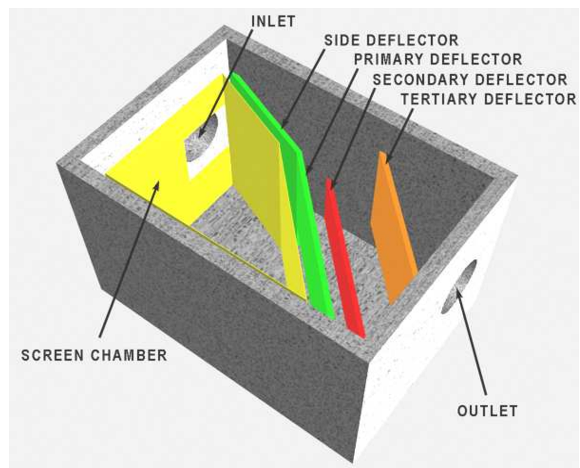
TECHNICAL SPECIFICATION

"It can never be the same, because we make it differently"

NEUTRALISING TURBULENT VORTEX SYSTEM (NTVS)

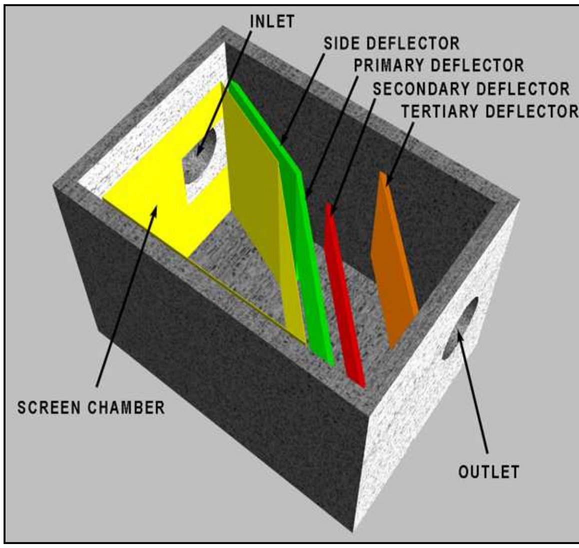


"NTVS, a unique trapping mechanism"

waico eng

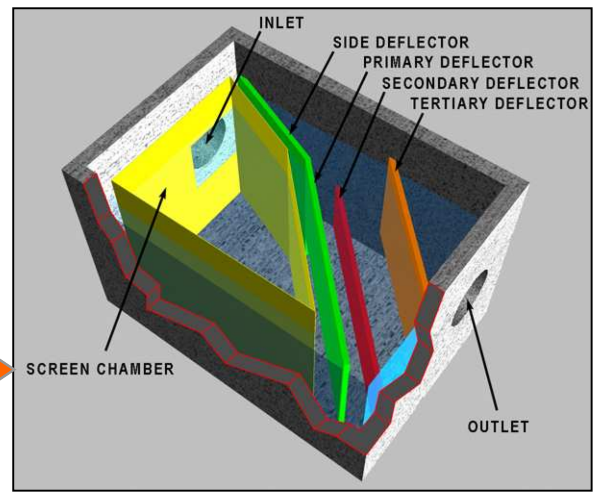
STORMWATER POLLUTANT TRAPS
SYSTEM & SOLUTIONS SERIES

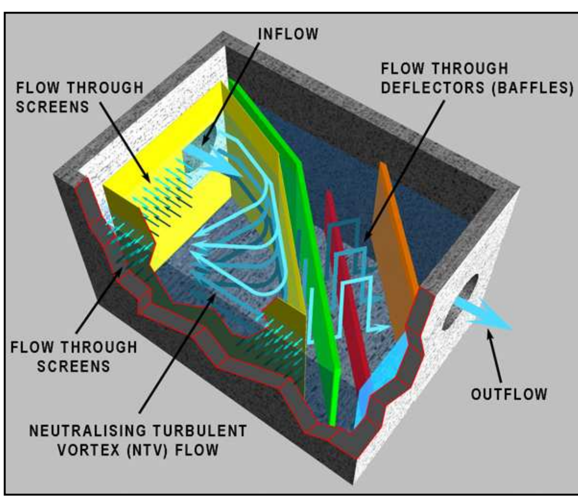
THE NTVS UNIT



The figure on the left shows the general arrangement of the NTVS unit, consisting of an external shell, a screen chamber and four deflectors. Note that the unit is unsymmetrical, but the NTVS is equally applicable with its componential arrangement mirrored longitudinally.

The figure on the right shows the NTVS unit with part of the external shell cut to show the internal components.



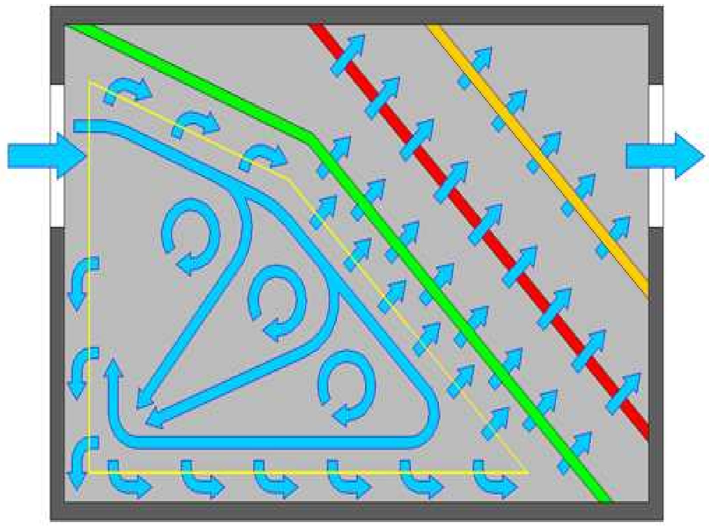


In the figure on the left, the water flow pattern is shown, demonstrating specifically the Neutralizing Turbulent Vortex (NTV) mechanism.

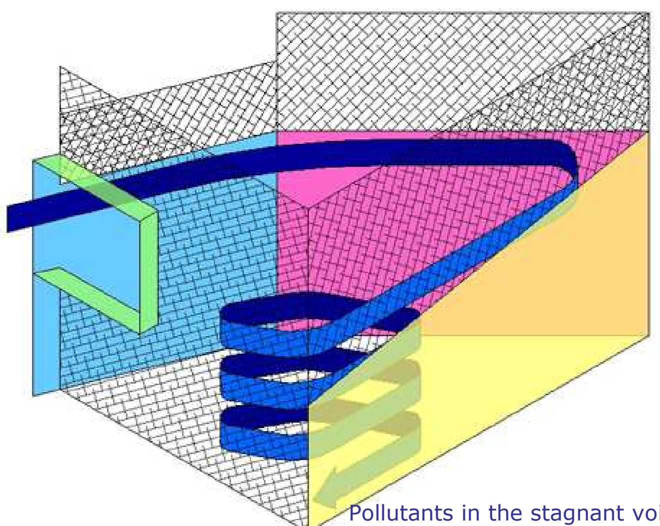
THE PATENTED NTVS TREATMENT MECHANISM

The patented NTVS treatment mechanism is expounded in the figure on the right.

Water enters the NTVS unit from the left. The water is directed into the screen chamber. The energy of the flow generates an unsymmetrical primary vortex along the walls of the screen chamber. In addition, due to the arrangement of the screen chamber walls, secondary vortices are also created. These secondary vortices roll along the chamber walls, as well as reflect off the walls towards the centre of the screen chamber. The primary and secondary vortices interact with each other and dissipate the energy contained, resulting in a stagnant void in the bottom left corner of the screen chamber.



Plan showing the simplified flow pattern of the NTV mechanism



Pollutants in the stagnant void gradually settles to the bottom

Due to the nature of the NTV flow, pollutants are pushed into the stagnant void created. Pollutants trapped in this area are virtually stationary and slowly settles towards the bottom of the NTVS unit.

It should be noted that the screens of the screen chamber do not become blocked with pollutants (such as plastic bags). The NTV flow skims parallel to the screen chamber walls and pushes pollutants along the walls into the stagnant void. Thus, any blockages are prevented.

The deflectors at the rear of the NTVS unit make up the secondary treatment mechanism. These deflectors act like baffle walls. The flow from the screen chamber must flow under the primary deflector (green), over the secondary deflector (red) and finally under the tertiary deflector (orange), before exiting the NTVS unit via the outlet. This has the effect of increasing the flow distance and thus, also increases the retention time. In addition, the deflectors trap free oils and grease that float as a top layer in the water.

Finally, it should be noted that the screen chamber and deflectors do not extend until the top of the NTVS unit. This is for a purpose, which is to allow for overflow when the incoming flow exceeds the TFR.

KEY NTVS BENEFITS

The key NTVS benefits are:

- Captures more than 95% of gross pollutants larger than 3mm.*
- Captures more than 50% of gross pollutants larger than 1mm.*
- Collects significant quantities of sediment, free oils and grease.
- Can capture more than 70% of free oils and grease with the addition of absorbents.*
- Low headloss.
- Resuspension of settled pollutants virtually non-existent.
- Can be sized to suit wide range of flows, gradients and conduit types and sizes.
- Can be installed in one complete unit (dependent on size).
- Unique and patented NTV flow eliminates blockage risk.
- Unique and patented basket design.

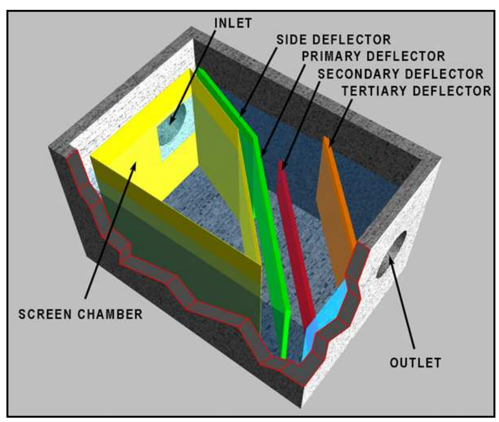
* Based on laboratory tests.

CAPTURE EFFICIENCIES

The NTVS is designed to capture a wide range of common pollutants present in stormwater. While the NTVS cannot claim to be able to efficiently capture all types of pollutants, the NTVS is designed based on a delicate balance of many issues and requirements.

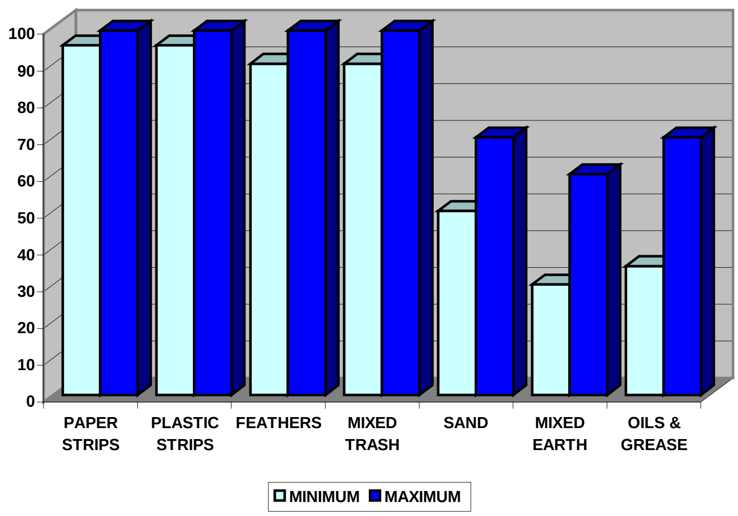
On one end, it is important to capture the gross pollutants, especially litter, because they are present in large amounts in stormwater. Their main detrimental effect is they choke up the stormwater system easily. Fortunately, gross pollutants are the easiest to capture due to their large size and hence, the capture efficiency is generally almost 100%. However, sufficient storage space must be provided due to the large volume of these pollutants captured.

On another end, fine sediments are difficult to capture. In order to become increasingly effective in capturing these fine particles, the treatment device generally has to be larger and the screen mesh apertures have to be smaller. In an urban environment, a larger device is not preferred due to space constraints, and smaller apertures are more prone to blockage. As such, it is impractical to design an SPT to be highly effective against sediments. Nonetheless, the NTVS is designed to be able to capture fine sediments to a certain extent, that it makes quite a positive impact on the water quality.



In addition, an overly efficient SPT may cause more headloss, although this is dependent on treatment mechanism and technology adopted.

As such, while the NTVS cannot claim to be the best on handling all types of pollutants, it is believed that the NTVS is one of the best in its class of SPTs, in the urban environment and for urban runoff, due to its balanced design.



The adjoining figure shows the results from laboratory testing for a range of pollutant types and sizes. It shows that the NTVS achieves high capture efficiencies for a wide range of pollutants. However, it is important to note that factors, such as the range of flows monitored, the homogeneity of the pollutants, the quantity of previously captured material, and the accuracy in flow and material measurement, can present difficulties in accurately determining the capture efficiencies.

Also, it should be noted that no blockage of the NTVS was observed, even after filling the storage area with trash up to the overflow level.

Importantly and unlike other systems, the NTVS continues to treat the specified TFR even under high flow conditions. While the composition and quantity of pollutants varies depending on the catchment size, area, land use, and rainfall patterns, the NTVS typically captures the following pollutants (see table on the right).

Litter	90% – 99%
Vegetation	90% – 99%
Coarse sediment	50% – 70%
Fine sediment	20% – 50%
Free oils and grease	30% – 60% (60% – 70% with absorbents)

Holding Capacities

In conjunction with its high capture efficiencies, the NTVS has the capacity to retain large quantities of captured pollutants. This large holding capacity ensures that the capture efficiency is maintained between scheduled cleaning events. The NTVS is also highly customisable to provide additional capacities to cater for special cases whereby the pollutant loading may be higher than normal or when the time between maintenance has to be increased.

Model No.	Holding Capacity (m^3)
NTVS 1000	1
NTVS 1500	3
NTVS 2000	5
NTVS 3000	13
NTVS 4000	29
NTVS 5000	53
NTVS 6000	86

The table on the left provides an indicative representation of the holding capacities for the various NTVS units. It is provided for illustrative purposes only. Waico's technical personnel are more than willing to provide any assistance on selecting and modifying the NTVS unit to cater for a specific holding capacity.

TREATABLE FLOW RATES

As mentioned previous, each NTVS unit is designed to satisfy a specific TFR, which is defined as the minimum flow at which the NTVS meets the desired pollutant removal criteria without any by-pass. Typically, these flows fall between the 1-in-3 month and 1-in-1 year ARI, but in some cases, may be increased to the 1-in-5 year ARI, depending on the characteristic of the catchment.

Model No.	Treatable Flow Rate (m^3/s)
NTVS 1000	0.03 – 0.04
NTVS 1500	0.10 – 0.11
NTVS 2000	0.20 – 0.22
NTVS 3000	0.58 – 0.61
NTVS 4000	1.22 – 1.26
NTVS 5000	2.14 – 2.19
NTVS 6000	3.39 – 3.46

The table on the right provides the indicative TFRs for the NTVS units, based on laboratory tests. It is provided for illustrative purposes only. Waico's technical personnel are more than willing to provide any assistance on sizing to cater for a particular TFR.

EQUIVALENT CATCHMENT AREA

Model No.	Estimated Catchment Area if Treatable Flow is Specified ARI Event (ha)					
	1-month	3-months	6-months	1-year	2-years	10-year
NTVS 1000	0.29	0.23	0.19	0.14	0.11	0.09
NTVS 1500	0.81	0.64	0.54	0.40	0.32	0.24
NTVS 2000	1.6	1.3	1.1	0.84	0.67	0.51
NTVS 3000	4.6	3.7	3.0	2.3	1.8	1.4
NTVS 4000	9.5	7.6	6.3	4.7	3.8	2.9
NTVS 5000	16.6	13.3	11.0	8.3	6.6	5.0
NTVS 6000	26.2	21.0	17.5	13.1	10.5	8.0

In order to assist the selection of the appropriate NTVS unit, a table is provided above to provide the indicative catchment areas for which each model of NTVS is catered for. It is provided for illustrative purposes only. Waico's technical personnel are more than willing to provide any assistance on sizing to cater for a particular catchment area.

HEADLOSS

Model No.	Headloss at TFR (mm)
NTVS 1000	100 – 125
NTVS 1500	150 – 175
NTVS 2000	200 – 225
NTVS 3000	300 – 325
NTVS 4000	400 – 450
NTVS 5000	500 – 550
NTVS 6000	600 – 650

The placement of any structure into a stormwater line will induce headloss, which is generally defined as the difference in water level upstream and downstream of the structure. In layman terms, the structure will act as a partial obstruction to the flow and hence, will cause some backflow towards the upstream. While this headloss in unavoidable, there are ways to minimise and mitigate the headloss and the amount of backflow.

Extensive laboratory tests have confirmed that the NTVS has one of the headloss factors of any SPT currently available. The table above provides an indicative representation of the headlosses for the various NTVS units. It is provided for illustrative purposes only. Waico's technical personnel are more than willing to provide any assistance on the headloss as well as ways to incorporate the NTVS units to minimise its effects on the flow.

SUMMARY DATA

The table below summarises the range of TFRs, the equivalent catchment area (for 6-months ARI), footprint sizes and holding capacities for each of the seven basic NTVS units. Nonetheless, this data is provided as an indicative guide only, as the actual TFR for each unit can vary depending upon a number of actual site factors. In addition, the NTVS is highly customisable to cater to the specific requirements of each site. As such, it is imperative that a Waico technical personnel be contacted to obtain the optimum benefits from the NTVS unit.

Model No.	Footprint Size (m x m)	Depth from Surface (m)	Treatable Flow Rate (m^3/s)	Equivalent Catchment Area (ha)	Holding Capacity (m^3)
NTVS 1000	1300 x 2300	2350	0.03 – 0.04	0.19	1
NTVS 1500	1900 x 2650	2450	0.10 – 0.11	0.54	3
NTVS 2000	2450 x 3500	2600	0.20 – 0.22	1.1	5
NTVS 3000	3500 x 5000	3600	0.58 – 0.61	3.0	13
NTVS 4000	4600 x 6600	4650	1.22 – 1.26	6.3	29
NTVS 5000	5700 x 8200	5450	2.14 – 2.19	11.0	53
NTVS 6000	6800 x 9800	6100	3.39 – 3.46	17.5	86

LACING WITH MICRO-ORGANISMS

As part of Waico's continual product development, the walls of the NTVS unit can optionally be laced with cultivated micro-organisms, whose primary function is to absorb and breakdown certain nutrients and chemicals present in stormwater. These micro-organisms are self-sustaining, as they feed on nutrients already present in stormwater. For the most effective treatment of microbes in stormwater, retaining time is very important. Waico Eng strongly believe that applying microbes in the urban drainage (the main sources of pollutants) will produce the best results as the NTVS will serve as an incubator for the microbes to populate and subsequently lacing the whole drainage and rivers network with microbes. With microbes treatment, the drainage and rivers with be free of unpleasant smell, especially useful in problematic areas with high level of organic waste like the wet markets, domestic farms and industrial area drainage.

TECHNICAL DRAWINGS

Due to the patented nature of the NTVS and its NTV technology, technical drawings will only provided upon request. However, Waico's technical personnel are more than willing to provide any assistance with regards to any of the NTVS' design and technical issues.

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NEUTRALISING
TURBULENT VORTEX
SYSTEM (NTVS)

"It can never be the same, because we make it differently"

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At WESB, our consultants are highly trained to assist you in providing the best solution to your stormwater needs.

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