Bioswales

Challenge: Too much water **Adaptation response:** Urban storm water management

Description

Bioswales are strips of vegetated areas that redirect and filter storm water. A typical bioswale is a long, linear strip of vegetation in an urban setting used to collect runoff water from large impermeable surfaces such as roads and parking lots. Bioswales serve a similar purpose to that of gutters. The advantage of using bioswales is that the vegetation and soil in them slows down and collects water, allowing it to infiltrate soil, in addition to filtering pollutants. The current increase in storm frequency and scale can result in sewage or other polluted water overflow, making bioswales important for climate change adaptation.

Bioswales are often found parallel to long roads as they require a long and straight area to increase retention and filtration time. Bioswales' slanted walls direct rain into the vegetated depressions. In some cases, check dams are built in the bioswale to further reduce water flow velocity.

Implementation

An analysis of local rainfall distribution and evapotranspiration patterns and existing absorption capacity of drainage systems informs bioswale siting and capacity. Soil and plants that improve infiltration capacity should be selected. Using native species helps avoid potential negative environmental consequences related to introduction of non-native species. While there are various bioswale building methods, typical construction activities would include digging a linear depression with slanted walls, adding a layer of gravel for stabilization and drainage, adding an additional layer of soil/compost mixture on top of the gravel, planting vegetation in the soil, and building check dams if necessary. Regular monitoring to ensure efficiency is necessary. Additional maintenance such as removal of non-native plant species, system redesign to improve direction of storm water into it, and cleaning to prevent clogging, may also be required.

Environmental Benefits

- Removes silt, heavy metals and other pollutants from storm water. This is important in urban settings, where concentrations of pollutants are high, particularly in proximity of roads.
- Provides water absorption and infiltration that improves recharge and helps avoid polluted water from entering groundwater.
- Results in a higher biodiversity value than alternative solutions such as gutters. Vegetation provides a diversity of flora that serves as a habitat for fauna.
- Promotes evaporation and does not absorb as much heat as paved surfaces reducing the urban heat island effect[1] in cities.
- Provides multiple benefits as a simple and low cost solution.

[1] Urban heat island effect is when cities are significantly warmer than their surroundings due to heat produced from human activity and technologies (cars, factories, appliances etc.), and the high concentration of buildings, which absorb heat much more than e.g. vegetation.

Socioeconomic Benefits

- Purifies water, which in turn decreases polluted water volume entering the drainage and sewer systems, subsequently reducing the costs of transporting and treating the water. Reduced loads on conventional storm water management systems may also help avoid extra expansion costs.
- Adds aesthetic and recreational value, improving quality of life for local communities. It may also help reduce sound pollution, if expanded to wider areas.

Opportunities and Barriers

Opportunities:

- Low cost technology
- Relatively simple and quick implementation
- Once bioswale vegetation has been established, little maintenance is required
- Multifunctional technology: it has aesthetic/recreational value as well as functional value

Barriers:

- Requires above ground space, which may be a barrier in densely populated areas
- Vegetation may fall prey to disease, invasive species or insects, which may require re-establishment

Implementation considerations*

Technological maturity:	4-5
Initial investment:	1-3
Operational costs:	1-2
Implementation timeframe:	1-3

* This adaptation technology brief includes a general assessment of four dimensions relating to implementation of the technology. It represents an indicative assessment scale of 1-5 as follows:
Technological maturity: 1 - in early stages of research and development, to 5 – fully mature and widely used
Initial investment: 1 – very low cost, to 5 – very high cost investment needed to implement technology
Operational costs: 1 – very low/no cost, to 5 – very high costs of operation and maintenance
Implementation timeframe: 1 – very quick to implement and reach desired capacity, to 5 – significant time investments needed to establish and/or reach full capacity
This assessment is to be used as an indication only and is to be seen as relative to the other technologies included in this guide. More specific costs and timelines are to be identified as relevant for the specific technology and geography.

Sources and further information

CNT & American Rivers (2010). Center for Neighborhood Technology and American Rivers, The Value of Green Infrastructure. A Guide to Recognizing its Economic, Environmental and Social Benefits. Available at: http://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf

CVC & TRCA (2010). Low Impact Development Stormwater Management Planning and Design Guide, *Version 1*, Credit Valley Conservation Authority and Toronto and Region Conservation Authority. Available at: http://www.creditvalleyca.ca/wp-content/uploads/2014/04/LID-SWM-Guide-v1.0_2010_1_no-appendices.pdf

EC (2012). European Commission, the Multifunctionality of Green Infrastructure, *Science for Environment Policy*. Available at: *ec.europa.eu/environment/nature/ecosystems/docs/Green_Infrastructure.pdf*

Ecoadapt.org (n.d.). Improve Your Project's Success: Consider Climate Change and Adaptation. Freshwater Future, EcoAdapt. Available at: http://ecoadapt.org/data/documents/Climate101FactSheet.pdf

NACTO (2016). Urban Street Design Guide, Bioswales. National Association of City Transportation Officials. Available at: http://nacto.org/publication/urban-street-design-guide/street-design-elements/stormwater-management/bioswales/

Soil Science Society of America (2014). Rain Gardens and Bioswales. Available at: https://www.soils.org/discover-soils/soils-in-the-city/green-infrastructure/important-terms/rain-gardens-bioswales

UNEP (2014). Green Infrastructure Guide for Water Management: Ecosystem-based management approaches for water related infrastructure projects. UNEP-DHI, IUCN, TNC, WRI, Green Community Ventures, U.S. Army Corps of Engineers.

Yocum, D. (n.d.). Design Manual: Biological Filtration Canal (Bioswale). Bren School of Environmental Science and Management, University of California, Santa Barbara. Available at: http://fiesta.bren.ucsb.edu/~chiapas2/Water%20Management_files/Bioswales-1.pdf