E8 - Water Sensitive Urban Design

Low Impact Development (LID)

Low Impact Development (LID) achieves stormwater management controls by changing site design to create a functional landscape that mimics natural catchment hydrologic functions (discharge, frequency, recharge and volume).

The objective of LID site design is to simulate predevelopment hydrologic conditions.

Impacts can be minimised by:

- Reducing imperviousness
- Conserving natural resources/ecosystems
- Maintaining natural drainage courses
- Reducing use of pipes
- Minimising clearing and grading
- Recreate detention and retention storage throughout a site by using open swales, flatter slopes, bioretention and rain barrels.
- Maintain predevelopment time of concentration by strategically routing flows to maintain travel time.
- Encourage property owners to reduce pollution and maintain management measures.

In designing development projects under Best Management Practice (BMP) principals many factors need to be investigated:

- Land cover
- Soils
- Existing flow regime
- Driveway and road cover
- Tree and shrub preservation (minimum disturbance)
- Use of rooftop rainwater tanks

Public education is essential to successful pollution prevention and BMP maintenance. It can be used as a marketing tool to attract environmentally conscious buyers, promote citizen stewardship, awareness and participation in environmental protection programs.

Changing the stormwater management approach from a “collect and treat” strategy to the low impact approach of simulating natural conditions significantly reduces site development costs, through less clearing, earth work, pipes, drainage control structures, minimum use of roadside curb/guttering, less road pavement, fewer footpaths and lower wetland, tree and stream mitigation costs.

Urban sprawl promotes automobile dependency and widens urban fringes, which puts pressure on environmentally sensitive areas.

Rainwater Harvesting

A rainwater harvesting system consists of:

1. A collection area which is usually a roof of a house or building. The effective roof area and the materials used in constructing the roof influence the efficiency of collection and the water quality.
2. A conveyance system of gutters or pipes and should be constructed of chemically inert materials such as wood, plastic, aluminium, or fibreglass to avoid adverse effects on water quality.
3. Storage facilities such as a storage tank or cistern, which should also be constructed from an inert material, such as reinforced concrete, fibreglass, or stainless steel.

All rainwater tank designs should include:

- A solid secure cover
- A coarse inlet filter
- An overflow pipe
- A manhole, sump and drain to allow cleaning
- An extraction system that does not contaminate the water eg tap or pump
- A soak-away to prevent spilled water from forming puddles near the tank
- covered to reduce the likelihood of frogs, lizards, mosquitoes and other pests using the cistern as a breeding ground.
- install a 'first flush' system if the water is to be used for drinking and domestic uses (chlorination of the water may be necessary or an in-line charcoal filter or other water treatment device could be used)

Vegetated Roof Cover

Vegetated roof covers have been used in Europe for over 25 years to control runoff volume, improve air and water quality and promote energy conservation. They typically include layers of drainage material and planting media on a high quality waterproof membrane, using foliage and a lightweight soil mixture to absorb, filter and detain rainfall.

Vegetated roofs require consideration of the load-bearing capacity of roof decks, the moisture and root penetration resistance of the roof membrane, hydraulics and wind shear. Existing structures can be successfully retrofitted in urban areas.

Benefits include:

- Extending roof life
- Reduction in energy costs
- Conserving valuable land that would otherwise be required for stormwater runoff controls.

Bioretention

Bioswales are open channels covered in grass and other plants through which runoff is directed during storm events. Aboveground plant parts (stems, leaves and stolons) retard flow and thereby encourage particulates and pollutants attached to them to settle out.

The befits of bioretention are:

- Temporary storage of runoff which reduces downstream flow as water is released over a period of days to the receiving water.
- provide shade and wind breaks, absorb noise and improve an area's landscape.
- Filtering out of some particulate matter and pollutants
- environment for the growth of microorganisms, which degrade petroleum based products and other organic material
- clay in the planting material provides site for the adsorption of hydrocarbons, heavy metals, nutrients and other pollutants.

Construction costs are slightly greater than simply landscaping a new development. However operation and maintenance costs are comparable to those of typical landscaping of the site Costs beyond the normal landscaping fees will include the cost for testing soils and may include costs for a sand bed and planting soil.

Plant material should be obtained from certified nurseries. Native species should be used and selected according to their moisture regime, morphology, susceptibility to pests and diseases and tolerance to pollutants. Plant sufficient species to ensure maintenance and promotion of biodiversity.

Nutrients and metal in the runoff will disrupt the normal soil functions by lowering the cation exchange capacity. It is therefore recommended that soils be tested annually and replaced when soil fertility is lost (approx 5-10 years).

Permeable Pavement

Porous pavements are best suited for low traffic areas such as driveways, car parks and footpaths.
Some benefits include:

- Reduced runoff
- Elimination of stormwater ponds
- Improved Water quality
- Low maintenance

Grass Swales

Grass swales are less costly than installing curb and gutter/storm drain inlet and storm drain/pipe systems. Concerns that open channels are potential nuisance problems, present maintenance problems or impact pavement stability can be alleviated by proper design. Periodic removal of sediments and mowing are the most effective maintenance requirements.

The benefits of Grass swales include encouragement of sedimentation by reducing velocity of run-off and potential nutrient and pollution reduction.

Site Planning

Careful urban design can reduce the impacts of urbanisation.
For example:

- Reduce parking lot spaces and overall imperviousness of streets, paths and other hard surfaces by minimising cover and using alternative strategies such as bioretention or permeable pavement.

- Advocate open space design development incorporating smaller lot sizes to minimise total impervious area, reduce total construction costs, conserve natural areas, provide community recreational space and promote catchment protection.
- Relax side yard setbacks and allow narrower frontages to reduce total road length and overall site imperviousness. Relax front setback requirements to minimise driveway lengths.
- Promote more flexible design standards for residential subdivision footpaths. Consider locating footpaths only on one side of the street and provide common walkways linking pedestrian access.
- Reduce overall lot imperviousness by promoting alternative driveway surfaces and shared driveways that connect two or more homes together.
- Disconnecting rain gutters from the stormwater system and redirecting the flow into grass swales, bioretention systems and other functional landscape devices. As long as the stormwater is transported well away from foundations, concerns of structural damage and basement flooding can be alleviated.
- Rain gutter flows can be directed into rain barrels or cisterns for later use in irrigating lawns and gardens.

Links

Low Impact Development
(http://www.asu.edu/caed/proceedings98/Coffmn.html)
(http://www.epa.gov/owowwtr1/watershed/Proceed/coffman.html)
(http://www.epa.gov/owow/nps/lid.pdf)
Rainwater Harvesting
(http://www.oas.org/usde/publications/Unit/oea59e/ch10.htm)
Vegetated Roof Cover
(http://www.epa.gov/owow/nps/roofcover.pdf)
(http://www.epa.gov/owow/nps/lid.pdf)
Bioretention
(http://depts.washington.edu/cuwrm/research/rc2.htm)
(http://www.fxbrowne.com/html/gs-facts/biortn.pdf)
(http://www.epa.gov/owow/nps/lid.pdf)
Permeable Pavement
(http://www.epa.gov/owow/nps/pavements.pdf)
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Grass Swales
(http://www.epa.gov/owow/nps/lid.pdf)
Other Lid Strategies
(http://www.epa.gov/owow/nps/lid.pdf)
Site Planning
(http://www.cwp.org/better.htm)