BIO-RETENTION

SOURCE CONTROL

An example of a Bio-retention Facility in the United States

PRIMARY CONSIDERATIONS	
Construction Cost	MEDIUM
Maintenance Requirements	MEDIUM
Land Take	MEDIUM

BENEFITS	
☑Water Quality Control	YES
☑Water Quantity Control	YES
☑Amenity Value	YES
☒Habitat Creation Value	NO
☒Biological Treatment	NO

DESCRIPTION

Bio-retention devices are landscaped features adapted to control run-off close to source. They are designed as depressions backfilled with a sand/soil mixture and planted with native vegetation. As the surface water passes through the vegetation it provides filtration and settlement as well as allowing for infiltration. Bio-retention facilities are typically under-drained and the filtered run-off is returned to the sewer network or to watercourses. They are most commonly used in high density urban areas in car parks, traffic islands or within small pockets in residential areas.

Design

Each system should incorporate 5 basic design features, which are dependant on site conditions:

1) Pretreatment;
2) Treatment;
3) Conveyance;
4) Maintenance Reduction, and
5) Landscaping.

1) Pretreatment:

Run-off is directed via an opening in the kerb across a grass filter strip, which reduces incoming velocities and coarser sediments. A sand or gravel sediment trap may also be incorporated into the design.

2) Treatment:

The bio-retention system should be sized to be between 5 to 7% of the impervious area draining to it and should consist of a sandy soil bed with an upper mulch layer.

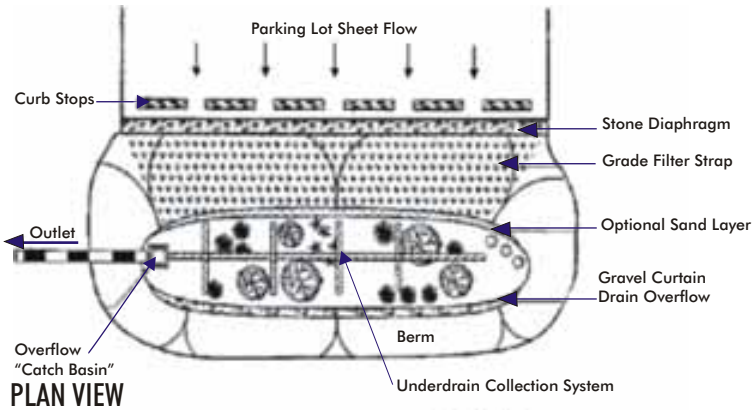
Once the sand reaches its infiltration capacity, run-off is directed into the planting bed. The sand bed keeps finer soil particles from washing out through the underdrain systems, augments the infiltration capacity of the planting bed and provides an aerobic filter. The maximum ponding depth should be between 15 and 22 cm above the filter bed.

3) Conveyance:

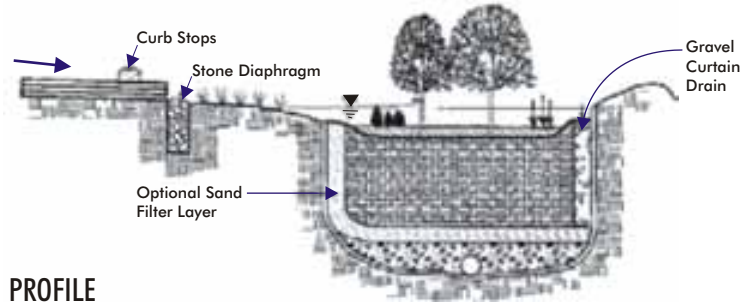
An underdrain system is used to collect the filtered run-off from the filter bed and direct it back into the sewerage network. The under drain consists of a perforated pipe in a gravel bed. An overflow system should also be incorporated into the design to allow larger storm flows to by pass the system.

4) Maintenance Reduction:

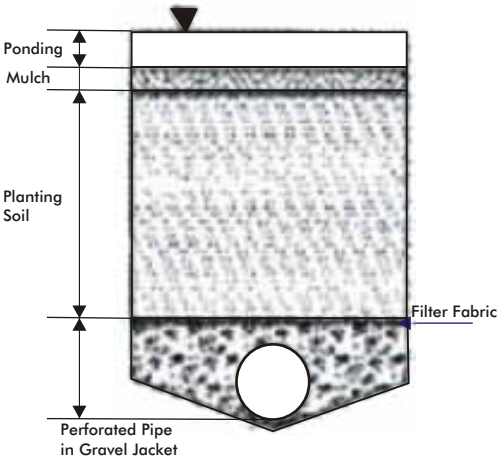
Incorporating filter strips and providing pre- treatment will minimise the maintenance requirements of the bio-retention area and will reduce the likelihood that the soil bed will clog over time.



PLAN VIEW



PROFILE



TYPICAL SECTION

MORE OVERLEAF - 1 of 2

BIO-RETENTION

SOURCE CONTROL

5) Landscaping:

Native plants which can withstand the hydrological regime; tolerate stresses such as pollutants, variable soil moisture and ponding fluctuations; and that provide habitat value should be used whenever possible. Other landscaping considerations include number and sizing of plants, soil fertilitiy and plant growth. The system can incorporate trees, preserving the natural character of the land.

6) Other Design Considerations:

- No construction run-off should be routed through the device.
- Should be used to drain areas of 5 ha or less.
- Best applied to relatively shallow slopes (usually about 5 %). However, sufficient slope is needed at the site to ensure that water that enters the bio-retention area can be connected with the sewer network.
- Should not be used where groundwater is within 1.5m of the filter bed. The use of an impermeable liner will reduce the risk of possible ground water contamination.
- Bio-retention systems are most effective, when they are placed as close to the source of run-off as possible. Systems should be designed to fully drain in less than 72 hours.
- Can be used in stormwater hotspots, such as industrial estates, as long as an impermeable liner is incorporated into the design.

Pollutant Removal

- Bio-retention facilities improve water quality, vegetative filtering, sedimentation and infiltration.
- Little data have been collected on the pollutant removal effectiveness of bio-retention areas.
- The Table below shows data gathered from two studies carried out in Maryland.
- There is considerable variability in the effectiveness of bio-retention areas, and it is believed that proper design and maintenance helps to improve their performance. Details of other studies are available from the (US) National Stormwater Best Management Practices Database. (www.bmpdatabase.org)

Pollutant	Removal (%)
Copper	43-97
Lead	70-95
Zinc	64-95
Phosphorous	65-87
TKN	52-67
NH4+	92
NO_3-	15-16
Total Nitrogen (TN)	49
Calcium	27

Maintenace Considerations

- Monthly inspections are recommended until vegetation is established.
- Litter removal should occur on a monthly basis.
- Inspections should occur twice a year, after the vegetation has become established.
- Sediment can accumulate near the inlets and removal of this material should be carried out as required.
- The filter strip will require mowing during the growing season.
- Other possible tasks will include replacement of dead vegetation, erosion repair, mulch replenishment and possibly unclogging of the subsurface drain.

International Experience

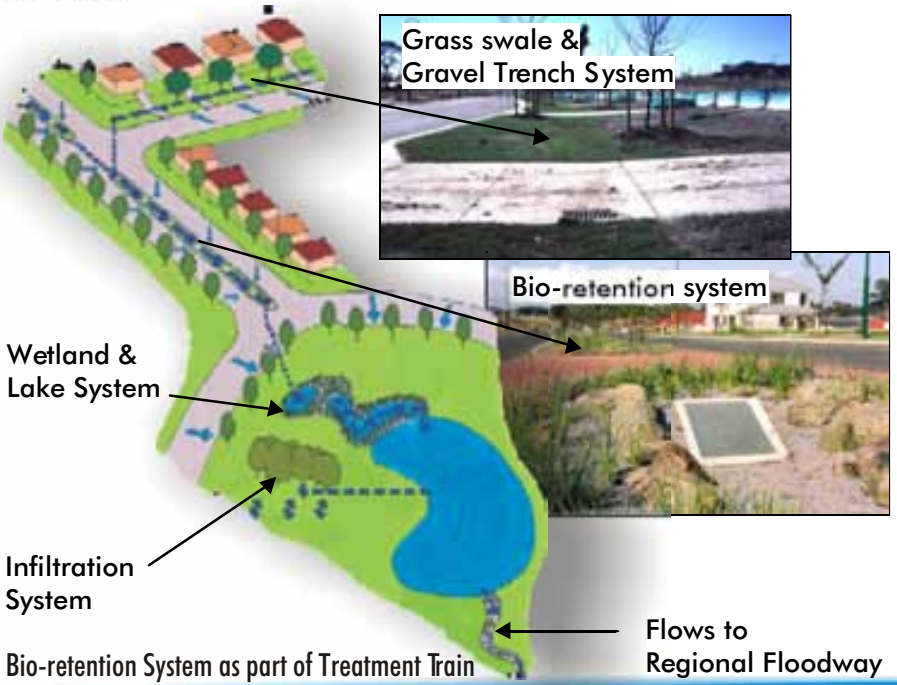
Bio-retention devices are a relatively new type of system and have been used mainly in the US and Australia.

Advantages

- ☑Creation of micro-habitats
- ☑Improved Aesthetics
- ☑Water quality improvement
- ☑Can be applied in almost any soils or topography
- ☑Suited to high-density urban areas and industrial sites

Limitations

- ☒Bio-retention areas provide a limited amount of flood control.
- ☒Cannot be used to drain large sites greater than 5 ha.



Bio-retention System as part of Treatment Train

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