of the first chamber fitting over the first corrugation of the next chamber. This assembly method can be used to create a row of chambers any length. Each end of the row is protected from the backfill material by an end cap as shown in the next section. Any number of rows can be placed side by side with a 200mm space between rows.

The chambers are backfilled with 35/50mm clean washed crushed angular stone. It is important that the stone is clean so the fines do not settle in the base of the tank. This may reduce the soak away rate in an infiltration system. The stone may need to be compacted depending on the application – trafficked or non-trafficked. (See installation manual for more details).

# HydroChamber Design Manual

## 2.1 HydroChamber End Caps

There are two end caps used in conjunction with the HydroChamber. Both End Caps are manufactured from medium density polyethylene. The end caps are designed to fit under any rib of the HydroChamber.

### 2.1.1 HC800-EC01

This end cap has six eccentric protruding circles of standard pipe sizes including 225, 300, 375, 450, 525 and 600mm. Each of these circles can be cut out to allow a pipe connection to form a manifold.



HC800-EC01 End Cap



HC800-EC02 End Cap

Fig 2.2 – HydroChamber End Caps

During installation all end caps are screwed to the HydroChamber in two to three evenly spaced places along the perimeter of the arch. The units are lightweight and can be easily installed by one person.

### 2.1.2 HC800-EC02

This end cap has a ribbed domed design and can be used to blank off all rows of chambers with no pipe connections.

## 2.2 Ancillary Components

The following components are used in conjunction with the HydroChamber and HydroChamber End Caps to create a complete infiltration or attenuation system.

- Inlet / outlet / Vent Pipe: CorriPipe
- Non Woven Geotextile
- Geosynthetic Clay Liner
- Impermeable Geomembrane
- Inspection Manifold
- Hydro-Valve (attenuation only)
- Hydro Seal (impermeable system only)



Fig 2.4 – Ancillary Components

# HydroChamber Design Manual

## 3.0 Structural Design

The structural design of the HydroChamber was developed using advanced 3D non-linear finite element analysis. The analysis was carried out in JFC's state of the art R&D facility with consultancy from specialised third parties. The analysis identified the area of maximum stress during dead and live loads which were verified during full scale field tests.



Fig. 3.2 – Instrumentation Installation



Fig. 3.3 – Instrumentation Setup



Fig. 3.4 – Traffic Loading

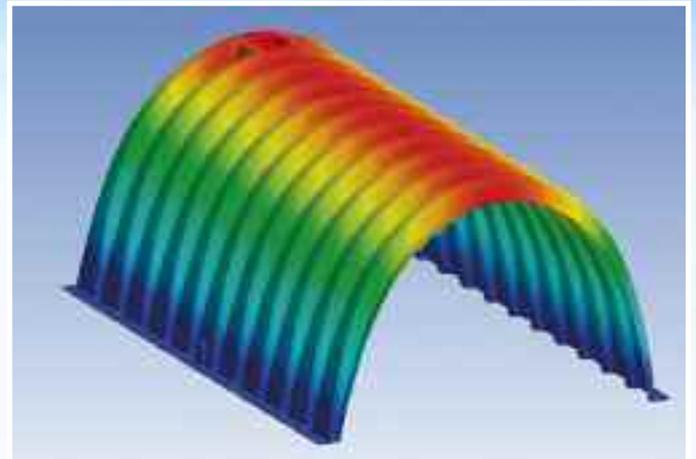


Fig. 3.1 – Finite Element Analysis

## 3.1 Field Testing

A full scale test specification was developed to establish dead and live load capabilities both short term and long term. The chambers were tested in two separate full scale field test and were independently witnessed by the BBA and WRc.

The tests used state of the art instrumentation including LVDT's, strain gauges, data loggers, temperature sensors, soil pressure cells etc.

Short term tests were carried out to establish minimum cover depths and maximum traffic loads. A short term live load factor or safety of 3.5 was established during these tests.

Long term loading capabilities was calculated from long term deep burial creep tests and long term material lab tests.

The HydroChamber system is suitable for use in green areas and lightly trafficked areas with occasional HGV traffic. See section 3.3 for more details.

The HydroChamber has a design life of 50 years when installed in accordance with manufacturer's recommendations.

# HydroChamber Design Manual

## 3.2 Trafficked Applications

The HydroChamber is suitable for installations under trafficked areas such as:

- Heavy goods vehicles with a maximum axle load of 115KN
- Car park traffic with a maximum axle load of 60KN
- Not suitable for Highway Applications.

Minimum cover is dependent on pavement type i.e. flexible pavement (e.g. asphalt) or rigid pavement (e.g. reinforced concrete). See table 3.1 below for more information on minimum and maximum cover levels.



Fig. 3.5 –Car Park

## 3.3 Non Trafficked Applications

The HydroChamber is suitable for installations under non trafficked areas such as:

- amenity areas
- playing fields
- pedestrian areas

The minimum recommended cover is 600mm and can be reduced to a lower level if construction traffic can be eliminated. Contact JFC for more information. The maximum cover over the HydroChamber is 2.4m assuming a soil density of 2000 kg/m<sup>3</sup>.



Fig. 3.6 – HGV Traffic



Fig. 3.7 – Non Trafficked Amenity Area

Table 3.1 – Min. & Max Cover Depths

Minimum/Maximum Cover Depths			
Application	Minimum Cover (mm) Flexible Pavement (eg Asphalt)	Minimum Cover (mm) Rigid Pavement (eg Reinforced Concrete)	Maximum Cover (mm) Trafficked or non-trafficked
Non-Trafficked	600 <sup>1</sup>	600 <sup>1</sup>	2400 <sup>3</sup>
Car park & LCV Traffic	600 <sup>2</sup>	600 <sup>2</sup>	2400 <sup>3</sup>
HGV Traffic	950 <sup>2</sup>	600 <sup>2</sup>	2400 <sup>3</sup>

<sup>1</sup> This value may be reduced to a lower level if construction traffic can be eliminated from the area over the installation. Contact JFC for more information

<sup>2</sup> Cover to underside of pavement for trafficked applications due to traffic from construction equipment installing the pavement layer

<sup>3</sup> Maximum Burial depth assumes a soil density of 2000kg/m<sup>3</sup>, for lighter soils deeper burials are possible, contact JFC for more information.

# HydroChamber Design Manual

## 4.0 System Selection

When designing a sustainable stormwater management system there are three different options available to the designer. A detailed site audit is required to determine what type of system is most suitable and should be carried out by the consultant engineer. The audit should include analysis of the following parameters: site topography, winter water table level, soil type, soil infiltration rate, soil contamination and local authority regulations.

### 4.1 Infiltration / Soak-away System

This is a permeable system with all the stormwater being discharged into the ground with no other outfall. This should always be the first option considered so as to mimic the grounds natural soakage and minimise the amount of stormwater bring discharged to the local storm drain or watercourse.

### 4.2 Permeable Attenuation System

This is an infiltration / soak-away system with a controlled discharge to the local watercourse or storm drain. The outlet to the watercourse provides an added factor of safety for long term sustainability.

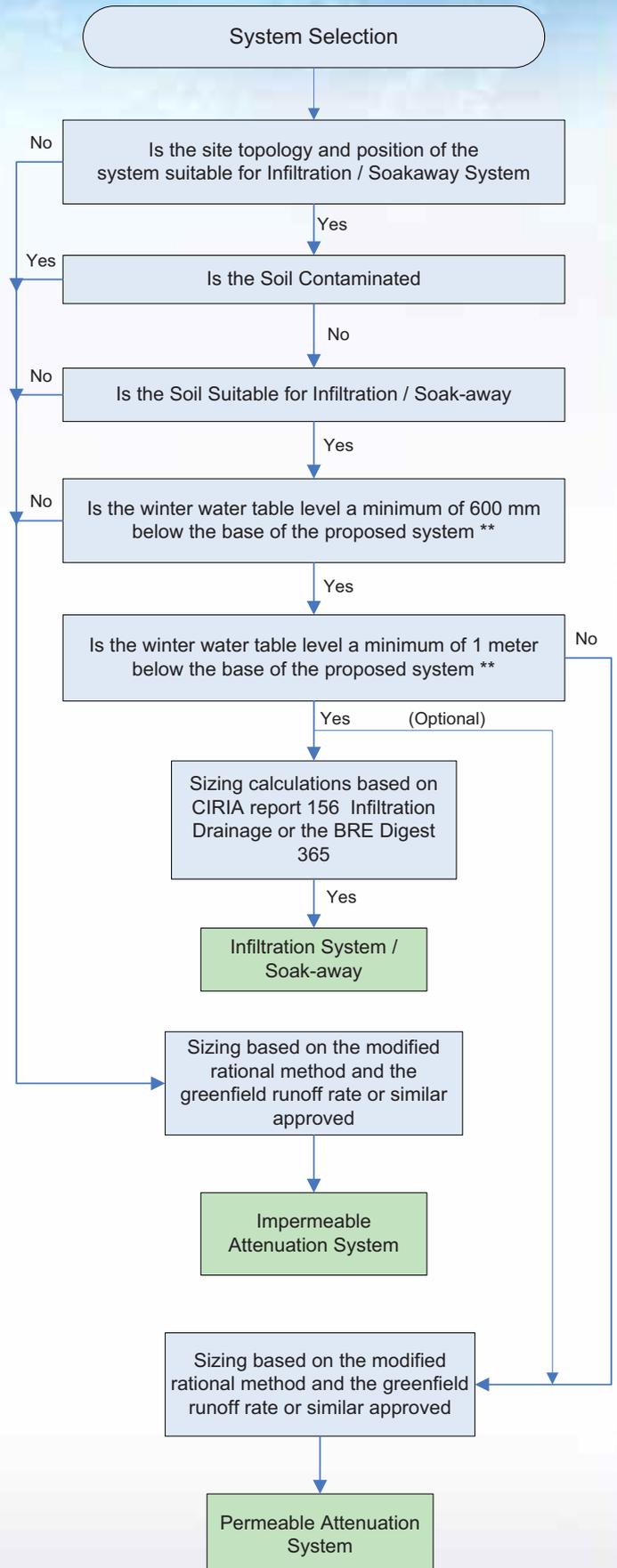
### 4.3 Impermeable Attenuation System

This is an impermeable system\* which contains all the stormwater in the holding tank while discharging to the local storm drain or watercourse at a controlled rate.

This system is normally used where there is a high water table\* and / or where the soil is not suitable for infiltration.

\*The impermeable system consists of an impermeable liner on the sides and base of the tank with the top covered with a non woven geotextile to allow infiltration from above the tank. Therefore is not a completely sealed system.

\*\* The designer may wish to alter allowable winter water table depths for system selection depending on site conditions



# HydroChamber Design Manual

## 5.0 Infiltration / Soak-away

During a rainstorm event all stormwater is piped into the catchpit manhole where sediment and floatables are trapped. It then flows through the inspection / inlet manhole and on to the perforated distribution pipe.

The water permeates through the perforated distribution pipe and into the surrounding stone as well as flowing through the inspection manifold into the chambers. The distribution pipe, HydroChambers and backfill stone provide the storage volume as the water infiltrates the surrounding ground.

## 5.1 Infiltration Design

The required size for the HydroChamber infiltration tank will be determined from the following parameters after a detailed site audit - site topography, winter water table level, soil type, soil infiltration rate, soil contamination and local authority regulations. The calculations should be based on either CIRIA Report 156 Infiltration Drainage or the BRE Digest 365 and comply with EN 725-2008 National Annex for Hydraulic Calculations. A trial hole should be dug in the proposed location of the system to determine infiltration characteristics for use in storage calculations.

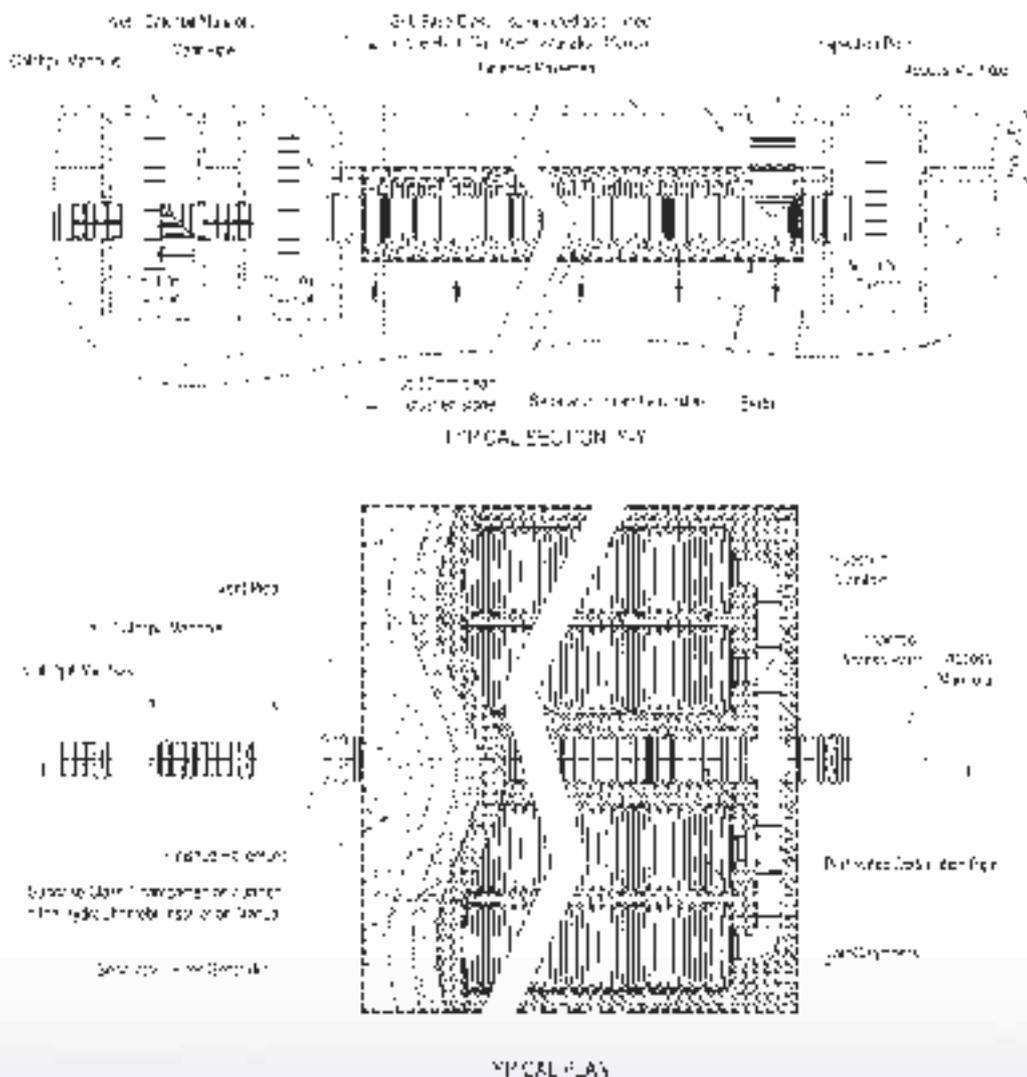


Fig.5.1 – Infiltration / Soakaway System Front Section and Plan

# HydroChamber Design Manual

## 5.2 System Sizing

System sizing is determined through the use of the HydroChamber Calculator which can be downloaded from the following website: [www.jfc.ie](http://www.jfc.ie)

System sizing is based on the following parameters:

- Required Storage Volume
- Size of Distribution Pipe
- Foundation Depth
- Width or Length Restrictions
- Excavation Dimensions

### 5.2.1 Calculator Instructions

1. Enter target storage capacity
2. Select proposed foundation depth
3. Select distribution pipe diameter
4. Enter number of chambers wide to provide the required excavation width
5. Modify number of chambers long to achieve the required actual storage volume.
6. Foundation depth may be modified in conjunction with number of chambers long to achieve the required actual storage volume.

## 5.3 Installation

The excavation is carried out as per design specification. The site engineer will inspect the excavation and determine the required depth of foundation stone depending on the CBR value of the soil.

The excavation is lined with a layer of non-woven geotextile with lapped joints of 300mm. The foundation stone is then installed and compacted as outlined in the HydroChamber Installation Manual.

The chambers are then placed side by side in rows across the width of the excavation with a minimum distance of 200mm between adjacent rows.

The backfill stone is then installed to a minimum depth of 150mm over the top of the chambers as shown in fig 5.2. A layer of separator / filter geotextile is placed on top of the stone. Backfill continues to a minimum cover of 600mm over the top of the chambers. Backfill material specification is dependent upon the finished use of the area above the tank.

See HydroChamber installation manual for full details and photographs.

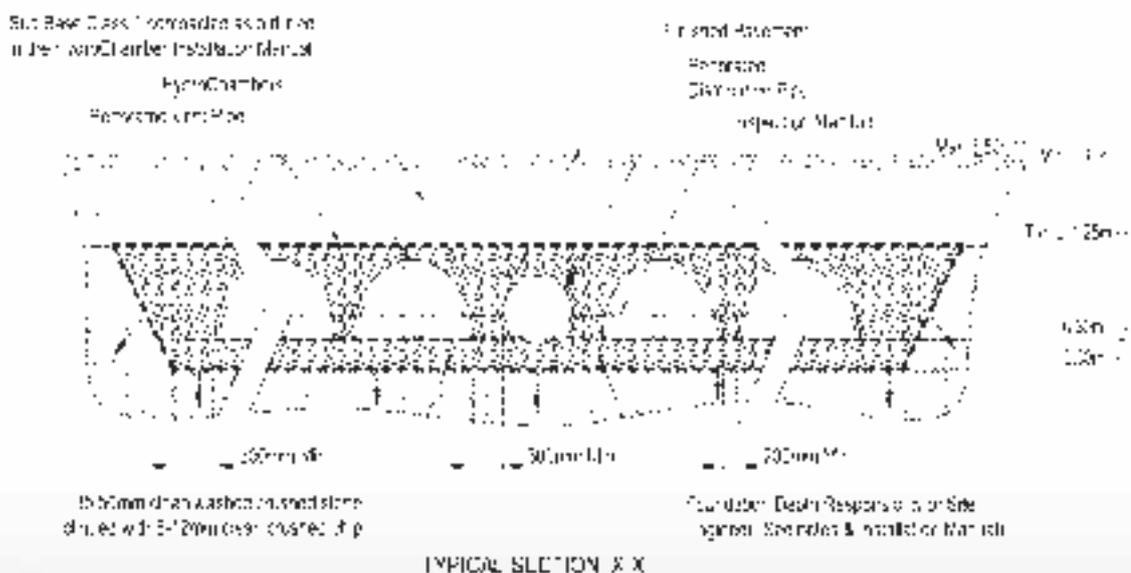


Fig.5.2 – Infiltration / Soakaway End Section

# HydroChamber Design Manual

## 6.0 Attenuation

During a rainstorm event all stormwater is piped to the catchpit manhole where sediment and floatables are trapped. It then flows through the inspection / inlet manhole and through the perforated distribution pipe.

The water permeates through the perforated distribution pipe and into the surrounding stone and chambers. During large storm events water flows out the inspection manifold directly into the two rows adjacent to the distribution pipe. The distribution pipe, HydroChambers and backfill stone provide the storage volume as the water exits the system at a controlled rate through the Hydro-Valve.

In an impermeable system the sides and base of the excavation are lined with an impermeable membrane or liner (GCL) which prevents the water infiltrating the ground and forces all water to exit through the flow control device.

Alternatively the system can be permeable by using a separator / filter geotextile in place of an impermeable liner, this discharges some water into the ground and some to the watercourse or storm drain.

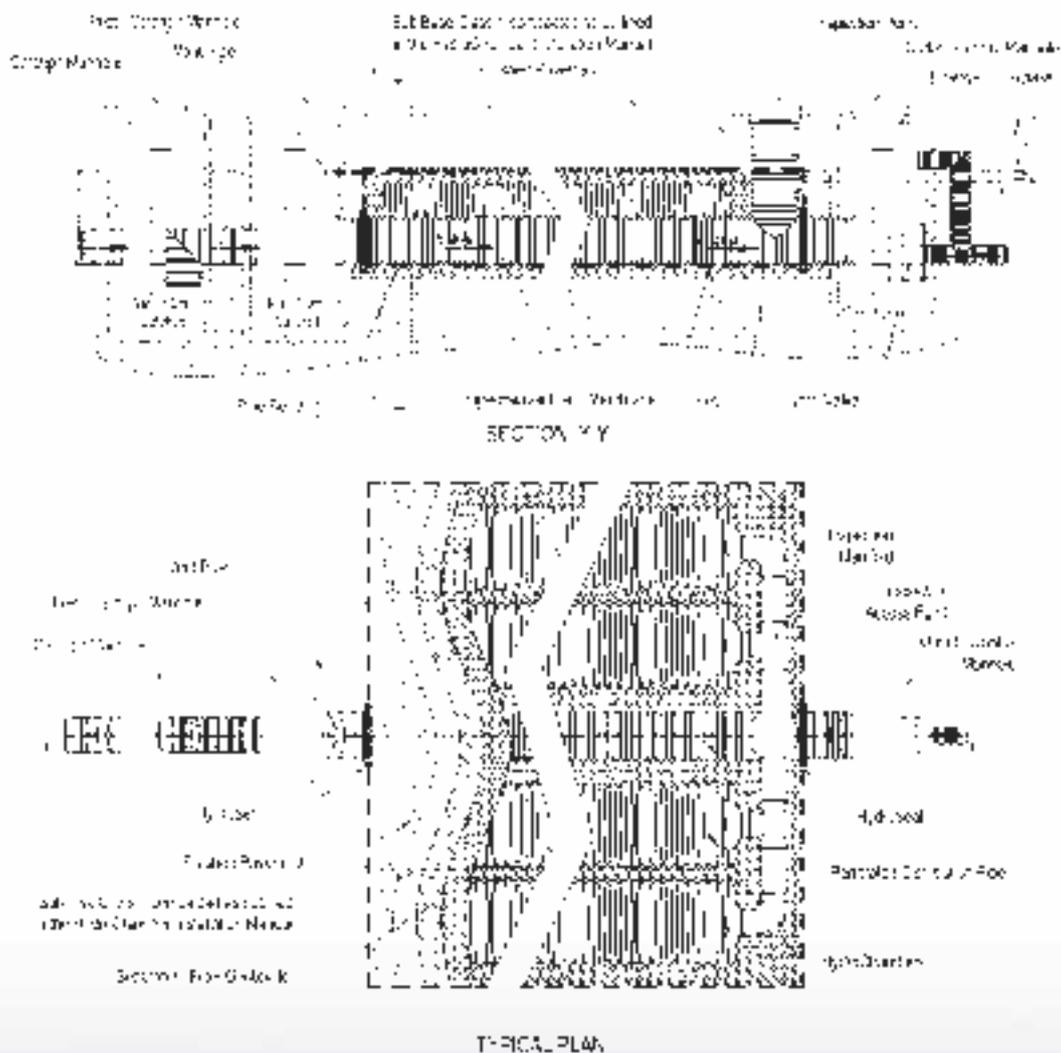


Fig.6.1 – Attenuation System Front Section and Plan

# HydroChamber Design Manual

## 6.1 Attenuation Design

A detailed site audit is required to determine if the tank should be impermeable or permeable and should be carried out by the consultant engineer. The audit should include analysis of the following parameters: site topography, winter water table level, soil type, soil infiltration rate and local authority regulations.

If an impermeable system is required the sizing calculation should be carried out using the modified rational method for developed run-off calculations and the institute of hydrology report no.124 for green field runoff or similar approved. For a permeable system the same method should be used and can be combined with the BRE Digest 365 to find the infiltration rate of the ground which can also be taken into account. All calculations should comply with EN 725-2008 National Annex for Hydraulic Calculations.

## 6.2 System Sizing

System sizing is determined through the use of the HydroChamber Calculator which can be downloaded from the following website: [www.jfc.ie](http://www.jfc.ie)

System sizing is based on the following parameters:

- Required Storage Volume
- Size of Distribution Pipe
- Foundation Depth
- Width or Length Restrictions
- Excavation Dimensions

### 6.2.1 Calculator Instructions

- Enter target storage capacity
- Select proposed foundation depth
- Select distribution pipe diameter
- Enter number of chambers wide to provide the required excavation width

- Modify number of chambers long to achieve the required actual storage volume.
- Foundation depth may be modified in conjunction with number of chambers long to achieve the required actual storage volume.

## 6.3 Installation

The excavation is carried out as per design specification. The site engineer will inspect the excavation and determine the required depth of foundation stone depending on the CBR value of the soil.

The excavation is lined with a suitable permeable or impermeable geotextile / geomembrane / GCL. When using a geomembrane it needs to be protected on either side with a suitable geotextile, see section 12 for more details. The foundation stone is then installed and compacted as outlined in the HydroChamber Installation Manual.

The chambers are then placed side by side in rows across the width of the excavation with a minimum distance of 200mm between adjacent rows.

The backfill stone is then installed to a minimum depth of 150mm over the top of the chambers as shown in fig 6.2. A layer of separator / filter geotextile is placed on top of the stone. Backfill continues to a minimum cover of 600mm over the top of the chambers. Backfill material specification is dependent upon the finished use of the area above the tank.

See HydroChamber installation manual for full details and photographs.

# HydroChamber Design Manual

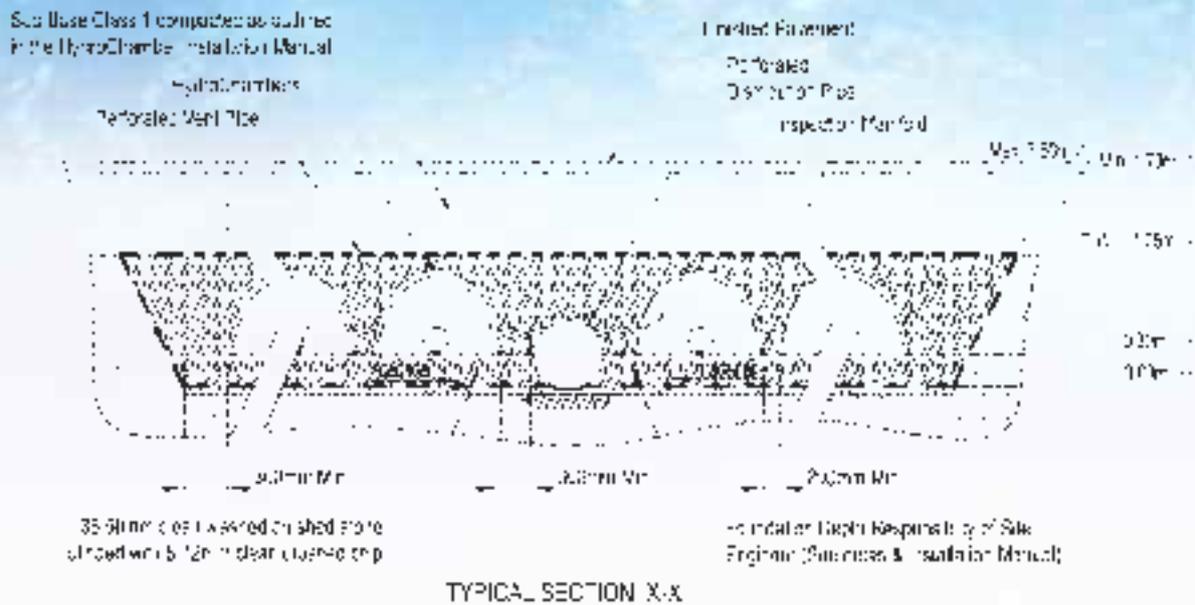


Fig.6.2 – Attenuation System End Section

## 7.0 Foundation Design

The foundation depth is dependent upon the structural stability of the soil beneath the foundation stone and is the responsibility of the consultant engineer. The subgrade strength should be established by means of a plate bearing test or similar approved to establish the CBR value of the soil as outlined in BS 1377: Part4: Section 7. The moisture content and density should mimic that in the subgrade when the stormwater management system is in operation. See tables 7.1 and 7.2 below.

**IMPORTANT NOTE:** Depending on outlet invert levels the liner used on impermeable systems can be placed in the middle of the foundation stone. e.g. 600mm foundation with impermeable liner installed 300mm deep in the foundation stone. See figure 6.2 for more details.

HydroChamber Foundation Requirements for Dead Soil Loads					
Soil Type	Condition	CBR Value	Foundation Depth		
			<1.5m Cover	1.6m - 2.0m Cover	2.1m - 2.4m Cover
		<2%	seek advise from a Geotechnical Engineer		
Sandy Clay / Boulder Clay	"firm" <sup>1</sup>	2%	0.3m	0.5m	0.6m
Sandy Clay / Boulder Clay	"stiff" <sup>2</sup>	3%	0.3m	0.3m	0.3m
Sand / Gravel	"compact" <sup>3</sup>	15%	0.15m	0.15m	0.15m

Table. 7.1 – Foundation Depth for Dead Soil Loads

HydroChamber Foundation Requirements for Live Traffic Loads					
Soil Type	Condition	CBR Value	Foundation Depth		
			<1.5m Cover	1.6m - 2.0m Cover	2.1m - 2.4m Cover
		<2%	seek advise from a Geotechnical Engineer		
Sandy Clay / Boulder Clay	"firm" <sup>1</sup>	2%	0.3m	0.6m	0.9m
Sandy Clay / Boulder Clay	"stiff" <sup>2</sup>	3%	0.3m	0.3m	0.6m
Sand / Gravel	"compact" <sup>3</sup>	15%	0.15m	0.3m	0.3m

Table. 7.2 – Foundation Depth for Live Traffic Loads

# HydroChamber Design Manual

## Notes:

1. Condition assessed following Building Regulations 1997, Technical guidance Document A, Structure – ‘firm’ sandy clay or boulder clay soil can be moulded by substantial pressure with the fingers and can be excavated with a spade, or see BS5930:1999. Soil stratum to be a minimum of 600mm thick beneath underside of granular fill.
2. Condition assessed following Building Regulations 1997, Technical Guidance Document A, Structure – ‘compact’ granular soils require pick for excavation; a wooden peg 50mm square hard to drive beyond 150mm, or see BS5930:1999. All sands and gravels should be proof-rolled as described in clause 613.7 of National Roads Authority Specification for Roadworks (NRA SRW) Series 600 Earthworks. Soil stratum to be minimum 600mm thick beneath underside of granular fill.
3. Condition assessed following Building Regulations 1997, Technical Guidance Document A, Structure – ‘stiff’ sandy clay or boulder clay soil cannot be moulded with the fingers and requires a pick or pneumatic or other mechanically operated spade for its removal, or see BS5930:1999. Soil stratum to be minimum 600mm thick beneath underside of granular fill.

## 8.0 Inlet / Catchpit Manholes & Silt Management

Best management practices recommend that two manholes be installed upstream of the stormwater management system. The first catchpit manhole is to have a minimum sump of 1m and a 90° bend installed on the outlet to prevent both settable solids and floatable contaminants entering the system.

A second catchpit manhole acts as an inlet to the system and allows access for maintenance and inspection.

There are two options available to the designer for the inlet / catchpit manhole configuration.

1. Inline Submerged System – The distribution pipe through the system is installed at the same level as the main inlet line.
2. Backdrop System – The distribution pipe through the system is installed at a lower level than the main line. This prevents surcharge in the mainline until the system is near full.

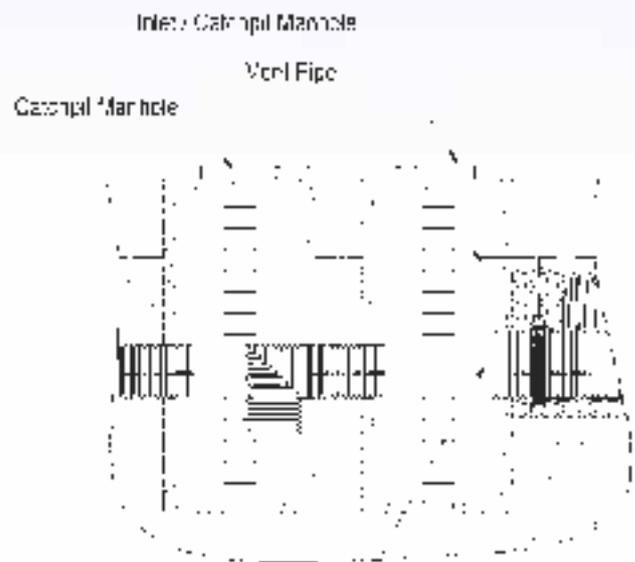


Fig. 8.1 – Inline Submerged System

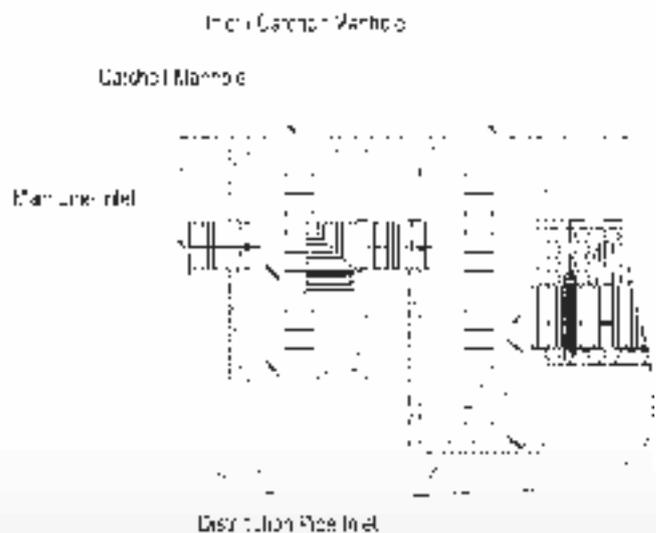


Fig.8.2 – Backdrop System

# HydroChamber Design Manual

## 9.0 Distribution Pipe & Inspection Manifold

The main distribution pipe runs from the inlet / catchpit manhole to the outlet / control manhole. The diameter is to be at minimum equal to the main line feeding the system and can be larger for maintenance and inspection if required.

When using an infiltration / soak-away system a fully perforated pipe is used between each manhole. If the system is impermeable a fully perforated pipe is run inside the liner / geomembrane and an unperforated pipe run from the liner to the manhole. A HydroSeal is used to create a watertight joint. (see figure 2.4)

The perforated pipe is to have four standard perforations on every other dwell and laid with no perforation directly on the base of the pipe to allow dry weather flow straight through.

The distribution pipe should be run at a fall of 1:150 for self cleansing velocities but can be run at shallower gradients if constrained by outfall levels.

1. Directly on the liner / geomembrane and is normally found on impermeable systems where it is used to drain the foundation stone. See fig. 5.2 and 9.1
2. Directly on top of the foundation stone at the same level as the chambers and is normally found on permeable attenuation or infiltration systems where the foundation is drained into the surrounding ground. See fig. 5.2 and 9.2



Fig.9.2 – Infiltration /Permeable System

The inspection manifold directly connects the main distribution pipe to a number of adjacent chamber rows. As standard it connects into four rows but can be connected to any number as per design requirements.

The inspection manifold pipe size is normally smaller than the main distribution pipe but can be sized as per design requirements.

The inspection manifold also acts as a direct overflow to the chambers during storm surges.



Fig.9.1 – Impermeable System

The distribution pipe can be laid in one of two positions and is dependent upon system operation.

1. Directly on the liner / geomembrane and is normally found on impermeable systems where it is used to drain the foundation stone. See fig. 6.2 and 9.1



Fig.9.3 – Inspection manifold

# HydroChamber Design Manual

## 10.0 Outlet / Control Manhole

When using an impermeable or permeable attenuation system a Hydro-Valve vortex flow control device is installed in the outlet / control manhole.

The device is used to control the flow into the local storm drain or watercourse and the allowable discharge is defined by the local authority or design engineer.

The outlet invert of the Hydro-Valve must be slightly lower than the distribution pipe invert level in order to completely drain the system. The outlet / control manhole must have a sump to accommodate the flow control device. The size of the sump is dependent on the specification of the Hydro-Valve.

It is recommended that an overflow pipe exits the manhole directly into the downstream pipe at the top water level. This prevents surface flooding in the event of a blockage. See fig. 10.1 below.

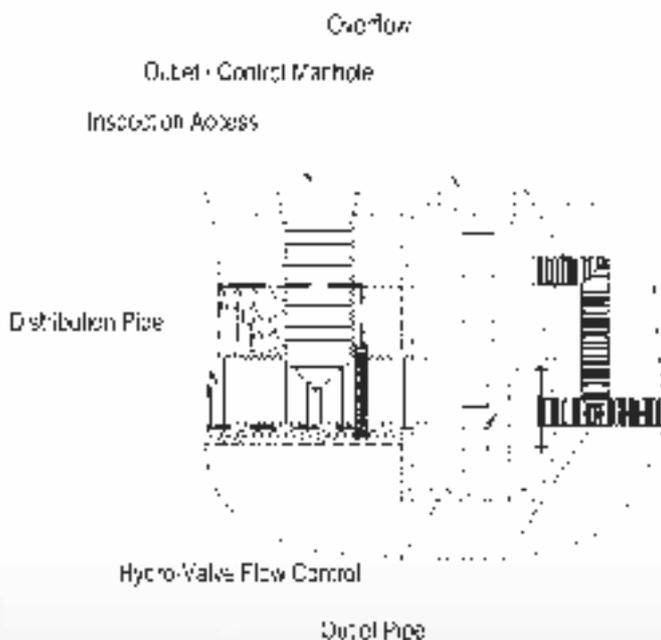


Fig.10.1 – Outlet / Control Manhole

## 11.0 Pipe Line Configurations

There are various pipeline configurations available to the designer when choosing a suitable solution.

### 11.1 Offline Configuration

Using this configuration the main pipeline does not pass through the tank. A flow control manhole is located on the main line, when the device restricts the flow it backs up into the tank until the storm subsides. See fig. 11.1 below.

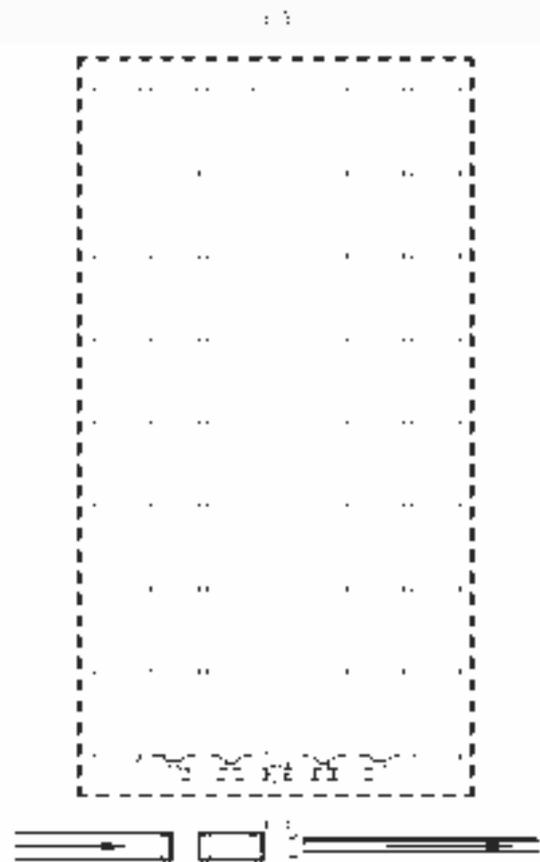
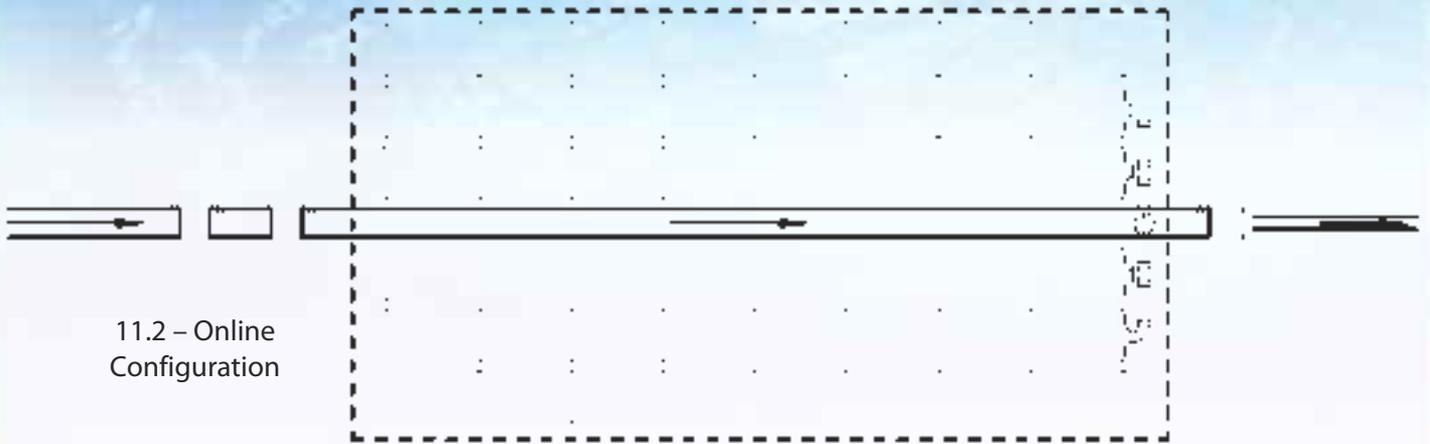


Fig.11.1 – Offline Configuration

### 11.2 Online Configuration

Using this configuration the main pipeline passes through the tank. A flow control manhole is located on the main line downstream of the tank. When the device restricts the flow it backs up into the tank until the storm subsides.

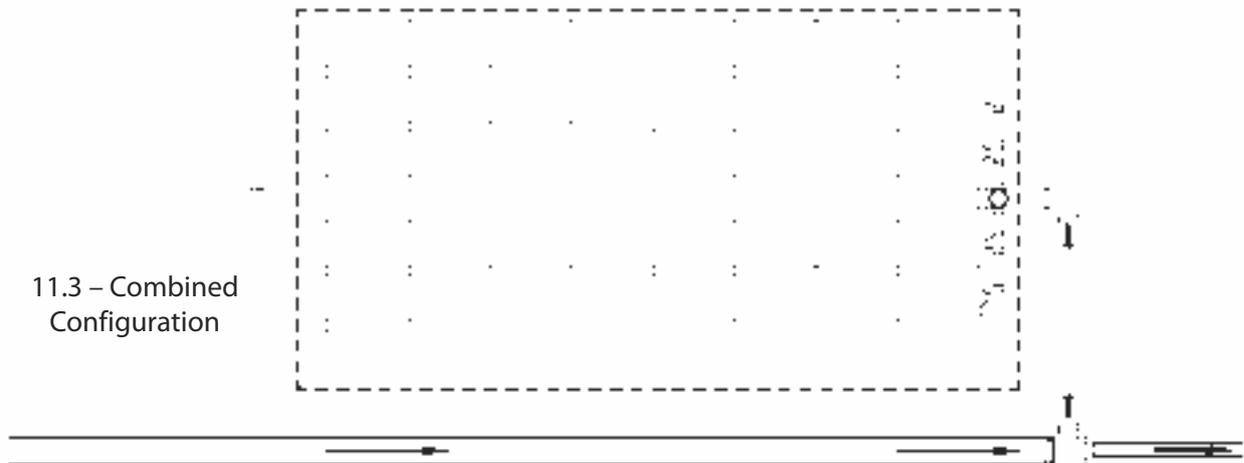
# HydroChamber Design Manual



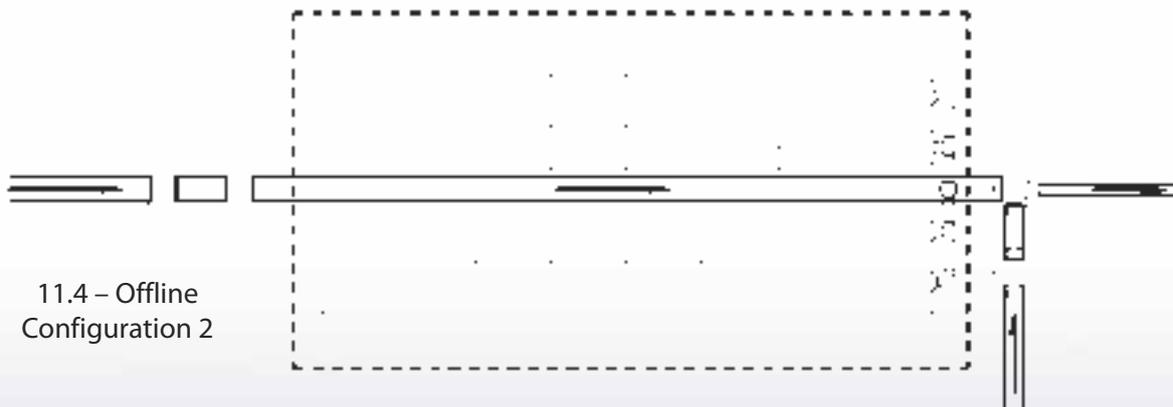
11.2 – Online Configuration

## 11.3 Combined Configuration

Using this configuration the main pipeline passes through the tank and has a second feed line that connects directly to the outlet manhole. A flow control device restricts the flow and it backs up into the tank until the storm subsides. See figure 11.4.



11.3 – Combined Configuration



11.4 – Offline Configuration 2

# HydroChamber Design Manual

## 12.0 Geotextile and Geomembrane

This section outlines the recommended types of geotextile, geomembrane and liners for use with the HydroChamber system.

### 12.1 Separator / Filter Geotextile

A 155g/m<sup>2</sup> staple fibre needle punched and thermally bonded non-woven Geotextile. This grade of geotextile is used to line the excavation on permeable attenuation systems and an infiltration / soak away system.

The geotextile is used to separate the subsoil from the clean crush stone aggregate preventing fines migrating into the system. It also provides excellent hydraulic properties allowing water infiltrate the surrounding subsoil. A typical specification is outlined in table 12.1.

### 12.2 Protector Geotextile

A 300g/m<sup>2</sup> staple fibre needle punched and thermally bonded non-woven Geotextile. This grade of geotextile is used to line the excavation and cover the impermeable geomembrane on impermeable attenuation systems.

It is used on either side of the Geomembrane to prevent the foundation material and backfill stone from puncturing or piercing the liner. A typical specification is outlined in table 12.2.

### 12.3 Impermeable Geomembranes

There are a number of geomembrane materials that can be used to line the system including Polypropylene (PP), Linear Low Density Polyethylene (LLDPE), High Density Polyethylene (HDPE) and Polyvinylchloride (PVC). The specification of the geomembrane must be able to:

- Withstand all loads during installation
- Resist Puncture and Piercing
- Resist tearing
- Remain intact for its design life
- Resist environmental stress cracking
- Be repaired if damaged

The minimum recommended thickness for LLDPE / HDPE / PP / PVC Geomembranes is 1mm. Some reinforced Geomembranes less than 1mm thick are also acceptable, check with geomembrane manufacturer for more information. A typical specification for polypropylene is outlined in table 12.3.

### 12.4 Geosynthetic Clay Liner

GCLs are liners consisting of sodium bentonite clay encased between two layers of protective geotextile. The bentonite clay liner provides the seal with the geotextile layers protecting the liner against puncture.

GCLs provide excellent sealing properties with their unique self sealing attributes reducing risk of failure due to adverse field and operating conditions. The GCL specification must be able to:

- Withstand all loads during installation
- Resist Puncture and Piercing
- Resist tearing
- Remain intact for its design life
- Be repaired if damaged.

A typical specification for a geosynthetic clay liner is outlined in table 12.4.

\*Constant technological advancements are being made in the design and manufacture of geotextiles and geomembranes which may allow new types and specifications be used with the HydroChamber system in the future.

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<b>Non-Woven Separator / Filter Geotextile</b>			
	<b>test method</b>	<b>value</b>	<b>tolerance</b>
<b>Mechanical properties</b>			
Tensile strength MD Tensile strength CD	EN ISO 10319	12 kN/m	-1,6 kN/m -1,6 kN/m
Elongation MD Elongation CD	EN ISO 10319	50 % 50 %	+/-11,50 % +/-11,50 %
Static puncture resistance – CBR	EN ISO 12236	2 kN	-0,00 kN
Dynamic perforation resistance – cone drop	EN 918	24 mm	+ 5 mm
Protection efficiency	WI 189066	124 N	-24.8 N
<b>Hydraulic properties</b>			
Water flow normal to the plane	EN ISO 11058	105 l/m <sup>2</sup> .s	-31,5 l/m <sup>2</sup> .s
Water flow capacity in the plane	EN ISO 12958	1x10 <sup>-7</sup> m <sup>2</sup> /s	-10% log q
Characteristic opening size	EN ISO 12956	110 µm	+/-33,00 µm
<b>Physical properties</b>			
Thickness under 2 kPa	EN 964/1	1,3 mm	+/- 0.26mm
Weight	EN 965	155 g/m <sup>2</sup>	+/- 15.50 g/m <sup>2</sup>
Composition	100 % polypropylene non-woven geotextile		

Table 12.1 – Separator / Filter Geotextile

<b>Non-Woven Protector Geotextile</b>			
	<b>test method</b>	<b>value</b>	<b>tolerance</b>
<b>Mechanical properties</b>			
Tensile strength MD Tensile strength CD	EN ISO 10319	20 kN/m - 22kN/m	-2,6 kN/m -2,9 kN/m
Elongation MD Elongation CD	EN ISO 10319	45 % 55 %	+/-10.4 % +/-12.7 %
Static puncture resistance – CBR	EN ISO 12236	3.8 kN	-0,76 kN
Dynamic perforation resistance – cone drop	EN 918	9mm	+ 1.80 mm
Protection efficiency	WI 189066	330N	-66 N
<b>Hydraulic properties</b>			
Water flow normal to the plane	EN ISO 11058	80 l/m <sup>2</sup> .s	-24 l/m <sup>2</sup> .s
Water flow capacity in the plane	EN ISO 12958	8x10 <sup>-6</sup> m <sup>2</sup> /s	-10% log q
Characteristic opening size	EN ISO 12956	80 µm	+/-24,00 µm
<b>Physical properties</b>			
Thickness under 2 kPa	EN 964/1	2.2 mm	+/- 0.44mm
Weight	EN 965	300 g/m <sup>2</sup>	+/- 30 g/m <sup>2</sup>
Composition	100 % polypropylene non-woven geotextile		

Table 12.2 – Protector Geotextile Specification

<b>Geosynthetic Clay Liner (GCL)</b>			
	<b>Test Method</b>	<b>Test Frequency</b>	<b>Required Values</b>
<b>Mechanical properties</b>			
GCL Index Flux	ASTM D5887	Weekly	2 X 10 e-9(m <sup>3</sup> /m <sup>2</sup> ).S e-1
GCL Permeability	ASTM D5084	Weekly	1 X 10 e-11 m.s e-1
pH <sup>2</sup>	BS 1377 Part 2	Weekly	9.8max
Bentonite Fluid Loss	ASTM D5891	5,000m <sup>2</sup>	18 mL max.
Bentonite Mass / Area <sup>3</sup>	ASTM D5261	5,000m <sup>2</sup>	4.8kg.m e-2
GCL Grab Strength	ASTM D4632	5,000m <sup>2</sup>	400N
GCL Grab Elongation	ASTM D4632	5,000m <sup>2</sup>	20% typical
GCL Peel Strength	ASTM D4632	5,000m <sup>2</sup>	65N
Bentonite Swell Index	ASTM D5890	5,000m <sup>2</sup>	24mL/2g min.

Table 12.5 – Geosynthetic Clay Liner

<b>Typical Polypropylene Geomembrane</b>			
	<b>Test Method</b>	<b>Units</b>	<b>Value</b>
Thickness			1mm
Density	ISO 1183	g/cm	>0.89
Tolerance Average Value	DIN 53370	%	±5
Tensile Stress at Break	ISO 5271	mpa	>18
Elongation at Break	ISO 5271	%	>700
Tear Propagation Resistance	DIN 53515	N/mm	>45
Piercing Resistance	FTMS 101C	N	>170
Stress Crack Resistance	ASTM D 1693	h	2000
Oxidation Induction Time	ASTM D 3895 (200°C)	min	>100
Water Absorption after 7 days	DIN ISO 62	%	<0.2
Dimensional Changes	DIN 53377	%	±2

Table 12.3 – Polypropylene Geomembrane

# HydroChamber Design Manual

## 13.0 Venting

Venting allows the air in the system to exit the chambers and stone as they are being filled with water. It also allows air enter the system to replace the water as it is emptying.

It is recommended that a 100mm perforated pipe be installed for every 500m<sup>3</sup> of storage provided. The perforated pipe is run from 12m inside the system into the highest manhole, this may be upstream or downstream depending on an online or offline configuration. See figure 13.1 and section 11.0.



Fig. 13.1 – Venting Detail

## 14.0 Inspection & Maintenance

The HydroChamber Storm Water Management System is designed to allow easy access inspection and maintenance. Access is provided by a number of methods detailed below.

There are two main options available for inspection, visual inspection and camera inspection. Depending on the maintenance program requirements the most suitable will be selected.

## 14.1 Visual Inspections

Visual Inspections can be carried out from one of the following points:

- Inlet / Catchpit manhole
- Outlet / Control Manhole

The manholes are to be de-sludging prior to entry and standard safety precautions should be taken when working in confined spaces.



Fig. 14.1 – Distribution Pipe Inspection

## 14.2 Camera Inspections

Camera inspection can be carried out from one of the following points:

- Access point on distribution pipe
- Inlet / Catchpit manhole
- Outlet / Control Manhole
- Chamber Inspection port



Fig. 14.2 – Chamber Inspection

# HydroChamber Design Manual

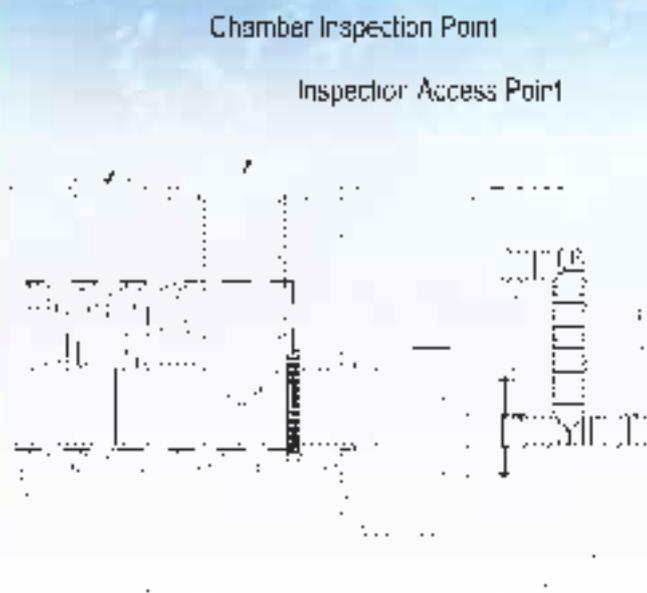


Fig. 14.2 – Inspection Points

A 100mm pipe may be installed in the inspection port of any chamber for camera access from the ground. The designer can specify any number of inspection ports at various locations as deemed necessary.

## 14.3 Inspection and Maintenance Programme During Construction

A large amount of settable solids are present in the stormwater network during construction and this is mainly due to the silt / grit present in construction runoff. To account for this the following inspection and maintenance programme is recommended.

- Inspect both inlet catchpit manholes monthly
- If either catchpit is 50% full, de sludge both with a standard vacuum tanker
- If a large amount of silt is present a silt screen may be fitted in the inlet manhole during construction
- When construction is finished a full camera inspection is recommended on the main

distribution line between inlet and outlet manholes.

- If any contaminants are found in the line it should be flushed / jetted and the catchpit manholes de sludged.
- Best management practices should be maintained to minimise contaminants entering the stormwater network.

## 14.4 Inspection and Maintenance Programme Post Construction

When the developed site is in use post construction the intensity of contaminants entering the system greatly reduces. The following inspection and maintenance programme is recommended.

- Inspect both inlet catchpit manholes at six monthly intervals in the first year.
- If either catchpit is 50% full, de sludge both with a standard vacuum tanker
- After the first year camera inspect the main distribution pipe and associated inspection points.
- If any contaminants are found in the line it should be flushed / jetted and the catchpit manholes de sludged.
- After the first year inspection should be carried out annually or bi-annually depending on activity and maintenance carried out as deemed appropriate.
- Best management practices should be maintained to minimise contaminants entering the stormwater network.

# HydroChamber Design Manual

## 15.0 Safety Information

### 15. Composition

Hazardous ingredients - None

Types of Material - medium / high density polyethylene, bentonite, polypropylene geotextile.

### 15.2 Hazards Identification

Nature of Hazard - There are no health risks from the products during normal use.

### 15.3 First Aid Measurers

Eye Contact – Plastic Materials may cause physical irritation in the eyes. Wash out with large amounts of water. If irritation persists seek medical advice.

Skin Contact – Not applicable

Inhalation – Not applicable

### 15.4 Fire Fighting Measurers

Extinguishing Media – On small fires use any hand held extinguisher type. On large fires use water.

Fire Hazards – Melting Plastic may flow and spread in a large fire. Products or fire will be black thick toxic smoke.

Material Characteristics– Polyethylene products will burn in the presence of a flame over 100°C.

Protective Equipment – Wear self contained breathing apparatus and protective clothing.

### 15.5 Handling and Storage

There are no hazards associated with the finished product, however when cutting it is recommended that the correct tools are used e.g. Handsaw or Alligator Saw. During cutting avoid inhaling dust. Pallets of HydroChambers must be stored on level

ground and must not be subject to strong winds. Pallets weigh approximately 750kgs, all equipment used to unload and move the pallets must be capable of lifting the weight safely. Prolonged (over one year) storage in direct sunlight should be avoided. The HydroChambers should not be stored near any fuel storage areas or any other solvents. HydroChambers should be stored in an area where they will not get damaged due to construction plant or vehicles.

### 15.6 Personal Protection

Respiratory Protection – Not required under normal conditions, when cutting use a disposable half mask to the standard FFP2S.

Hand Protection – Wear impervious strong gloves.

Eye Protection – Wear safety glasses when cutting.

Skin Protection – Wear Overalls

### 15.7 Site Hazards

Working below ground – HydroChambers are installed underground and all necessary safety regulations must be adhered to when excavating the trench, work below ground and backfilling the trench.

### 15.8 Environmental Information

Stability – These products are stable at temperatures up to normal operating conditions.

Biodegradability - Plastic products are not readily biodegradable but are not detrimental to terrestrial wildlife.

Aquatic Toxicity – Not toxic to marine life

### 15.9 Other Information

As the handling, storage, use and disposal are beyond our control, JFC disclaim all liability for loss, damage or other expense during handling and storage.

# HydroChamber Design Manual

## 16.0 References

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