

## 9. Vortex devices

It is well known that when a fluid is forced to flow in a circular arc, secondary currents are set up that tend to move denser objects towards the floor on the inside of the bend, whilst floatables tend to move towards the surface on the outside of the bend. This has been extensively exploited in the past for sediment removal (see for example: Salakhov, 1975, Cecen and Bayazit, 1975, Ogihara and Sakaguchi, 1984, Mashauri, 1986, Paul et. al., 1991, Weiss and Michelbach, 1995, Konicek et. al., 1995, and Evance et. al., 1995). Most of these devices, however, require that the sediment is continuously withdrawn, and are more suitable for the separation of sediments from sewage than for the removal of litter from stormwater.

Some vortex devices suitable for the treatment of stormwater have been designed and constructed in the USA and have proven effective in the removal of sand and other dense objects with a relatively high settling velocity. Most of these devices are however relatively ineffective in the removal of plastics for the simple reason that objects such as polyethylene shopping bags have a density close to that of water and tend to follow the streamlines, particularly in conditions of high turbulence (Pisano, 1995).

It is evident that vortex type devices will only be effective in the trapping of litter if used in conjunction with some form of screen or baffle to ensure that suspended material does not get carried through the structure with the stormwater.

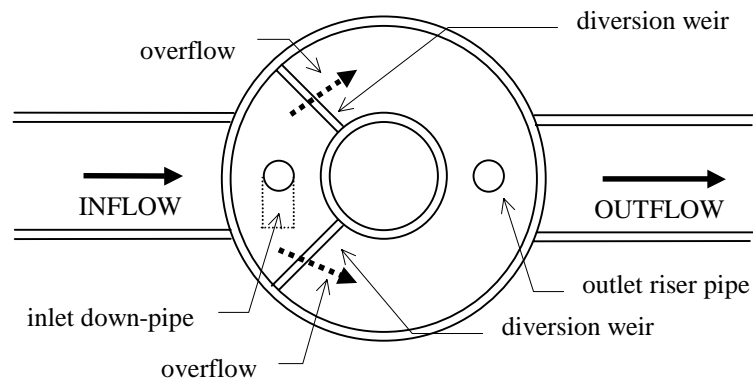
In a sense, this is the principle of the Continuous Deflective Separation (CDS) unit which has already been described in Section 5.10. However, although the CDS unit looks like a vortex separation device, the main separation element is a self-cleaning screen rather than the secondary currents induced by the vortex. Here the vortex performs two functions - it provides the shear velocity needed to keep the screen clear, and helps to collect the sediment in the sump ready for removal (Wong and Wootton, 1995).

A more promising example of a vortex device for use with stormwater is the Stormceptor® device which has recently been developed in Canada.

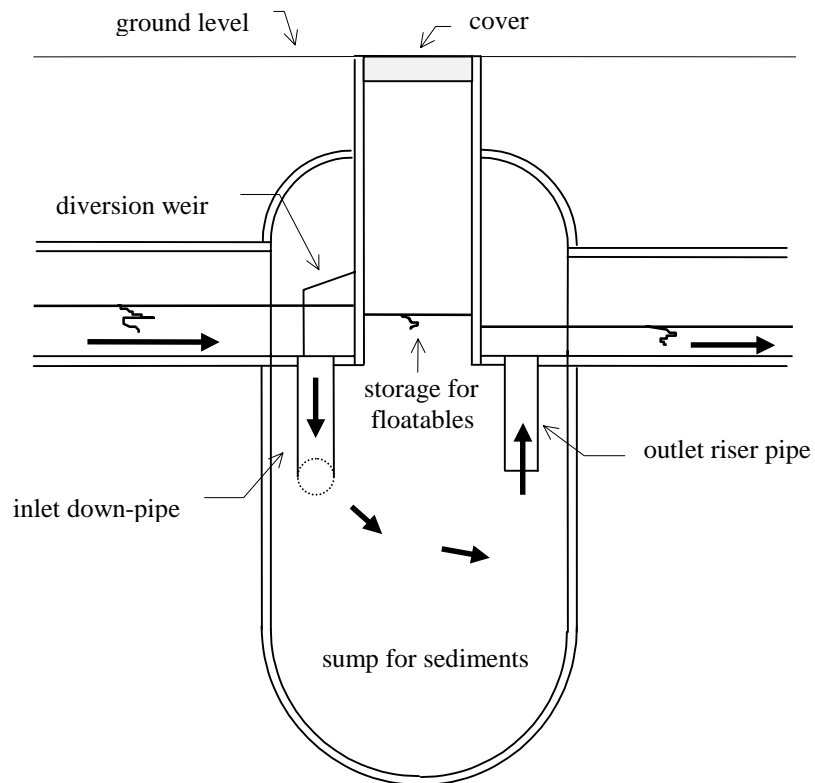
The Stormceptor® is really a type of oil-grit separator (OGS), designed to protect drainage systems from the ingress and oil and grit arising from potentially highly polluting areas such as service stations, parking areas and industrial developments. The device is cylindrical in shape, and is divided into an upper diversion chamber and a lower treatment chamber. See Figure 9-1.

Water is directed by a diversion weir into an inlet down-pipe which discharges into the lower treatment chamber through a 90° bend orientated so as to spin the contents of the chamber. Water exits the treatment chamber through an outlet riser pipe. The inlet and outlet pipes are set to the same elevation, thus providing for oil storage volume above the inlet / outlet elevation, and sedimentation volume below. The sediment and oil may be removed through an access hole provided through the centre of the diversion structure.

## a) Plan



## b) Section



**Figure 9-1 : Stormceptor® plan and section**

The Stormceptor® comes in different sizes and may be constructed entirely out of fibreglass, or with the body out of concrete and the diversion structure out of a fibreglass insert.

The system operates in two modes depending on the flow into the system. At low to medium flows, all of the flow, along with the sediment and oil, is diverted to the treatment

chamber by the diversion weir. Oil rises above the exit elevation and sediment settles to the bottom. During higher flows, a proportion of the flow overflows the weir and bypasses the treatment chamber.

The flow diversion proportion is governed by the height of the weir. Up to the level of the weir, 100% of the flow is diverted to the treatment chamber. As flow increases, the weir is over-topped. At the same time, the head over the inlet down-pipe is increased which would normally result in continued increase in flow. However, in the Stormceptor® design, the increased flow over the weir also results in an increased head over the outlet riser pipe. As a consequence, as the flow increases, the flow diverted to the treatment chamber increases by only an additional 10% before decreasing with further increases in flow. This feature prevents the resuspension and scouring of trapped sediments.

Head losses for the system measured in the laboratory showed that the head loss depended on the weir setting and varied between 1,83 and 2,5 of the velocity head ( $V^2/2g$ ), with the higher values for higher weir configurations (Weatherbe et. al, 1995).

The performance of the Stormceptor® with respect to the removal of litter is not reported, but it is probable that it would quickly block if there is a high proportion of litter in the flow.