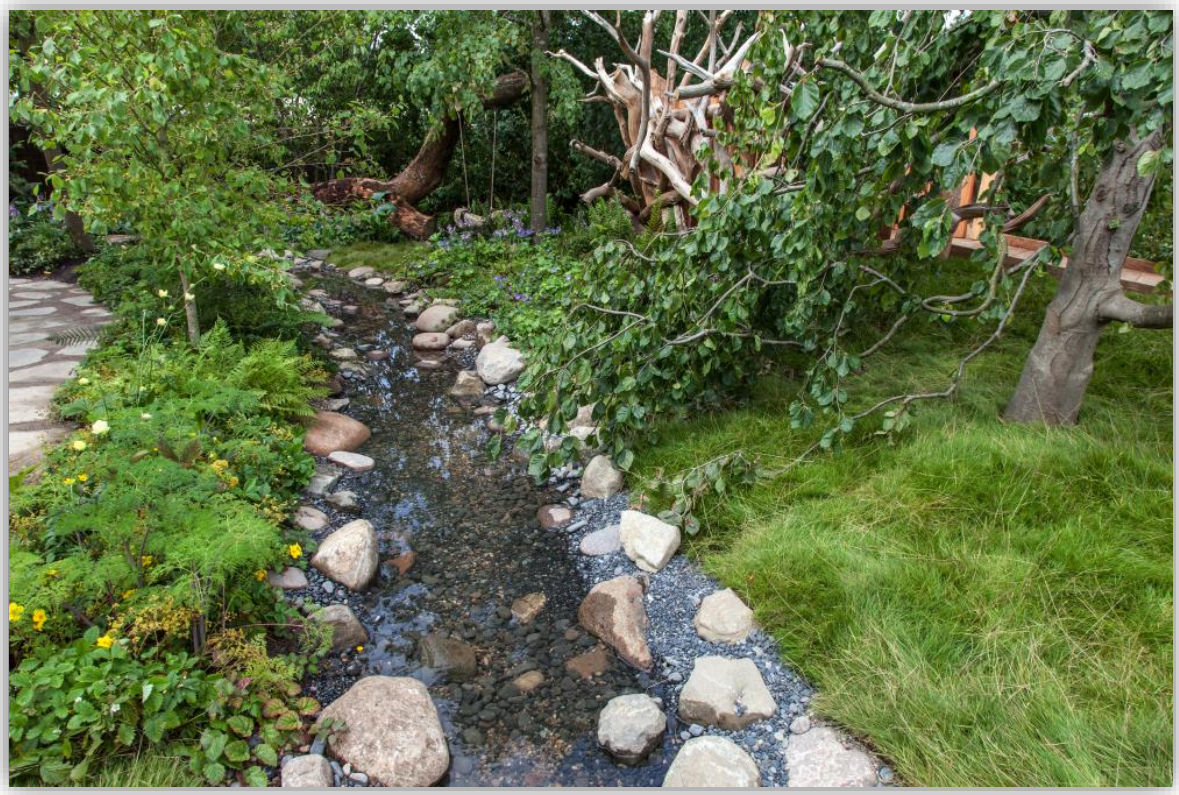
What is the purpose of an Open Channel?

The most basic way to drain off rain and stormwater is via **Open Channels**. Open channels are natural or manmade conveyance structures that normally have an open top, and they include rivers, streams and estuaries. An important characteristic of open-channel flow is that it has a free surface at atmospheric pressure. Open channel flow transports water by gravity with a free surface exposed to the atmosphere.

The main goal of open channels is to convey stormwater runoff from the site without damage to adjacent properties or developments; to retention zones (dry or wet); or to the storm drainage system connected to it.



Classification of Channel Types

Type 1: Natural Channels:
Natural open channels include all channels that exist naturally on the earth. They are generally very irregular in shape.

Type 1: Artificial Channels:
Artificial open channels are the channels develops by men. They are usually designed with regular geometric shapes.
Example: Irrigation canals, laboratory flumes, spillway chutes, drops, culverts, roadside gutters, etc.

Type 2: Prismatic Channels:
A channel with unvarying cross-section and the constant bottom slope is called a prismatic channel. All artificial channels are usually prismatic. The rectangular, trapezoid, parabola and circle are the most commonly used shapes of prismatic channels.

Type 2: Non-prismatic Channels:
A channel with either varying cross-section or the varying bottom slope is called a non-prismatic channel. The natural channels are usually prismatic.

Type 3: Rigid Boundary Channels:
A channel with an immovable bed and sides is known as a rigid boundary channel. Example: Lined canals, sewers, and non-erodible unlined canals.

Type 3: Mobile Boundary Channels:
If a channel boundary is composed of loose sedimentary particles moving under the action of flowing water, the channel is called a mobile boundary channel.

Type 4: Small Slope Channels
An open channel having a bottom slope of less than 1 in 10 is called a channel of small slope. The slopes of ordinary channels, natural or artificial, are far less than 1 in 10.

Type 4: Large Slope Channels
An open channel having a bottom slope greater than 1 in 10 is called a channel of small slope. Some artificial channels like drops and chutes have far more than 1 in 10.

Water Quality Swales and Grass Channels

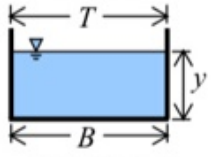
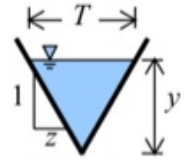
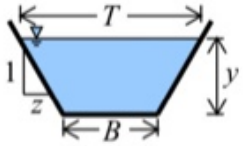
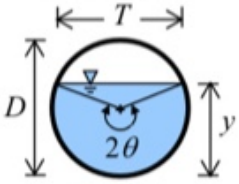
Water quality swales and **grass channels**, on the other hand, are designed for the required water quality volume and incorporate specific features to enhance their stormwater pollutant removal effectiveness. Pollutant removal rates are significantly higher for water quality swales and grass channels. A water quality swale or **grass channel** must be used in place of the drainage channel when a water quality treatment credit is sought.

Calculating the Open Channel Size:

Any of the principal methods of discharge measurement outlined below can be used to measure open channel flow. Some methods are more accurate than others while some methods measure a large range of discharge. Stormwater is variable and thus the method for measuring stormwater discharge must be able to measure small values of discharge accurately while also having the capacity to measure large values of discharge.

In an open channel flow, if the flow parameters such as depth of flow, the velocity of flow and the rate of flow at a particular point on the fluid do not change with respect to time, then it is called as **steady flow**. If v is the velocity of the fluid, Q is the rate of flow and d is the depth of flow, then for a steady flow: dv/dt = 0; dQ / dt = 0; dy /dt = 0;

And is at any point on the open channel flow, the flow parameters like depth of flow, the velocity of flow and rate of flow do change their value with respect to time, then it is called as an **unsteady flow**. It is hence given by: dv/dt, dQ / dt and dy / dt not equal to Zero.

Section	Area A	Top width T	Wetted perimeter P
 Rectangular	By	B	$B+2y$
 Triangular	zy^2	$2zy$	$2y\sqrt{1+z^2}$
 Trapezoidal	$By+zy^2$	$B+2zy$	$B+2y\sqrt{1+z^2}$
 Circular	$\frac{D^2}{8}(2\theta-\sin 2\theta)$	$D\sin\theta$	θD

Erosion prevention practices - RIPRAP

Riprap is a permanent layer of large angular stone, cobbles, or boulders typically used to stabilize, and protect the soil surface against erosion in areas of concentrated flow or wave energy. Riprap is typically placed along graded ditch, channel, and shoreline banks over geotextile, which prevents erosional undercutting. It can also be used with other mixed size rock to construct retention berms for sediment traps protecting high volume/velocity culvert inlets.

Operation and Maintenance

Keeping drains free of refuse poses a problematical obstacle. Unfortunately, it is commonly believed that a drain is a convenient place for depositing solid waste, wastewater, greywater and even fecal sludge, especially where there is no adequate refuse or wastewater collection service.

Refuse and fecal matter in drains quickly becomes malodorous as it decomposes and poses as a suitable medium for flies and mosquitoes for egg-laying and as a hospitable site for many pathogenic bacteria and viruses. Removal of such material is not a popular task, but crucial for protecting the public health.

However, the most important issues to optimize existing open drain systems are: preventing overflow and waste entering the system. To prevent fecal matter and solid waste from entering the system is to cover the drains and provide adequate wastewater treatment and collection systems as well as solid waste management.

The main duties and responsibilities for operation and maintenance of an open channel drainage system are:

- Routine cleaning: Trash, dirt, or excessive sediment clogging or obstructing outlets.
- Reporting of defects and blockages
- Erosion on the slopes or at the top of the head wall.
- Excessive vegetation around and surrounding the pond.
- Pilot channels should be clear and open.
- Pipes in the inlet and outlet are in good shape

Open Rock-lined Channel Maintenance:

- Channels should periodically and after significant storm events. Check for scour or dislodges rock. Repair damage areas immediately.
- Closely inspect the outer edges of the rock protection. Ensure water entry into the channel or chute is not causing erosion along the edge of the rock protection.
- Carefully check the stability of the rock looking for indications of piping, scour holes, or bank erosion.
- Replace any displaced rock with rock of a significantly (minimum 110%) larger size than the displaced rock.

Backing Material or Filter Layer

Non-vegetated armour rock must be placed over a layer of suitably graded filter rock or geotextile filter cloth (minimum 'bidim' A24 or equivalent). The geotextile filter cloth must have sufficient strength and must be suitably overlapped to withstand the placement of the rock.

Armour rock that is intended to be vegetated by appropriately filling all voids with soil and pocket planting generally will usually not require an underlying filter layer, unless the long-term viability of the vegetation is questioned due to possible high scour velocities, or limited natural light or rainfall conditions.

If the soils adjacent to the rock surface are dispersive (e.g. sodic soils), then **prior** to placing the filter cloth or filter layer, the exposed bank **must** first be covered with a layer of non-dispersive soil (Figure 2), typically minimum 200mm thickness, but preferably 300mm.

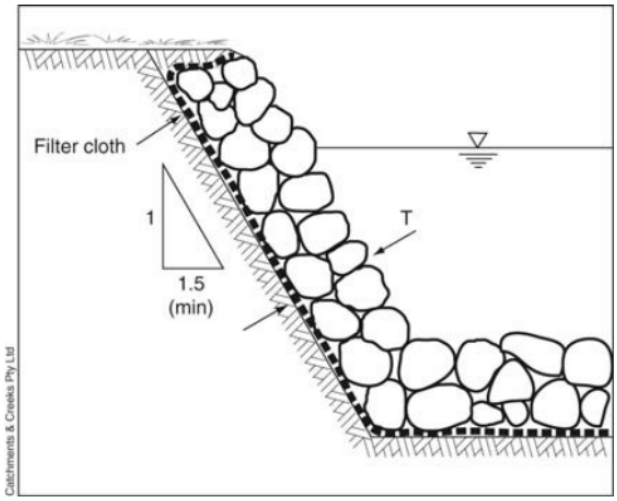


Figure 1 – Rock placement (without vegetation) on non-dispersive soil

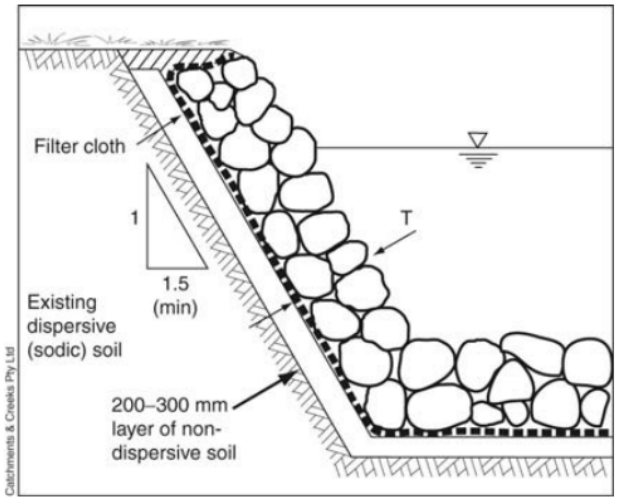


Figure 2 – Rock placement (without vegetation) on dispersive soil

Placement of Rock

It is important to ensure that the top of the rock surface is level with, or slightly below, the surrounding land surface to allow the free entry of water including lateral inflows (if required) as shown in Figure 4.

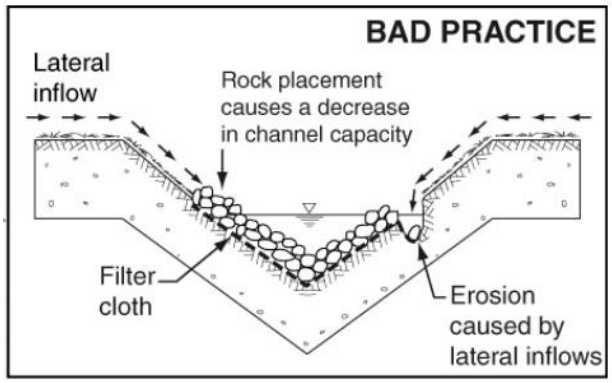


Figure 3 – Incorrect placement of rock causing loss of flow area and erosion along the outer limits of the rock

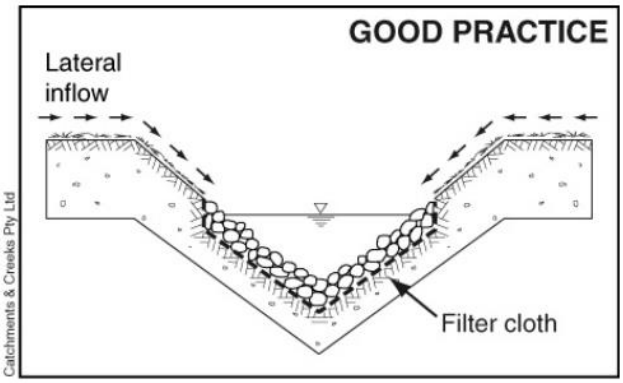


Figure 4 – Rock recessed into the soil to allow the free entry of lateral inflows