DETENTION BASINS *SITE CONTROL*

Grassed Detention Basin, South Dublin

PRIMARY CONSIDERATIONS

Construction Cost	LOW
Maintenance Requirements	HIGH
Land Take	MEDIUM

BENEFITS

☑ Water Quality Control	YES
☑ Water Quantity Control	YES
+/- Amenity Value	SOMETIMES
☒ Habitat Creation Value	NO
☒ Biological Treatment	NO

Description

Detention basins are vegetated depressions designed to impound run-off in basins during large storms and gradually release it. Detention basins mainly provide runoff rate control as opposed to water quality control and are therefore best used as part of an overall treatment train approach. However, a limited amount of treatment is provided through settlement of suspended solids.

Detention Basin, Residential Area, Scotland

Design

Basic Design Features:

- Basins should be designed to empty within 24 hours of a storm thus not have a permanent pool of water.
- The treatment volume required for water quality control is 1 x Vt (Wallingford Pocedure).
- The maximum water depth in the basin should not exceed 3 m.
- The side slopes of the basin should ideally be terraced with an average 3:1 slope or flatter, which will minimise the potential for erosion and will allow easy access for maintenance and for safety purposes. Slope protection may be required during the construction of the basin.
- The side slopes and base should be planted with dense native vegetation which can tolerate periodic inundation and water flow. This will provide slope protection and assist sediment removal.
- The basin should have a length to width ratio greater than 3:1 to increase basin performance.

The inlet structures should be designed to incorporate energy dissipaters (such as micropools or flow spreaders) to reduce the inflow velocity and turbulence.

- The outlet device should be designed so that the facility temporarily impounds runoff in the basin during large storms, to reduce the peak rate of discharge for a given design storm to pre-development levels (e.g., 2-, 5-, 10- or 100-year storm). (Texas Nonpoint Sourcebook).
- An overflow or spillway should also be included in the basin design, to prevent the water levels from over topping the embankment.
- Design can be adjusted to suit areas of limestone topography or rapidly percolating soils such as sands.
- Impermeable liners should be incorporated where there is significant potential for seepage of pollutants to groundwater.

Design Enhacement Options:

- Sediment forebay to assist sediment removal.
- Extended detention can provide the required treatment for certain industrial premises.
- Micro-pool (typically shallow and undrained) at the outlet to concentrate finer sediment and reduce re-suspension. Can be planted with wetland species.
- Low flow channels to prevent erosion at the inlet and to route the last remaining run-off to the outlet after the event, ensuring the basin dries completely. For Design and Operation Details, refer to the Minnesota Urban Small Sites Manual

Dry Detention Basin, South Dublin

MORE OVERLEAF - 1 of 2

DETENTION BASINS *Site Control*

Volumetric Design Criteria

Defined by a matrix of parameters:

1) Depth / Area Storage Relationship:

- Largely dictated by topography and outfall levels. Volumetric allowances for vegetation of up to 25% should be provided.

2) Head / Discharge Relationship:

- The pond/basin should be designed to a maximum discharge rate achieved, when the structure is full but consideration must be given to outfall conditions, e.g. receiving water levels.

3) Throttle Rate:

- Throttle sizes are generally a minimum of 150mm. In smaller developments, the volumetric element of storage is likely to be achieved by other drainage components such as lined or unlined permeable pavement car parks or soak-aways.

4) Effective Contributing Area:

- The paved and pervious catchment surfaces which contribute run-off after various losses. The relationship between contributing area and throttle rate will define the critical duration of the design rainfall events. Events will be longer for tighter throttle rates and storage volumes larger.

5) Rainfall Characteristics of the Area:

- Ireland has been analysed for hydrological characteristics. These have been processed to enable appropriate design storm events to be produced for any location, duration and return period. This is based on the Flood Studies Report undertaken in the 1970s.

6) Level of Service:

- Design should be for a range of return periods (up to 100 years). It is unlikely that one structure will serve the needs of the various criteria. Temporary flooding of car parks and public space areas are likely to be acceptable on occasions. The hydraulic implications for loss of volume due to sediment or vegetation should also be considered.

7.) Safety:

- Should be considered for all stages of construction, operation, maintenance and decommissioning.
- Appropriate design criteria should be applied to protect against overtopping in extreme events.
- Large storage areas may have to consider not only the freeboard and wave development. The return period for such design is likely to relate to dam legislation and the downstream risk with the occurrence of a failure.
- Blockage of the pass forward structure must be catered for and an alternative method of drawing down the storage system must be provided.

Pollutant Removal

- Detention basins provide moderate pollutant removal.
- Removal efficiency is limited for soluble pollutants due to the absence of a permanent pool of run-off, although they can be effective at removing some pollutants through settling.
- Typical removal rates, as reported by Winer (2000) are:

Pollutant	Removal (%)
TSS	61 ± 32[1]
TP	20 ± 13
TN	31 ± 16
NOx	-2 ± 23
Metals	29 - 54
Bacteria	78[2]

1: ± values represent one standard deviation
2: Data based on less than five data points

For details of other studies, refer to the National Stormwater Best Management Practices Database. (www.bmpdatabase.org)

Maintenace Considerations

- The basin should be inspected after severe events to check bank stability and vegetation growth.
- Twice yearly inspections will be required to check for subsidence, erosion and sediment accumulation.
- Inlet and outlet structures should be inspected for debris and erosion at least twice a year or after large storms (CIRIA , 2000). Any problems should be addressed immediately.
- Debris and litter should be removed, as required.
- Sediment should be removed from the basin, as necessary. CIRIA (2000) suggest sediment removal will be required every 7 to 10 years (up to 25 years depending upon the design and inclusion of a sediment forebay).

International Experience

Detention Basins have been used for several years in Scotland. They were first used as part of the drainage masterplan for a development called the Dunfermline Eastern Expansion Area. This masterplan was developed using the treatment train concept, where the basins were located upstream of regional control facilities. Monitoring work carried out in Scotland, has highlighted the habitat value of such basins, when grass cutting is kept to a minimum. This research has also reinforced the importance of providing adequate vegetation cover. In several basins, planting took place at the wrong time of year leading to erosion and operational difficulties.

Vegetated Detention Basin

Advantages

- ☑ Provides for flow control.
- ☑ Can limit downstream scour by reducing peak flow rate and dissipating the energy of the run-off.
- ☑ Can be used as recreational areas such as football pitches.
- ☑ Could be integrated into green space areas, typically found in Irish housing estates.
- ☑ Limited safety concerns.
- ☑ Can be used in almost all soils and geology, with minor design adjustments for regions of limestone topography or rapidly percolating soils such as sand.
- ☑ Can accept run-off from stormwater hotspot such as industrial sites.
- ☑ Can be used to trap construction run-off, as long as all deposited sediment is removed before normal operation begins.
- ☑ Detention basins are relatively long lived facilities.
- ☑ When appropriate wetland species are planted on the base, basins can provide important micro-habitats.

Limitations

- ☒ Limited pollutant removal capabilities.
- ☒ Potential for clogging of outlets.
- ☒ Needs a relatively large land area therefore may be limited to greenfield sites.