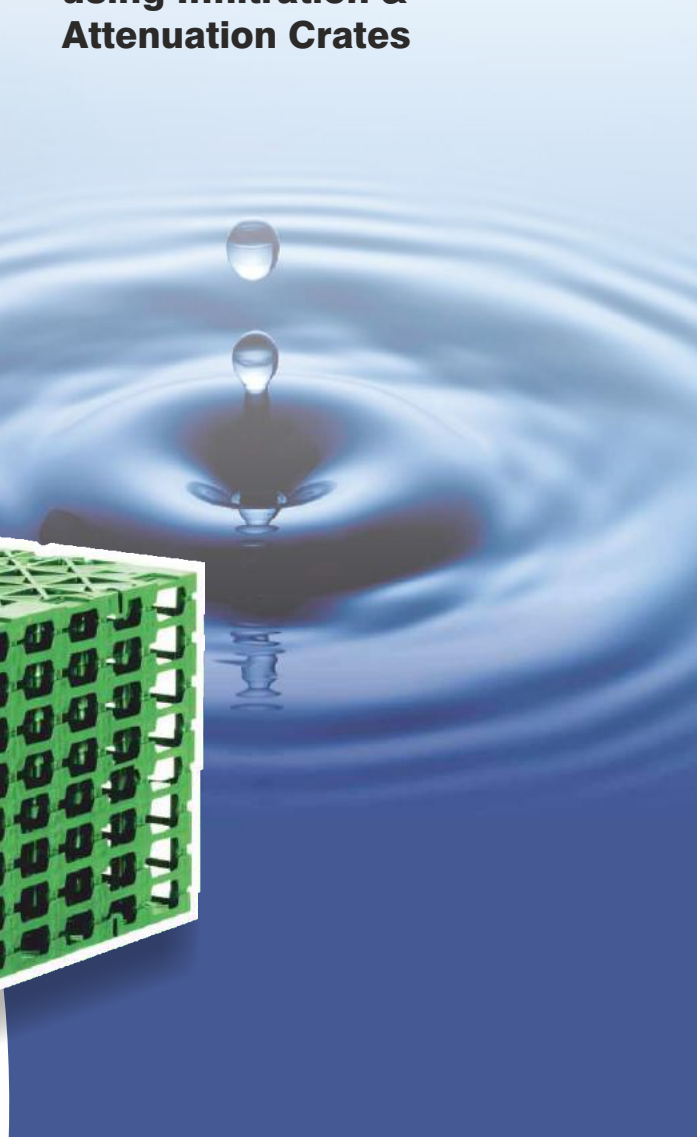
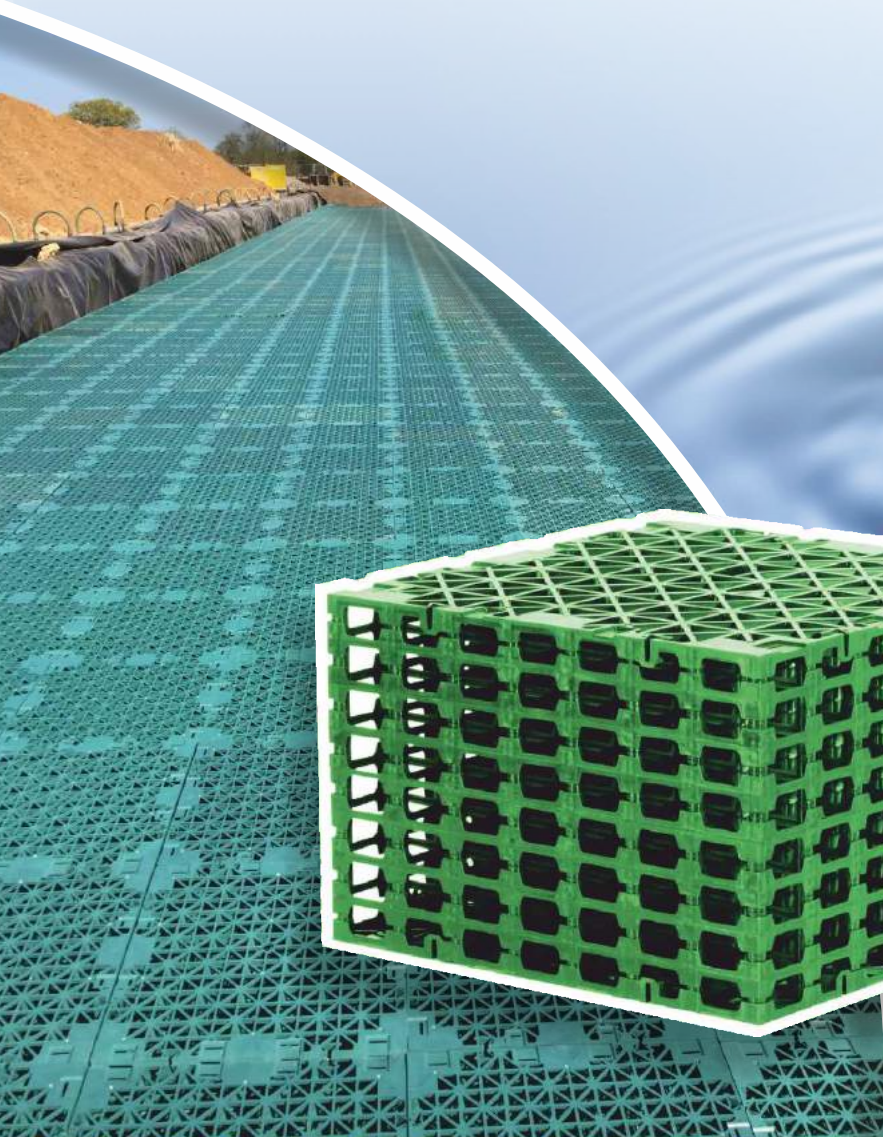


**NAYLOR**  
ENVIRONMENTAL

# Sustainable Urban Drainage Systems (SuDS)

**Stormwater Management  
using Infiltration &  
Attenuation Crates**



**email: [environmental@naylor.co.uk](mailto:environmental@naylor.co.uk) web: [www.naylor.co.uk](http://www.naylor.co.uk)**



Naylor Aquavoid<sup>®</sup>-Traffic  
Heavy Duty (400kN/m<sup>2\*\*</sup>)

Naylor Aquavoid<sup>®</sup>-Plus  
Extra Heavy Duty (700kN/m<sup>2\*\*</sup>)

## About Naylor Environmental

Naylor Environmental, part of Naylor Industries, is an innovative company specialising in multi-product systems designed for environmental protection projects within the Construction Industry. The principal activities of the company are concentrated within the Sustainable Urban Drainage Systems arena and are split into five distinct areas:

**Surface Water Storage & Infiltration** - Aquavoid® Crates

**Reinforced Grass** - TechTurf Systems

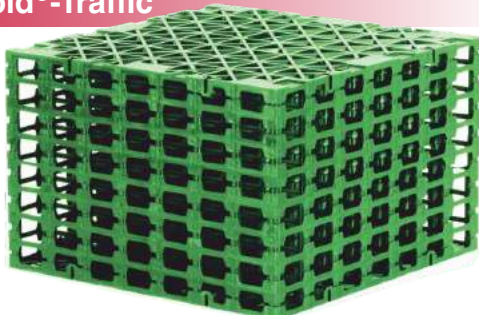
**Stormwater Quality** - Smart Sponge®

**Porous Paving** - Grid Systems for Vehicles & HGVs

**Land Drainage** - Enviroflow®

The **Naylor Aquavoid®** range of attenuation crates provides an economic and versatile stormwater storage system for general (Traffic) and heavy duty use (Plus). Used as a soakaway, rainwater collected through pipes from a roof and/or road can be slowly infiltrated into the soil. By infiltrating relatively clean water into the soil, the drainage system is relieved and drying out of the subsurface is prevented. Rainwater infiltration is part of the UK Government's sustainable construction policy. When a normal drainage system cannot cope with large volumes of storm water it can divert the flow into a Naylor Aquavoid® storage, infiltration and attenuation system, to slowly release water after the storm has passed, thus avoiding localised flooding. Aquavoid® is stocked in 400mm high units but is also available in 100mm increments to order allowing complete flexibility of design.

### Aquavoid®-Traffic



<b>Nominal Size</b>	600 (L) x 600 (W) x 400mm (H)
<b>Coverage Rate</b>	6.944 units/m <sup>3</sup>
<b>Unit Weight</b>	7.2kg
<b>Short Term Comp. Strength</b>	400kN/m <sup>2</sup> * Vertical 100kN/m <sup>2</sup> * Lateral
<b>Maximum Depth</b>	5.85m**
<b>Minimum Coven</b>	0.5m landscape, 0.6m car parks

### Aquavoid®-Plus



<b>Nominal Size</b>	600 (L) x 600 (W) x 400mm (H)
<b>Coverage Rate</b>	6.944 units/m <sup>3</sup>
<b>Unit Weight</b>	7.2kg
<b>Short Term Comp. Strength</b>	700kN/m <sup>2</sup> * Vertical 200kN/m <sup>2</sup> * Lateral
<b>Maximum Depth</b>	11.3m**
<b>Minimum Coven</b>	0.6m car parks, 0.8m HGV areas

Notes: \*Naylor Aquavoid® has been tested to the quoted values under the conditions specified in the German DIBT standards.

\*\*Maximum depth to base of structure depends on anticipated loadings, sheer resistance of surrounding soil etc.

## Features of the Aquavoid® system

### Advantages of Naylor Aquavoid®:

- High Load Capacity, (pedestrian, traffic & HGV use)
- Economic to install and maintain
- Prevents peak flows to main drainage system
- Inlets/Outlets: 110, 160, 200, 225 & 300mm dia pipes
- Large Storage Capacity, 95% voids
- Suitable for high and low groundwater situations
- Integral silt solution
- Reduces environmental impact of development

**Clips and shear connectors:** The connecting butterfly clips (supplied FOC) are simply tapped into place with a mallet on adjoining units to prevent displacement during backfilling of the structure. On multi layer structures special shear connectors are supplied to ensure layers lock correctly onto the preceding layer.

**Inspection & Control units:** The 600mm x 600mm units provide; Multiple diameter connections; a silt retention device for the structure and a 500mm x 500mm clear opening through the structure used for maintenance via jetting if required.



## Structural Testing

The Naylor Aquavoid® systems have been subjected to extensive testing by an independent accredited testing laboratory and have been certified by the German DiBT standards. This testing was carried out to determine the strength characteristics of the Aquavoid® to enable structural calculations for loading to be carried out.

Short term Compressive tests were carried out to establish deflection under load and ultimate compressive strength at failure in both a vertical and lateral plane. These tests were carried out using a full plate covering the whole unit to duplicate in-situ conditions. Creep tests were carried out for 10,000 hrs in compliance with the latest CIRIA guidelines.

Manufacture is subject to third party auditing and includes regular checks on dimensional aspects and load bearing capability.

Deutsches  
Institut  
für  
Bautechnik

DIBt



### Aquavoid Accessories

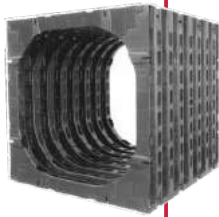
#### Connections

The Aquavoid® units can be provided with 170mm dia access points to receive standard connections.



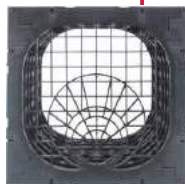
#### Control Units

These multi use units (600mm x 600mm x 600mm) have been created with a clear 500mm x 500mm opening facility to allow their usage as silt collection devices (see opposite section) and to accept an end plate for incoming/outgoing connections.



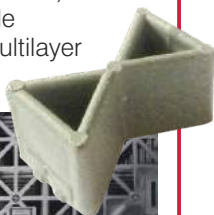
#### Other Inlet/Outlet Options

Special end plates are available with connections of 110, 160, 200, 225mm & 300mm to suit the Control Units.



#### Clips & Shear Connectors

Special butterfly clips are provided (FOC 4 per crate) to secure Aquavoid units to adjacent units. Special shear connectors (1 per crate) are also provided to provide connections for multilayer installations.

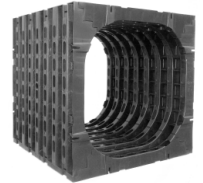


## Silt Control & Maintenance Access

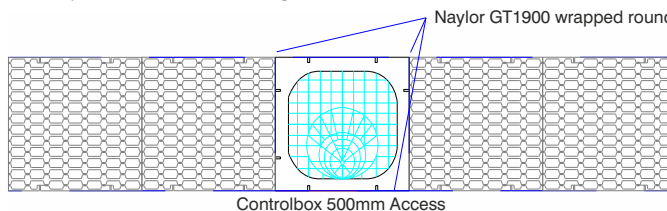
**Silt Control:** The Aquavoid® system has the benefit of a unique Control Box which serves two functions:

Firstly it allows connections of various different diameters to be made to the system and secondly, it allows a clear 500mm x 500mm route to be created through the structure for inspection and maintenance purposes.

This also allows for the creation of a full length silt entrapment system, which traps the incoming silt within the inspection route preventing the rest of the structure from silt build up, allowing easy access for maintenance.



**Creating a silt & maintenance channel:** Once the location of the incoming connection has been established, connect a single line of Control Units together to form a continuous run using the butterfly connectors. Wrap the units on three sides with a Naylor GT1500 geotextile allowing sufficient overlap and temporarily tape these tightly round the units. Position adjacent units either side of the Control Units and clip these into position using the special clips to also secure the geotextile. Cut the excess geotextile from the top of the units leaving a central channel as shown.



Silt channel created using Naylor Aquavoid® Control Unit as both access point for up to 500 ID pipe and inspection and collection route for silt.

**Inspection & Maintenance:** The 500mm clear opening, running right through the structure allows for easy access for monitoring or maintenance procedures. This can also be used with a high pressure jetting system to clean the system if a silt channel is not deemed appropriate during the design process.



## Alternative Silt Control

**The Alternatives:** If a maintenance access is not specified that also doubles as a form of silt control, then an alternative means of providing this facility should be investigated. A conventional silt trap can also be utilised to keep the structure free of silt and is a useful way of limiting silt during the construction phase of the project without allowing the high levels of silt occurring during this period to enter the system.

**The Naylor filter and silt trap** has been especially developed for this purpose. It has all the benefits of a conventional silt trap but has been fitted with Naylor's unique Enviroflow system to retain and filter out silts using its 30 micron void structure. The unit is positioned up stream of the structure, has no head drop across the unit and is very easy to maintain and service with a conventional gully sucker machine.



## Vortex Flow Controls (VFC's) - For controlling the flow

Naylor Environmental offer a full range of flow controls to meet every surface water application, Each unit is individually designed and built to meet your precise requirements. All of our controls are made to the highest standards under an externally regulated ISO 9001 Quality Management System.

Developed specifically for use in drainage systems, our custom made

vortex flow controls offer an effective solution to your storm water management problems. Each unit is configured to suit the site and to fit easily into the drainage infrastructure.

### Introduction

The Naylor VFCs enable precise control of discharge rates to optimise the design and performance of the Aquavoid<sup>®</sup> storage systems. During normal flow conditions the surface water passes through the VFC unit without restriction. As the flow builds during storm conditions the unit creates a vortex within the unit until a central air filled core develops restricting the flow under controlled conditions. Unlike an orifice plate small debris is allowed to pass through the unit without hindrance.

### Use & applications

The Naylor VFCs are designed to be used in conjunction with the Naylor Aquavoid<sup>®</sup> modular stormwater attenuation systems, but can be used with any attenuation system that requires managing, such as excess flow from infiltration or soakaway systems, wetlands or ponds.

### Features & benefits

- Enables precise flow control to optimise storage
- No moving parts to wear or replace
- No external power required
- Manufactured from 3mm thick 304 grade Stainless Steel
- Reduced risk of blockages
- Removable access plate allows access for cleaning
- Custom designed and built with fast delivery

### Manufacturing

By using modern production methods we are able to offer a well engineered, tailor made product quickly and at an extremely competitive price.

We use 3mm thick grade 304 Stainless Steel to BS 1449 as standard and welders approved to BS 4872. Components are cut via a Computer Aided Design program by automated industrial lasers working to ultra fine tolerances. All seams are continuous welded for maximum strength by pulsed arc Tungsten Inert Gas coded to BS4872 and are individually designed to deliver optimum performance and built to order. Removable access plates are provided on each unit that can be easily removed for access to the downstream pipe. The units can be fitted with a bypass facility to allow system drain down from cover level should a blockage occur.

Full performance and installation details are provided for each unit specified.

### Product Specification & Design

Each Naylor VFC is individually designed to deliver optimum performance and to ensure ease of installation. Our technical staff will be pleased to discuss your requirements and to specify a suitable flow control unit.

#### What Design Information Do We Need?

- The Design Flow Maximum Discharge
- The Design Head Invert to Top Water Level
- Type of drainage Surface Water (only)

From this information we will specify and design the VFC to meet the design criteria and to suit the proposed infrastructure.

#### Specification

On receipt of the design information we will produce a specification that will include:

A data sheet showing the Head/Discharge Characteristic, both graphically and numerically.

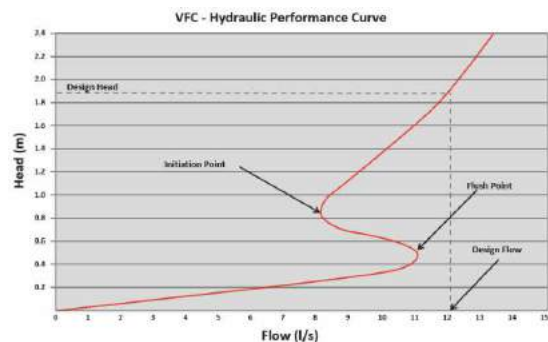
An installation guide showing the outline dimensions of the specified Vortex Flow Control and the method of fixing,

A Quotation covering the design, manufacture and delivery of the specified unit(s) complete with fixings.

From this information we will size and design the VFC to meet the design criteria and to suit the proposed infrastructure.

#### Performance

The discharge curve of a flow control unit has a bi-stable characteristic. At low heads the discharge coefficient is relatively large allowing water to flow comparatively freely. At a predetermined head the vortex begins to form within the Vortex Chamber causing a reduction in the Discharge Coefficient. There is a short transitional phase where the coefficient is reduced as the vortex becomes fully formed. This is represented by the classic "kickback" in the curve.



*The significant points to note on the curve are:*

- The Flush Point** - The point at which the initial flow peaks. For optimum performance this should be as close as practical to the design flow without exceeding it.
- The Initiation Point** - The point at which the vortex becomes fully formed and the discharge coefficient is stabilised.
- The Design Head** - The head at which the design flow is to be achieved. This should always be above the initiation point.
- The Design Flow** - The maximum discharge rate required for the system. This should always be in the stable region above the initiation point.

#### Maintenance

The Naylor VFC's have no moving parts so maintenance requirements are minimal. However, each VFC is fitted with a bypass door accessed from ground level allowing drainage of the system in case of blockage, allowing any obstruction to be accessed and removed.



## Pollution Control

Pollution control is a constant battle to ensure the environmental impact of modern developments is kept to a minimum. The Naylor Aquavoid® storage system is designed to deal with the excess flows from new developments and is capable of removing silts and debris from the discharges, but this does not address the hydrocarbons that are a natural part of modern development. Harmful oil discharges are a major problem and have been identified by the Water Framework Directive as a major contributory factor in modern pollution. It is considered a hazardous substance within the directive, under the protection of groundwater against pollution and deterioration. The environmental damage caused as a result of a pollution incident due to the release of oil can be significant and expensive to remedy. Naylor Environmental have addressed this in two ways:

### Treatment at Source

The unique Smart Gully Adapter (SGA) utilises the abilities of the Naylor Smart Sponge® to remove and permanently bind the hydrocarbons found typically in car parks and hard standing areas to enable their simple and efficient disposal.



The SGAs are simply inserted into the rodding eye of standard concrete or plastic gully pot as shown and skim any hydrocarbons from the surface of the water within the gully. The SGAs do not interfere with the flow or maintenance of the gully and only the Smart Sponge® Smart Paks need to be changed on a bi-annual basis.

### Treatment at Pipe End

If it is not practical or desirable to use the Smart Gully Adapters then an alternative method of capturing the hydrocarbons is via a discharge manhole chamber using a Naylor Smart Filter.



The discharge water is directed to a downstream chamber with a suitably sized Smart Filter, installed to enable the polluted water to flow through the Smart Filter, removing the harmful hydrocarbons prior to discharge further down the system. The Smart Filters (dependant on design) are capable of high levels of removal and can store up to 11 litres of oil before replacement. The Smart Filters have a bypass flow that can be adjusted to suit requirements.

## Pollution and Flow Control

Based on the Naylor Smart Filter, it is also possible to combine the advantages of the Smart Filter with that of an orifice plate.

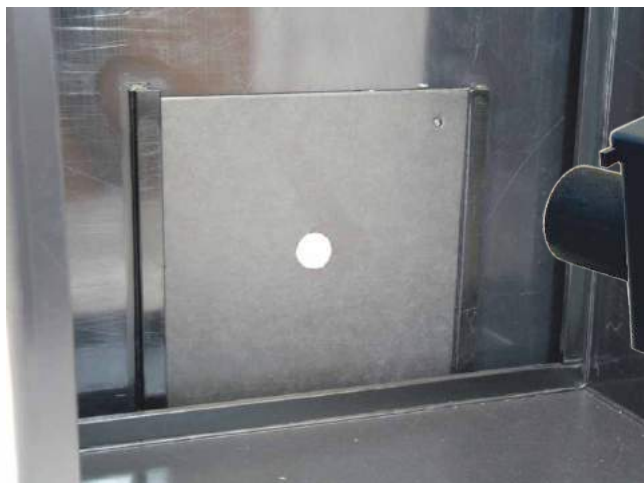
The main reason why orifice plates have been unpopular as a method of flow control in the past is that

they have a tendency to block up, unlike a Vortex Flow Control.

To address this issue we have used the design of the Smart Filter with an orifice plate positioned behind the Smart Sponge® media to create the Smart Brake, to both filter debris and hydrocarbons out and also protect the orifice plate from getting blocked up.

The Smart Brake units are available with oil capacities identical to the standard Smart Filters and an appropriate sized orifice plate simply slides down into the back of the unit to provide a restricted flow.

Full details of the Smart Filters and the rest of the Smart Sponge® range are available in a dedicated brochure, downloadable from our web site [www.naylor.co.uk](http://www.naylor.co.uk).



## Design Guidance

### General:

Naylor Aquavoid® is ideal for the bulk storage of storm water in both attenuation and infiltration schemes. Buried with typically 0.5m of cover for non vehicular use or 0.75m for vehicular, connections of most diameters can be made to the system. Ideally suited to amenity areas and underneath car parks, the Naylor Aquavoid® Traffic has been designed to take light traffic loads, making it suitable for most applications. The Aquavoid® Plus is designed for extreme loading conditions such as beneath HGV areas, poor ground conditions or where an exceptionally deep installation is required.

In general the units require 0.5m of cover for landscape use and 0.75m beneath car parks (0.6m where access is restricted). In areas where HGV traffic is expected the Naylor Aquavoid®-Plus should be used with a cover of 800mm. Where the cover will be less than these please contact our technical department for a detailed design.

## Design Guidelines

Establish the parameters of your development: e.g. Infiltration or attenuation of the flow; Do you need a Naylor Vortex Flow Control to limit the flow. Using this information, carry out a detailed assessment of the required volume of stormwater to be stored in accordance with the latest CIRIA guidance, currently C522, R156 & BRE 365.

Using the calculated volume required divide this by the void ratio (0.95) to give the attenuation crate volume you need. Use this figure to create a suitable structure to suit based on the 0.6m x 0.6m x 0.4m high module.



### For soakaway structures:

The Naylor Aquavoid® structure should be wrapped in special non woven, needle punched geotextile (Naylor GT1900) to allow water discharge to the subsurface, but without allowing any soil or sand particles to go through.

### For attenuation structures:

These are very similar to soakaway structures but the units should be wrapped by an impervious membrane (Naylor GM1) that surrounds the whole structure and is welded to form a gas tight seal prior to the geotextile wrap. This acts as a protective fleece to the geomembrane protecting it from puncture.



**Reminders - to be considered during design (CIRIA C737):**

- Anticipated traffic loadings (CIRIA C522)
- Strength of surrounding soil
- Silt barrier to reduce maintenance
- Consider both eventual and construction loadings
- Establish depth of water table
- Hydrocarbon barrier to comply with Water Framework Directive (WFD)

## Typical Installations

- Decide on the system application: Determine whether it is porous paving and attenuation or infiltration.
- Decide on the location and quantity of storage systems: Locate the best site position to minimise excavation and pipe runs (normally the low point).
- Decide the surfacing above the structure: Parking or leisure area etc (this will decide loading on the units),
- Calculate required capacity: This is based on storm intensity, duration, porosity of soil, EA restrictions etc.
- Calculate quantity of Aquavoid® units: (6.944/m<sup>3</sup> for 400mm high but 100mm high increments are available to order).
- Based on the layer depth of Naylor Aquavoid® of 400mm calculate the dimensions of the tank to suit local site conditions.
- Decide on a silt strategy including trap positions and inflow locations: Water entering any storage device is best passed through a silt trap prior to storage. This can be achieved using the Naylor Aquavoid® Control Units to provide access for maintenance and inspection. For infiltration systems this can be the geotextile barrier. If hydrocarbons are present (car parks etc) a Smart Filter may be required see Naylor Smart Sponge® brochure.
- Decide on outflow locations (if required); Attenuation systems would normally be at the base of the unit for these and should be of a size required to suit the outflow requirements.
- Select Naylor Aquavoid® liner: If a permeable infiltration system is required choose a single layer of Naylor GT 1900 needle punched non woven type. If an attenuated system is required a Geomembrane (Naylor GM1) should envelope the units with a Naylor GT1900 protective fleece around it.
- Decide position of maintenance access: Although systems of this type require virtually no maintenance, it is advisable to provide for visual inspection of all types of system.
- For attenuated systems decide on position of vent: This can be a simple 100mm dia pipe per 7,000m<sup>2</sup> of drained area taken to the nearest chamber.



### Inspection & Maintenance route

The use of a line of Naylor Aquavoid® Control Units will provide a route through the system with a 500mm x 500mm open access for easy maintenance and inspection. When positioned at the base of the structure, these allow visual inspection and mechanical jetting if required, across the full length of the structure.

### Gas testing of welded Geomembrane joints

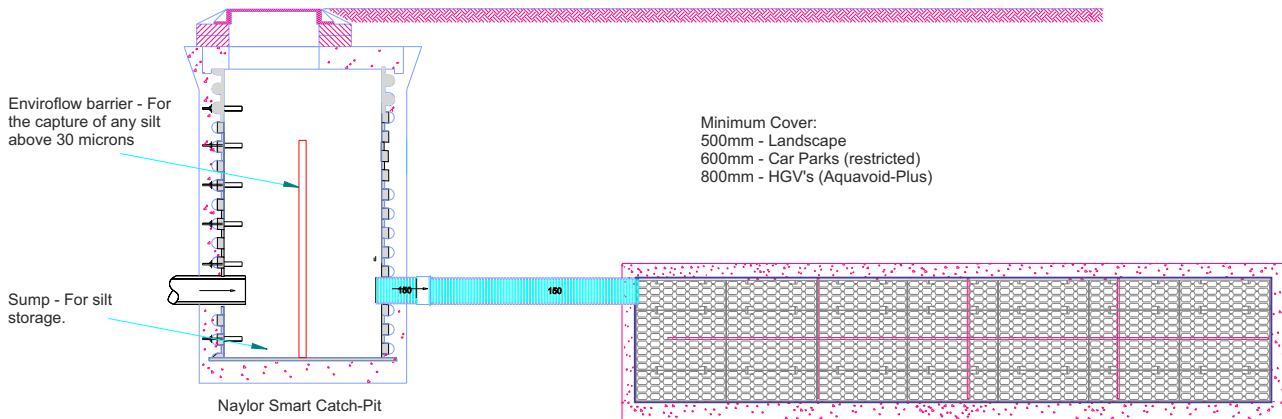
Prior to backfilling and handover all welded joints should be gas tested to ensure integrity of the structure.



## Typical Installations

### Soakaway

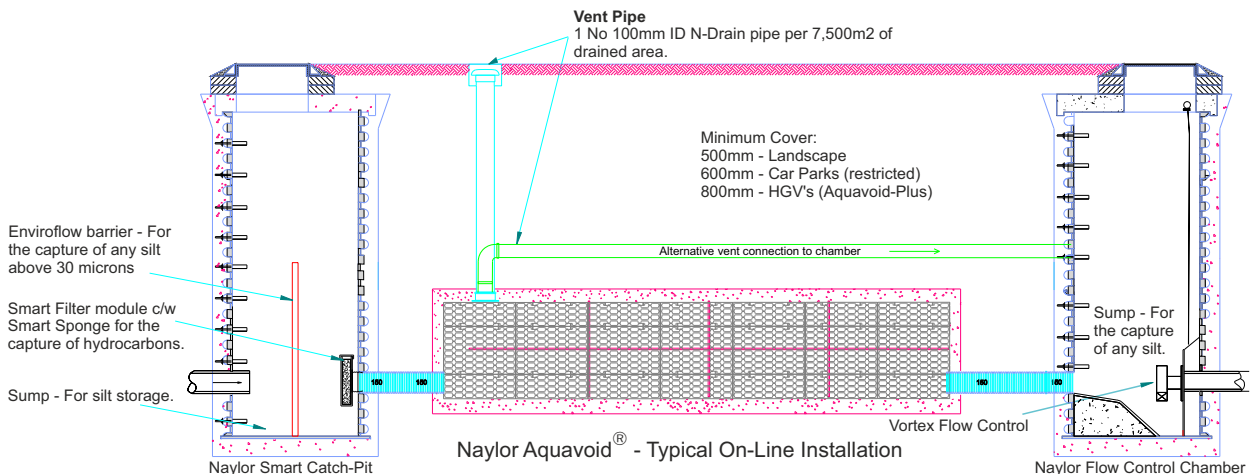
Diagram shows a multi layer soakaway installed with geotextile surround. Incoming pipe is at a high level and the Naylor Aquavoid®-Traffic is below a parking area.



Naylor Aquavoid® - Typical Soakaway

### On-Line Attenuation

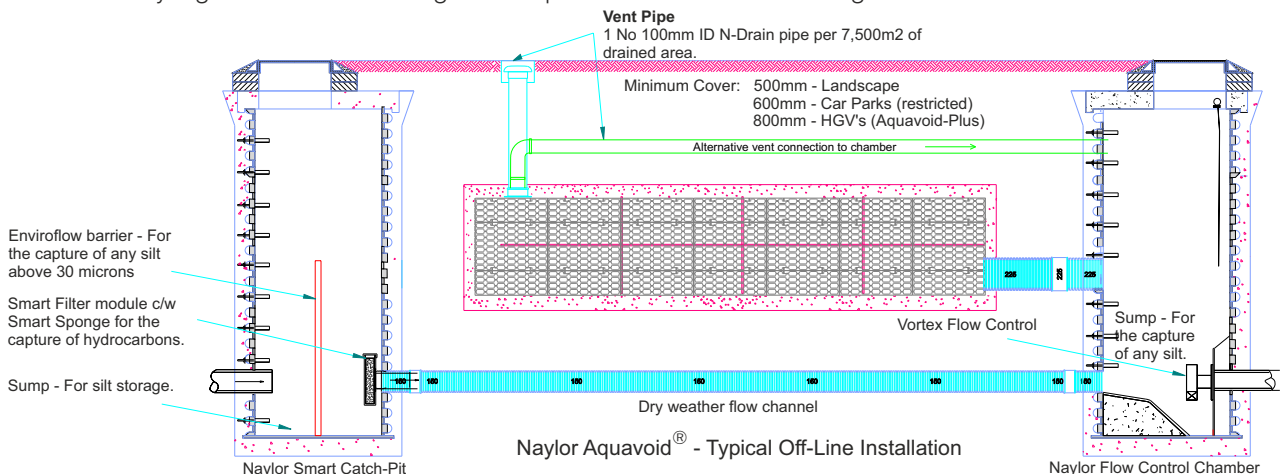
Drawing shows a multi layer installation with a central silt route (Control Units) positioned within the bottom layer. Surface water is fed through the system to a Vortex Flow Control at the exit, which when operational backs up the flow to fill the attenuation structure. Hydrocarbon removal is through Naylor Smart Filters



Naylor Aquavoid® - Typical On-Line Installation

### Off-Line Attenuation

This attenuation structure is used as an overflow storage with a single in/out access at base level. Surface water is diverted into the system when the flow in the main sewer reaches capacity. The diagram shows the system surrounded by a geomembrane with a geotextile protection fleece surrounding it.



Naylor Aquavoid® - Typical Off-Line Installation



## Installation

**General:** The Naylor Aquavoid®Traffic and Aquavoid®Plus systems are simple to install for both attenuation and soakaway configurations.

The Aquavoid®Traffic (400kN/m<sup>2</sup>) is suitable for the vast majority of situations from landscape to vehicular use beneath car parks etc.

The Aquavoid®Plus (700kN/m<sup>2</sup>) is specifically designed to cope with deep installations, poor surrounding soil conditions or where excessive loads are present (HGV).

Establish the system application: Determine whether its porous paving and attenuation or infiltration. Locate the best site position to minimise excavation and pipe runs (normally the low point) and establish the surfacing above the structure: Parking or leisure area etc (this will decide loading on the units).



Decide on a **silt strategy** that will capture the silt prior to going into the main structure. This can be achieved at the inlet by the use of geotextile wrapped Control Units, which also provide access for maintenance and inspection to the system. For infiltration systems this can be the geotextile wrap which acts as a barrier if hydrocarbons are present (car parks etc) a Smart Filter may be required.

Decide on outflow locations (if required - attenuation systems): This would normally be at the base of the unit for attenuation systems and should be of a size required to suit the outflow requirements, Selection of an appropriate geotextile (soakaways) or geotextile and geomembrane (attenuation systems) is an essential part of a successful project. We recommend the Naylor products GT1900 for the geotextile and a GM1 for the membrane - the membrane should always have welded joints.

For attenuation systems decide on position of vent: This can be a simple 100mm ID N-Drain pipe per 7,500m<sup>2</sup> of drained area taken back to the inlet chamber at a high level.



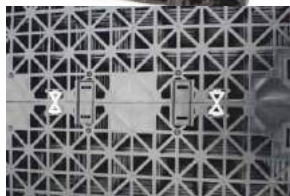
### Inspection & Maintenance route

Construction of inspection and maintenance routes through the system can be achieved using the modular Control Units to provide a 0.5m x 0.5m open access at any point in a system for inspection or maintenance.

**Connections:** These can be made via a Control Unit fitted with an end plate to connect 110-300mm diameter pipework, or for simple connections a 160mm dia connection can be provided as part of a standard unit if required,

### Butterfly Clips & Shear Connectors

**Connectors:** Adjacent units are secured using the purpose designed butterfly clips (supplied FOC) and special double connectors are supplied for use with multi-layer structures to provide a shear connection ensuring layer stability



### Installation Procedure

1. Excavate to the required length, width and depth and level the base. Ensure area is large enough to allow plant access around sides to compact the backfill material (300mm minimum). Ensure base is smooth and level with no sharp protrusions. Cut back slopes to a safe angle or adequately support and allow safe access for site personnel.
2. Inspect the base for soft spots and if any are present, excavate and replace with compacted granular fill material.
3. Lay 100mm sharp sand bedding layer to the base of the excavation and level off. Lay the geotextile protection fleece (non woven, needle punched type GT1900), ensuring a minimum 150mm overlap. This is required for both attenuation and infiltration structures.
4. Lay the geomembrane (if attenuation) over the geotextile and sand bedding layer and up the sides of the excavation. Examine the geomembrane for damage and test all welds if apparent.
5. install the Naylor Aquavoid® units within the void in accordance with the plans to form the required structure. Twin connectors are placed between all layers of the units to give structural support to the tank (2 per side), with single clips on the top layer to secure the structure. The Control Units should be positioned as indicated on the plans to provide both pipe connection points and silt collection bays as required.
6. Complete the geotextile and/or geomembrane encapsulation to the sides and top of the installation, ensuring 150mm min overlap for the protection fleece. Geomembrane should be welded with double seams and inspected for damage, testing the welds as required.
7. Make connections using top hats (attenuation) and weld to secure. For attenuated systems, vent connections (one 100mm ID dia per 7,500m<sup>2</sup>) should also be welded with the vent pipe taken back to the downstream chamber.
8. Backfill around the sides of the installation with coarse sand or Class 6H selected granular material immediately adjacent to the units. Install and lightly compact a 100mm thick layer of similar material to the top of the structure,
9. Completion of the backfill is dependant on anticipated loading (Compaction equipment on top and immediately adjacent to the structure not to exceed 2,300kg/m width):

### Landscape Use:

Selected "as dug" material with a unit size no more than 75mm compacted to 90% maximum dry density compacted in 150mm layers in accordance with the Specification for Highway Works. Backfill within 300mm above the units should be free from particles above 40mm diameter.

### Lightly Trafficked (Car Parks & restricted access)

Backfill with Class 1 or 2 material in accordance with MCHW, Volume 1, Series 600. Backfill material should be compacted in 150mm layers. Where the units are installed beneath a paved area, the pavement sub base may form part of the backfill material provided that minimum cover depths are maintained,

### Heavily Trafficked (Service areas or roads)

Due to the nature of this load situation a specialist structural or geotechnical engineer should be engaged to ensure all conditions are taken into account when calculating the required backfill procedure, this may involve a site survey and capping layer, dependant on localised conditions and frequency of HGV movements.



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Available throughout the UK

### Product manufactured in the EU

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Until 2019

**NAYLOR**  
ENVIRONMENTAL

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