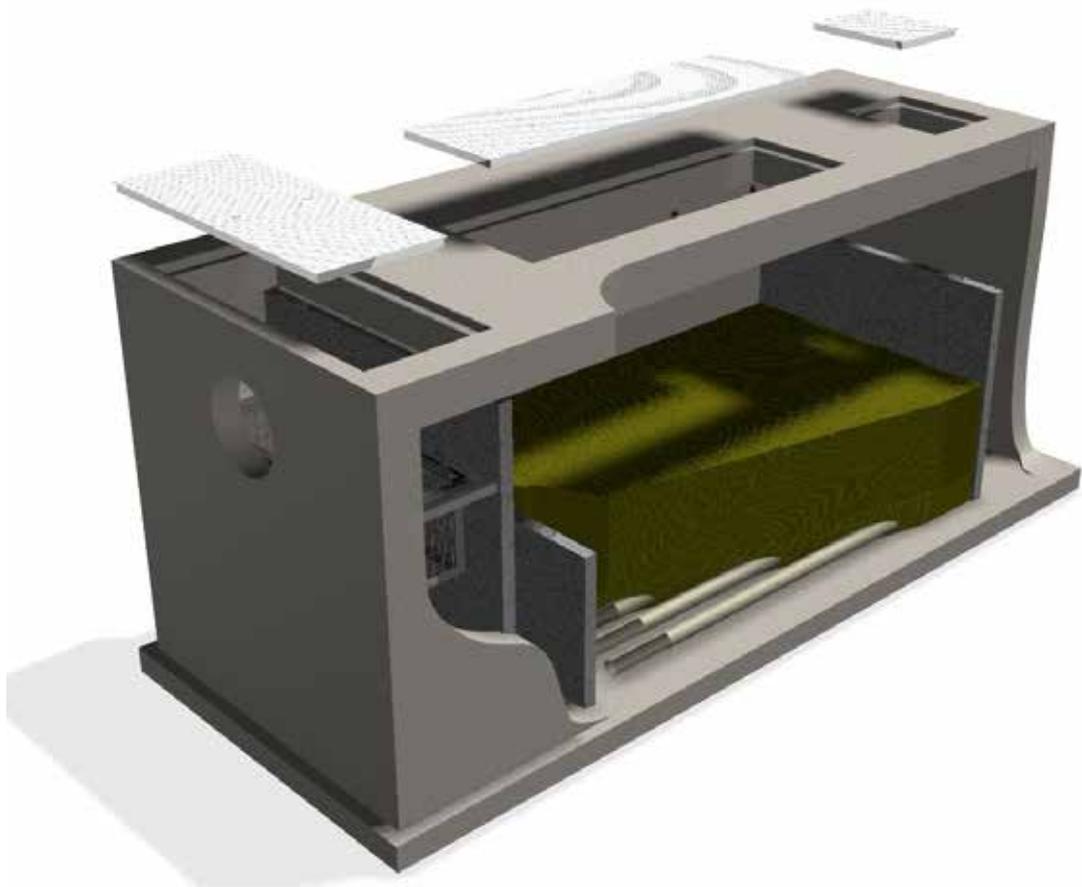


Ecosol™ Sand Filter Technical Specification



environmentally engineered
for a better future



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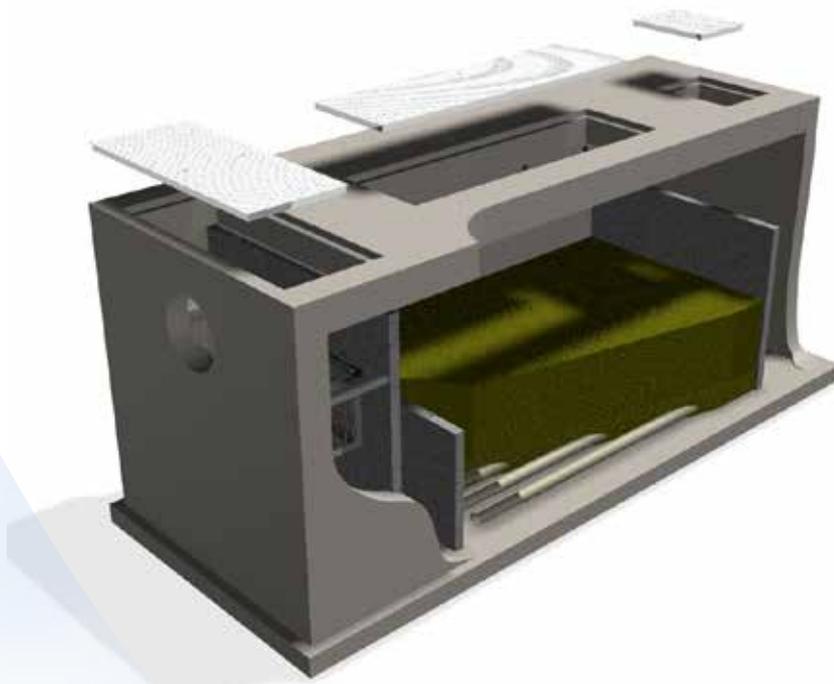
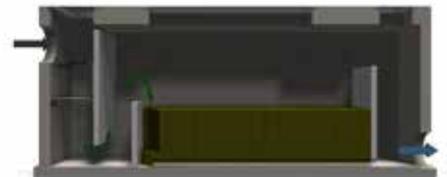
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1.0 Introduction

Increasingly stringent environmental best management practice requires planners and developers to apply a fit-for-purpose treatment train approach to stormwater treatment to achieve today's water quality objectives (WQO's).

A sand filter is typically used in water-sensitive urban design (WSUD) as a component of a treatment train to remove pollution from stormwater before discharge to receiving waters or to groundwater or for collection and reuse.

Sand filters operate in a similar manner to bio-retention systems, with stormwater percolating downwards through a filter media and then being intercepted by perforated pipes located at the base of the media for conveyance downstream. Prior to entering the filter media (typically sand), flows must be subjected to pre-treatment to remove litter, debris and coarse sediment. This is typically achieved via an 'inlet chamber fitted with a primary treatment litter basket as part of the system.



Unlike bio-retention systems, sand filters do not incorporate vegetation and the absence of vegetation and associated biological process means sand filters have a reduced stormwater treatment performance. However they still do have their application where site conditions, such as space limitation, or drainage grades, limit the use of bio-retention systems.

The range of Ecosol™ Sand Filters is able to be custom built to suit most applications and can be easily retrofitted into existing drainage networks.

In developing this secondary stormwater treatment system careful consideration has been given to durability, longevity, cost, and maintainability.

This technical manual describes the operation and performance characteristics of the system.

2.0 How the Ecosol Sand Filter Works

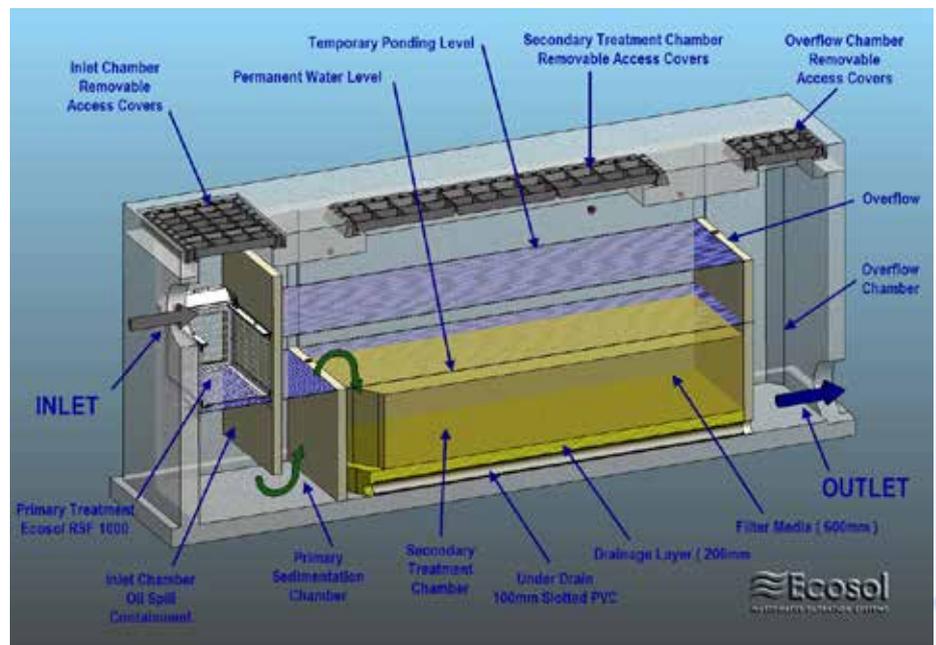
Ecosol™ Sand Filters are designed to remove and retain gross pollutants, sediment, free oils (hydrocarbons) and other pollutants such as SS, N & P present in stormwater flows. The system is unique as it provides both primary and secondary treatment of stormwater flows within the one device.

Stormwater enters the unit via a conventional underground pipe network. Stormwater flows enter the primary treatment chamber where all gross pollutants are captured and retained. Flows then pass through the fore bay chamber and then enter the secondary chamber with stormwater percolating downwards through a sand filter media where finer contaminants conveyed in stormwater are captured and retained. Subsequently the filtered stormwater is then conveyed by perforated pipes located at the base of the unit to a free draining outlet.

The units also consist of an overflow chamber. This chamber is necessary in the event of the unit blocking (due to poor cleaning and maintenance practices) or in a major storm event to ensure adequate by pass of peak flows.

The Ecosol™ Sand Filter is a multi-chamber engineered pre-cast concrete system consisting of:

- An inlet chamber with removable filtration basket designed for pretreatment (primary treatment) of stormwater flows. Pretreatment of stormwater entering any infiltration system is critical as it minimizes the potential for clogging of the infiltration media;
- A fore bay chamber to reduce flow velocities entering the systems;
- A secondary filtration chamber consisting of a sand filtration media with ponding for removal of finer particulate pollutants conveyed in stormwater flows (secondary filtration); and
- An overflow chamber ensuring adequate discharge at peak flow eliminating the potential for scouring of the secondary infiltration media.

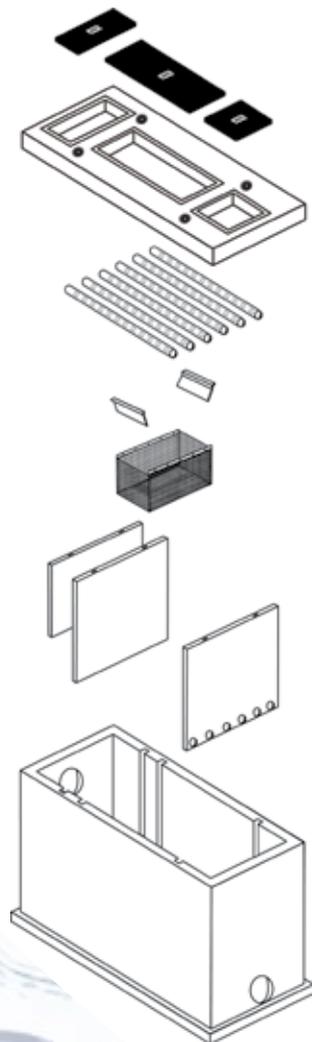


Urban Asset Solutions Pty Ltd Sand Filter series are predominately installed as off-line systems.

3.0 Warranty and Life Expectancy

The Ecosol™ Sand Filter has a one-year warranty covering all components and workmanship. Urban Asset Solutions Pty Ltd will rectify any defects that fall within the warranty period. The warranty does not cover damage caused by vandalism and may be invalidated by inappropriate cleaning procedures or where the unit is not cleaned with the recommended frequency.

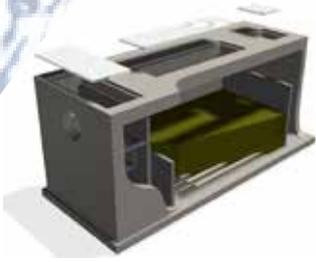
The Ecosol™ Sand Filter is designed to meet strict engineering guidelines and manufacturers guarantees and is one of the most durable stormwater treatment systems available. The stainless steel components have a life expectancy of 15 years while the pre-cast concrete pit has a life expectancy of 50 years providing appropriate maintenance practices are employed



4.0 Safety Considerations

The simple, yet effective design of the Ecosol™ Sand Filter reduces OH&S risks as most of the work is undertaken in a controlled factory environment. The unit arrives to site complete and ready for installation reducing significantly on-site time, an important factor given the costs associated with delays that can be caused by inclement weather.

5.0 Key Features and Benefits



The Ecosol™ Sand Filter is an all-in-one primary and secondary filtration system that helps overcome the need for multiple treatment measures on catchments where space or the drainage grade limits the use of bio-retention systems.

The unit is designed to treat 100% of incoming flows at a predetermined designed treatable flow rate, capturing and retaining pollutants conveyed from impervious areas in a rain event.

Independent testing has confirmed that the unit captures and retains more than 98% of pollutants larger than 2mm, up to 86% of Suspended Solids, 76% Phosphorous, and 15% Nitrogen as well as free floating hydrocarbons and heavy metals.

Compact and flexible and installed underground the unit is designed for high-density residential, commercial and industrial catchments.

Key Features	Benefits
Hydraulics	<ul style="list-style-type: none"> • Designed and managed hydraulics optimises performance • Designed ponding increases inlet and infiltration capacity • Treats 100% of the designed treatable flow
Pollutant Capture and Retention	<ul style="list-style-type: none"> • High capture efficiency of SS and P • Unique primary treatment chamber captures and retains gross pollutants thereby significantly increasing the operational life of the secondary treatment media. • Retains free floating hydrocarbons • Does not remobilise captured pollutants
Design and Construction	<ul style="list-style-type: none"> • Modular systems with all internal plumbing factory fitted thereby reducing onsite installation time and costs • Product is made in house thereby reducing lead times significantly • Modular pre-cast concrete unit with a designed life of 100 years • Simple compact trafficable design with durable corrosive resistant materials • Fits pipes sizes up to 600mm diameter
Cleaning and Maintenance	<ul style="list-style-type: none"> • Cost Effective system to maintain • Multiple access points makes cleaning easy by eductor truck • Pollutants do not need to be handled during cleaning • Dry storage of pollutants helps reduce the risk of toxic fermentation
Environmental Impact	<ul style="list-style-type: none"> • Primary and secondary treatment solutions within one compact unit • Unit is housed in its own pit underground with little effect on the site aesthetics
Tried and Tested	<ul style="list-style-type: none"> • Widely recognised treatment system • Complies with current WUSD best management practice

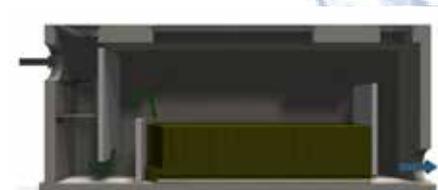
6.0 Key Dimensions

The Ecosol™ Sand Filter is a multi-chamber engineered pre-cast concrete system consisting of an inlet chamber with a removable primary filtration basket into which stormwater enters from a conventional underground pipe. Gross Pollutants are captured and retained in this basket helping protect the engineered infiltration media from premature blocking.

The unique design of the inlet chamber also enables free-floating oils and hydrocarbons, such as cooking and motor oils that do not emulsify in aqueous solution, to be captured and retained, again helping protect the infiltration media.

The stormwater then continues into the fore-bay chamber which is designed to reduce flow velocity. This chamber is designed to have a permanent standing water level that helps it retain coarse to medium sediment larger than 125µm. The flow then passes over the fore-bay weir and into the third chamber where it percolates downwards through the engineered sand media. The system is also designed with an overflow by-pass weir.

The table below highlights the key dimensions for the range of Ecosol™ Sand Filter.



Ecosol Product Code	Maximum Inlet Pipe Diameter	Approximate External Product Dimensions			Designed Loading Class	Heaviest Lift Tonne	Maximum Designed Treatable Flow Rate L/s
		mm	Length (m)	Width (m)			
ESF 5450	150	3.600	1.650	1.600	D	11.0	2.4
ESF 5600	225	4.500	1.950	1.600	D	13.0	5.2
ESF 5750	450	5.550	2.250	1.600	D	17.0	9.3
ESF 5900	600	6.450	2.550	1.600	D	24.0	14.0

Table 1 - Ecosol™ Sand Filter Product Range and key dimensions

6.0 Key Dimensions continued

Engineered layers of sand provide secondary treatment of stormwater run-off. These layers consist of the drainage layer (clean washed, fine gravel such as 2 – 5mm screenings) designed to avoid migration of the filter media into the drainage layer. The drainage layer, that collects the treated stormwater and conveys it to the under drain pipes where it can then exit the system to the nearest drainage connection.

Product Code	Filter Media Details			
	Drainage Layer		Infiltration Layer	
	Volume of material	Material layer depth	Volume of material	Material layer depth
ESF 5450	0.30m ³	200mm	0.9m ³	600mm
ESF 5600	0.64m ³	200mm	1.93m ³	600mm
ESF 5750	1.15m ³	200mm	3.46m ³	600mm
ESF 5900	1.72m ³	200mm	5.172m ³	600mm

Notes: Engineered sand and gravel filter media is supplied separately and installation is the responsibility of the purchaser.

Installation and operation of the Ecosol™ Sand Filter is recommended once site conditions have stabilised. The under drain collection pipes, geo-fabric, inlet primary filtration basket and Ductile Iron access covers are supplied factory fitted with the Ecosol™ Sand Filter. For optimal performance a temporary ponding depth of 200 – 300mm above the infiltration layer is recommended.

Table 2 - Filtration Media Details

7.0 Collection and Removal Efficiencies

Sand filters have long been recognised as an effective, economical stormwater treatment system. They operate in a similar manner to bioretention systems are generally easier to maintain. Urban Asset Solutions Pty Ltd has designed its range of sand filters of varying sizes to accommodate various flow capacities and site constraints such as space limitations. Ecosol™ Sand Filters are unique as they incorporate a pre-treatment chamber and provide significantly greater access to the system than traditional and filters; however the units main designed elements are based on the widely publicised and well published industry standards for sand filters. Additionally the Ecosol™ Sand Filter has been extensively independently laboratory tested to validate the key performance characteristics of the system.

Ecosol™ Sand Filters are sized to treat (based on a 100% impervious surface) catchments of 100 – 2000m². Consideration is also given to site location, catchment type, size and condition..

7.0 Collection and Removal Efficiencies continued

In order to determine a meaningful characterisation of the products collection efficiency, an extensive verification phase was undertaken by Avocet Consulting Pty Ltd, Ecosol and EngTest (The University of Adelaide). To best summarise the capture efficiency results of extensive laboratory product testing a regression of the data points using a sigmoidal regression curve was selected as it provided a conservative fit to the data collected. Refer to figure 1 for details. Table 3 summarises particle size reduction results.

Pollutant Capture Efficiency PSD	
Sieve Size (micron)	Capture Efficiency (%)
600 - 2000	98%
200 - 600	92%
60 - 200	72%
20 - 60	40%

Table 3 – Typical PSD and particulate reductions for the Ecosol Sand Filter

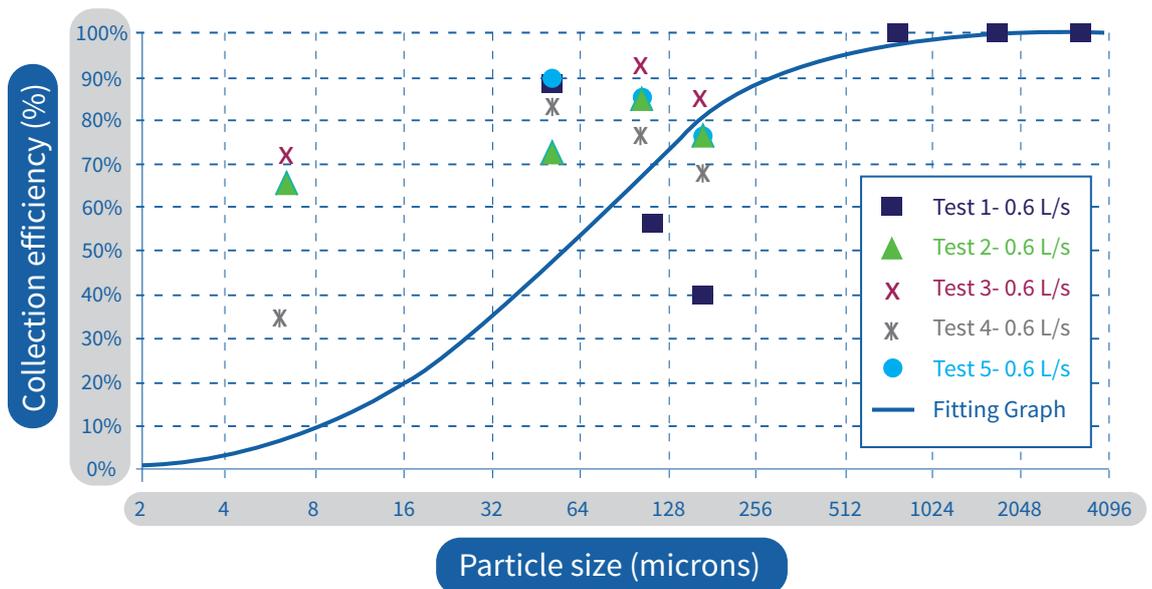


Figure 1 –Sigmoidal regression line for the Ecosol™ Sand Filter confirming particulate pollutant reductions through the system.

7.0 Collection and Removal Efficiencies continued

The Ecosol™ Sand Filter is an integral part of the treatment train providing essential primary and secondary treatment of stormwater within the one system.

Quoted Capture Efficiency (CE) values are intended as a general guide only, and are subject to site specific stormwater quality modelling, giving consideration to catchment size, type and typical pollutant concentrations.

Performance Criteria Ecosol Sand Filters

Pollutants	Capture Efficiency (%) (Up to)
Gross Pollutants >2mm	Up to 98%
Suspended Solids (SS)	Up to 86%
Phosphorous (P)	Up to 76%
Nitrogen (N)	Up to 15%
Total Petroleum Hydrocarbon (TPH)	Up to 50%

Table 4 – Suggested collection efficiency (particulate bound pollutants) for the Ecosol™ Sand Filter based on third party testing results.

8.0 Hydraulic Specification

Treatable Flow Rate (TFR) is defined as the maximum flow rate through the Ecosol™ Sand Filter before the flow over tops the designed overflow weir within the system. The system Treatable Flow Rate is constrained by the infiltration capacity (Hydraulic Conductivity) of the engineered sand filter media. Extensive testing was undertaken on full sized units at actual designed media depths to avoid any possible error in interpolating TFR data.

Product Code	Infiltration Bed Dimensions			Bed Area (Length x Width) (m ²)	TFR (L/s)	
	Length (m)	Width (m)	Depth (m)		Head (200mm)	Head (300mm)
ESF 5450	1.255	1.200	0.800	1.506	2.22	2.43
ESF 5600	2.155	1.500	0.800	3.233	4.78	5.21
ESF 5750	3.205	1.800	0.800	5.769	8.53	9.30
ESF 5900	4.105	2.100	0.800	8.621	12.75	13.90

Table 5 – Summary of Treatable Flow Rates for the range of Ecosol™ Sand Filter based on averaged flow per area result for the test unit. From these tests the optimal Treatable Flow Rate (TFR) and ponding depth for the range of Ecosol Sand Filter is up to 1.6L/s/m² at ponding depths of 200 – 300mm respectively.

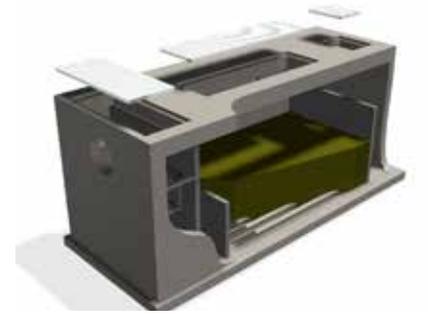
9.0 Cleaning and Maintenance

When designing the Ecosol™ Sand Filter careful consideration was given to ensure it was able to be maintained easily. Multiple access points over each chamber have been incorporated into the design, eliminating the need for direct physical access inside the unit.

As with all filtration systems the Ecosol™ Sand Filter should be cleaned regularly. The cleaning frequency and the cost depends heavily on catchment conditions and rainfall.

One of the key advantages of the Ecosol™ Sand Filter is that the primary filtration basket can be manually cleaned. As this is most likely to need regular maintenance, having the ability to clean it manually significantly reduces ongoing third party maintenance costs. The wet sump chamber containing captured coarse sediment and hydrocarbons will need to be cleaned at recommended intervals with a small vacuum truck removing all retained contaminants with each clean.

The tables below provides broad guidelines about the typical activities necessary to monitor and maintain your Ecosol™ Sand Filter to ensure it continues to perform to its designed specification.



Item	Activity	Reccomended Frequency
Primary Treatment Chamber (Inlet Litter Basket)	Remove by either manual or vacuum method all captured and retained gross pollutant from within the pre-screening inlet litter basket.	Every 3 months or immediately after a storm event.
Inlet Forebay Chamber (Sediment and Hydrocarbon Sump)	Remove by vaccum method all retained free floating hydrocarbons and settled sediment.	Every 3 months or immediately after a storm event.
Secondary Treatment Chamber (Sand Bed)	Remove the top 50mm of sand and replace with an approved clean washed sand.	Every 6 months or earlier if there is a noticeable reduction in the infiltration rate.
	Remove by vacuum method all sand and drainage media and replace. During this process flush out all underdrain filtration pipes to remove any accumulated sediment and replace the protective geofabric and engineered media.	Every 24 months.
Outlet/Over flow chamber	Remove by vacuum method any sediment or debris from within the outlet chamber.	Every 24 months.
Structural Components	Inspect all structural elements to ensure structural integrity.	Annually.
	Ensure all inlets and outlets from the system are free of any debris.	Annually.

Table 6 – Recommended maintenance frequencies

10.0 Monitoring

Initially, Urban Asset Solutions Pty Ltd recommends that monitoring is undertaken monthly. Once the unit has been in operation for an extended period of time (say, 12 months) the monitoring schedule can be adjusted to reflect the actual operating conditions specific to the catchment. It is also recommended that the unit is inspected after every major storm event.



11.0 Monitoring, Cleaning and Maintenance Services

Urban Asset Solutions Pty Ltd has a very competitive cleaning service. After each clean we provide a report detailing the volume and type of pollutants removed. We believe that it is in your best interests for Urban Asset Solutions Pty Ltd staff to clean and maintain the unit, not only because we are specialists, but also because proper monitoring and maintenance enhances the unit life significantly. Should you use another company to clean the unit, or undertake this work yourself, we request that it be conducted according to Urban Asset Solutions Pty Ltd specifications. Otherwise, you may invalidate your warranty, as damage caused by inappropriate cleaning procedures is not covered. The advantages of using Urban Asset Solutions Pty Ltd to clean and maintain your unit are that you get:

- regular inspections of your unit;
- a comprehensive cleaning service with removal and disposal of all captured pollutants;
- a detailed report provided on completion of each clean;
- trained and experienced staff; and
- remedial work completed, if required.



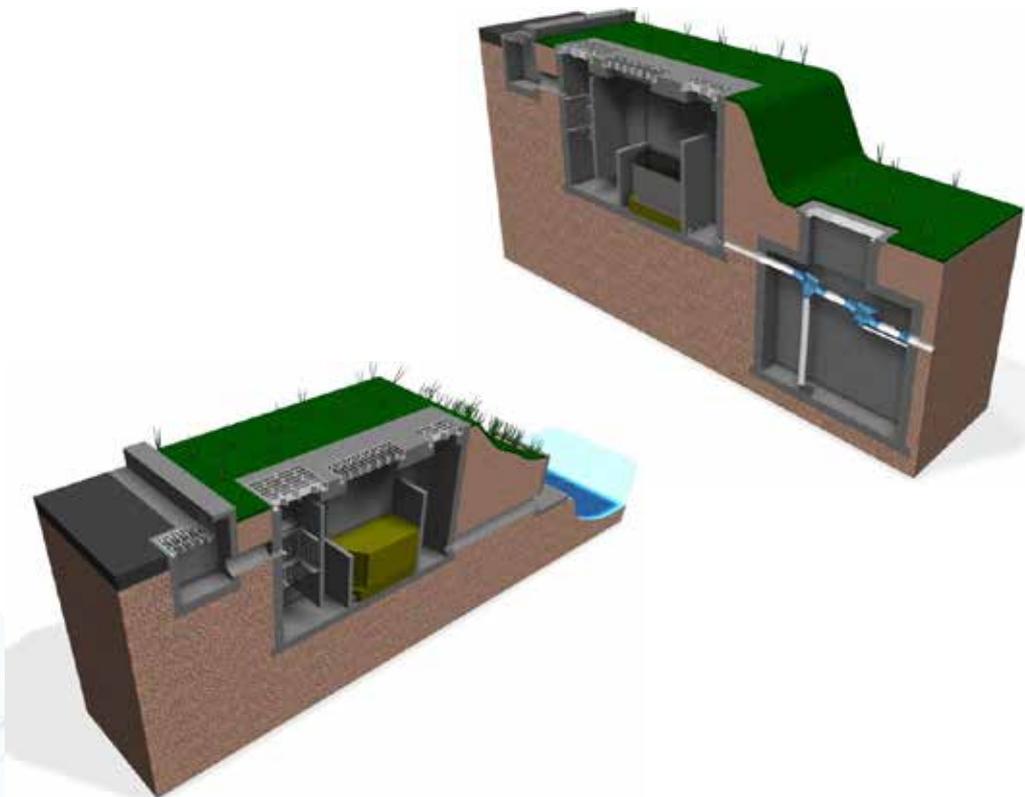
12.0 Applications and Configurations

The Ecosol™ Sand Filter is usually fitted off-line onto pipes ranging in diameter up to 450mm in high density developments with little or no landscape areas and where there are space constraints or the drainage grade makes the use of bio-retention systems unsuitable.

Typically the units, which have been designed for trafficable loadings, are located in industrial and commercial car parks, shopping centres, residential housing developments and truck stops, freeways and maintenance yards.

Sand filters are often used to remove suspended solids, biochemical oxygen demand (BOD), total phosphorous, and faecal coliform bacteria. As the Ecosol™ Sand Filter not only has a primary treatment capture basket for retention of gross pollutants such as litter, vegetative matter, and coarse sediment and a separate chamber for fine sediment and hydrocarbons, it is a particularly effective pre-screening system. This primary treatment significantly extends the life of the secondary treatment chamber which would otherwise become clogged with gross pollutants.

The primary and secondary treatment design of the Ecosol™ Sand Filter enables it to be utilised as an efficient pre-screening system upstream of rainwater harvesting systems such as the Ecosol™ Rain Tank, or on site detention systems. It can also be installed upstream of a wetland to enhance the life of the wetland reducing on-going maintenance.



13.0 Turnkey Services

Urban Asset Solutions Pty Ltd design and estimating staff provide a dedicated management approach towards your project. In addition all staff are capable of liaising with the client, the consulting engineer, the contractor, and all other interested third parties to achieve a successful outcome.

14.0 Accreditation

Urban Asset Solutions Pty Ltd is accredited to AS/NZS ISO 14001 (Environment) and AS/NZS 9001 (Quality). Our commitment to continuously improving our products and services is demonstrated by our ongoing accreditation for Quality and Environmental Management. Urban Asset Solutions Pty Ltd is also committed to a safe environment for its employees. We are fully third-party accredited to AS/NZS 4801 and OHSAS 18001



15.0 Supplier and Technical Product Contact Details

For any maintenance or technical product enquiries please contact:
Urban Asset Solutions Pty Ltd
Tel: 1300 706 624
Fax: 1300 706 634
Email: info@urbanassetsolutions.com.au

Appendix 1

Ecosol™ Sand Filter Essential Information Form

To ensure your system is appropriately designed for its intended application and meets local water quality objectives it is essential that the following minimum information is provided:

Customer Details

Contact Person:

Company Name:

Phone:

Fax:

Email:

Project and Site Information

Project Name:

Project Address:

Type of Development/Catchment Type: (residential, commercial or industrial)

Catchment Size:

Ha

Percentage of impervious catchment area:

%

Local authority:

Device Location or structure number:

Designed Discharge (Peak ARI Flow Rate) L/s:

L/s

Treatable Flow Rate:

L/s

Proposed In-Line or Off-Line configuration

Inlet Pipe Diameter:

mm

Depth to inlet pipe invert level:

mm

Outlet Pipe Diameter:

mm

Depth to outlet pipe invert level:

mm

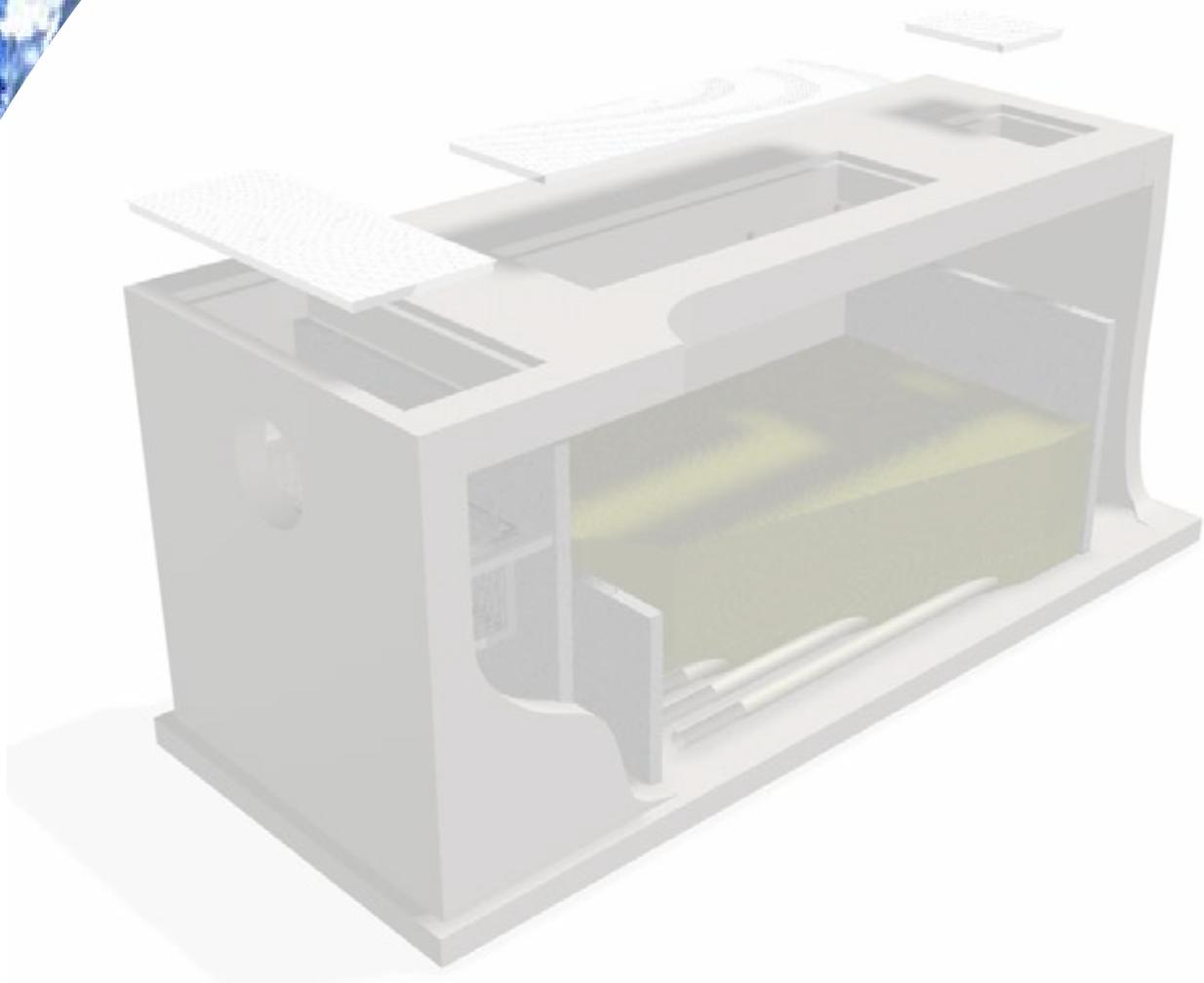
Other essential design or site relevant information:

Please forward the above information for your next project to your local Urban Asset Solutions Pty Ltd representative. On receipt Urban Asset Solutions Pty Ltd will model and design the most appropriately sized system to suit your application and to assist you achieve the project Water Sensitive Urban design objectives.

Email: info@urbanassetsolutions.com.au

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