Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 3, Issue 4; April-June, 2016, pp. 323-326

http://www.krishisanskriti.org/Publication.html

Importance of Swale

Sumpa Dey

M.Tech, 2nd Sem, CEM, SRM University
E-mail: sumpadey13@gmail.com

Abstract—*The swale concept has been popularized as a rainwater harvesting and soil conservation strategy. A swale is a low tract of land, especially one that is moist or marshy. Artificial swales are often designed to manage water runoff, filter pollutants, and increase rainwater infiltration. In this context it usually refers to a water-harvesting ditch on contour. Swales are great for filling dams anywhere except for arid or hyper-arid environments, where it would dry up too quickly. In this way, the swale fulfils three important functions: it carries water from the ditch to fill the dam, it rehydrates the landscape, and it prevents the dam from overflowing by acting as a channel back to the ditch. The purpose of this paper is to know about the importance of swale as it is good removal of urban pollutants and its capital cost is low. It is designed to slow and capture runoff by spreading it horizontally across the landscape along an elevation contour line, facilitating runoff infiltration into the soil. This type of swale is created by digging a ditch on contour and piling the dirt on the downhill side of the ditch to create a berm. In arid climates, vegetation (existing or planted) along the swale can benefit from the concentration of runoff. Trees and shrubs along the swale can provide shade which decreases water evaporation.*

1. INTRODUCTION

Swales are long, narrow and usually shallow channels designed to store or convey runoff and remove pollutants. They may be used as conveyance structure to pass the runoff to the next stage of the treatment train and can be designed to promote inflation where soil and groundwater condition allow. Check dams and berm also can be installed across the flow path of a swale in order to promote settling and infiltration. In other words these are water-harvesting ditches, built on the contour of a landscape. Most ditches are designed to move water away from an area, so the bottom of the ditch is built on a modest slope, usually between 200:1 to 400:1. Simply put, swales are water-harvesting ditches, built on the contour of a landscape.

Swales, however, are flat on the bottom because they're designed to do the opposite; they slow water down to a standstill, eliminate erosion, infiltrate the surrounding area with water, and recharge the groundwater table. When water moves along the flat bottom of a swale, it fills it up like a bathtub that is; all parts of the bath tub fill at the same rate. The water in a swale is therefore passive; it doesn't flow the way it would on a slope. To install a swale, we have to find a contour line. A contour is a horizontal line (with a constant elevation), along a landscape. The term swale or "beach swale" is also used to describe long, narrow, usually shallow troughs between ridges or sandbars on a beach that run parallel to the shoreline.

Artificial swales are often designed to manage water runoff, filter pollutants, and increase rainwater infiltration. The maximum or permissible velocity for a given swale depends on

a) The soil's resistance to erosion
b) Type of grass
c) Height of grass
d) Slope of swale

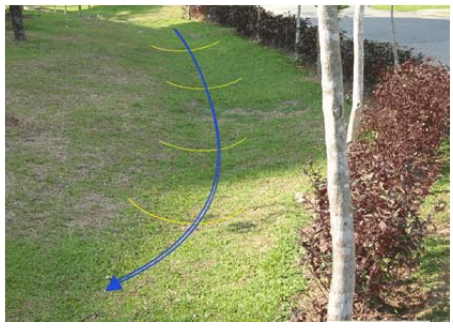

Fig. 1: Swale

2. OBJECTIVE

The objectives are as follows:

a) Limit erosion damage by making sure permissible velocity in not exceeded during peak flow
b) Ensure sufficient capacity to accommodate peak flow

3. FUNCTION OF SWALE

In general, swales are designed to:

a) Slow water down to standstill
b) Eliminate erosion

c) Infiltrate the surrounding with water

d) It carries water from the ditch to fill the dam

e) It rehydrates the landscape

f) It prevents the dam from overflowing by acting as a channel back to the ditch

4. TYPES OF SWALE

Swales are categorized mainly as dry swale and wet swale.

4.1 Dry swale

Dry swales are above the groundwater, such that they only hold water above the soil surface temporarily. A dry swale is a shallow, gently sloping channel with broad, vegetated, side slopes. Water flow is slowed by a series of check dams. A dry swale provides temporary storage, filtration, and infiltration of storm water runoff. Dry swales function similarly to bio retention, and are comparable to wet swales; however, unlike a wet swale, a dry swale should remain dry during periods of no rainfall. It is an engineered best management practice (BMP) that is designed to reduce pollution through runoff reduction and pollutant removal and is part of a site's storm water treatment practice. A dry swale is versatile because the area it requires is relatively small. It can be used in place of curbs, gutters, and sewer systems. Depending on the soil permeability, the water either infiltrates the soil or recharges groundwater, or it is collected in the under drain and directed toward the storm water conveyance system. Dry swales are effective at removing excess nutrients and sediment and significantly reducing runoff.

Fig. 2: Dry Swale

4.1.1 Function of dry swale

a) It effectively reduces and retards peak runoff by acting like a buffer or shock absorber for flows
b) It temporarily stores and then filters runoff
c) It uses in low to moderate density developments

4.2 Wet Swale

Wet swales intersect the groundwater, and behave almost like linear constructed wetlands. Wet swales can provide runoff filtering and treatment within the conveyance system and are a cross between a wetland and a swale. It is easy to design and can be built in relatively impervious soils or in seasonally saturated soils or intersecting water table. It creates visually appealing and beneficial habitat between uplands and surface waters. These are less expensive to build and maintain than a traditional curb and gutter system.

Fig. 3: Wet Swale

4.2.1 Function of wet swale

a) It traps and removes sediments and other pollutants with increased efficiency and thus improves water quality.
b) It functions as a linear wetlands
c) It reduces peak flows and runoff velocity and promote infiltration
d) It provide effective pre-treatment of storm water passing through for further processing by additional storm water management practices

5. DIFFERENT FORMS OF SWALE

Different forms of swales are as follows:

5.1 Grass Swale

A grassed swale is a graded and engineered landscape feature appearing as a linear, shallow, open channel with trapezoidal or parabolic shape. The swale is vegetated with flood tolerant, erosion resistant plants. The design of grassed swales promotes the conveyance of storm water at a slower, controlled rate and acts as a filter medium removing pollutants and allowing storm water infiltration. When it is properly designed to accommodate a predetermined storm event volume, a grassed swale results in a significant improvement over the traditional drainage ditch in both slowing and cleaning of water. Swales are a low cost low maintenance option to remove sediments, nutrients and pollutants. They increase storm water infiltration and add a visually aesthetic component to a site. Establishment of grassed swales is a potential solution wherever storm water needs to be transported from impervious surfaces, slowed down and allowed to infiltrate into soils.

Fig. 4: Grass Swale

5.2 Rock Swale

Rock swales are conveyance systems designed, shaped, and lined to convey surface runoff in a non-erosive manner downstream, preferably to a treatment and infiltration system. Rock swales may decrease the velocity of water and facilitate some infiltration. High maintenance costs can reduce the effectiveness of rock-lined channel. They are effective if properly designed and installed as part of a drainage system.

Fig. 5: Rock Swale

5.3 Concrete swale

Concrete swales are concrete channels used to catch and direct surface runoff. Construction involves the installation of a concrete channel, 12", 18", and 24" or more wide, 4 or more inches thick installed across the length of the area to be protected. Steel reinforcement bars are embedded in the concrete to provide strength. Concrete swales convert sheet flow and pipe flow to channel flow in order to transport water. An A/C swale has no water quality benefit alone; however, in a developed watershed it is often a required component of a drainage system that as a whole has a water quality benefit. It converts sheet flow to channel flow, which increases flow velocities and erosive energy. Paved swales do not infiltrate storm water and concentrates the volume of runoff.

Fig. 6: Concrete Swale

5.4 Grass swale with check dams

Small temporary stone dams are constructed across a swale is known as grass swale with check dam. Check dams are used to create shallow pools of water that reduce the velocity of runoff through the channel while also promoting infiltration. Check dams are effective in reducing flow velocity and thereby the potential for channel erosion. It traps sediment generated from adjacent area mainly by ponding of storm water runoff. It can be used where temporary swales which, because of their short length of service, cannot receive non erodible lining but still need protection to reduce erosion.

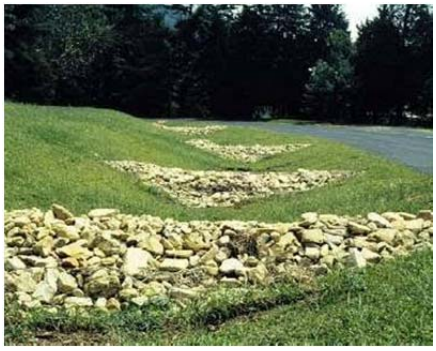

Fig. 7: Grass swale with check dams

6. ADVANTAGES OF SWALE

i. Easy to incorporate into landscaping
ii. Good removal of urban pollutants
iii. Reduces runoff rates and volumes
iv. Low capital cost
v. Maintenance can be incorporate into general landscape management
vi. Pollution blockage are visible and easily dealt with

7. DISADVANTAGES OF SWALE

i. Not suitable for steep areas with roadside parking

ii. Risks of blockages in connecting pipe work

8. MAINTENANCE OF SWALE

It includes:

i. Debris removal

ii. Grass cutting and removal of grass cutting

iii. Repair of eroded or damaged areas.

9. LIMITATIONS

a) Grassed swales are not recommended for large drainage areas.

b) Grassed swales are a cheap alternative to curbs and gutters; however their efficacy is dependent on careful design and construction, a thoughtful selection of plants as well as provision of dependable maintenance over time. Badly designed grass swales will not remove significant quantities of pollutants.

c) If vegetation is not sufficiently established the swale will not function.

d) Wet swales should not be used in high density residential areas because of potential for mosquito generation and smells.

e) Grassed swales are not the best management practice for:

   i. Ultra urban areas because the areas of pervious surfaces required for swale development are usually unavailable.

   ii. Storm water hot spots where land use will generate storm water with high levels of contaminants.

f) In cold weather climates, adjustments to design and maintenance must occur to deal with high snow loads and significant frost depths.

g) Groundwater contamination could result from dry swale use in commercial and industrial areas. This is due to increased infiltration into the water table and potential contaminants.

REFERENCES

[1] https://en.wikipedia.org/wiki/Swale_(landform)

[2] http://www.lakesuperiorstreams.org/stormwater/toolkit/swales.html

[3] http://www.susdrain.org/delivering-suds/using-suds/suds-components/swales-and-conveyance-channels/swales.html