

Source: Modified from Knoxville BMP Manual, 2003.

Description	Flared culvert end sections are devices placed at the inlet or outlet of pipes and channels to enhance hydraulic operation while minimizing scour and erosion.
Applications	Flared culvert end sections may be placed at inlets and outlets of slope drains and culverts.
Installation and Implementation Requirements	<ul style="list-style-type: none">• Construct on level ground where possible.• Supplement with other outlet protection.• Protect the transition to the flared end section at inlets to prevent scouring.• Obtain guidance from the District Maintenance Engineer or Highways Division's Hydraulic Section and refer to Highways Division's Standard Plans.
Limitations	Limited use as an erosion control measure since primarily used to increase hydraulic efficiency.
Inspections and Maintenance	<ul style="list-style-type: none">• Establish an inspection schedule and conduct inspections.• Monitor accumulation of debris and sediment and remove within 60 days of notification. Immediately clean culverts located where Class AA or Class 1 waters or highway safety may be adversely affected. Refer to HAR Chapter 11-54 for State waters classification.• Inspect around and beneath flared end sections for scour. Report any scour for evaluation by the HWY-OM Engineer or Highway Design Section, as appropriate.• Establish a repair schedule with priorities based on highway safety and protection of Class AA and Class 1 waters, followed by erosion

Flared Culvert End Sections

EC-4

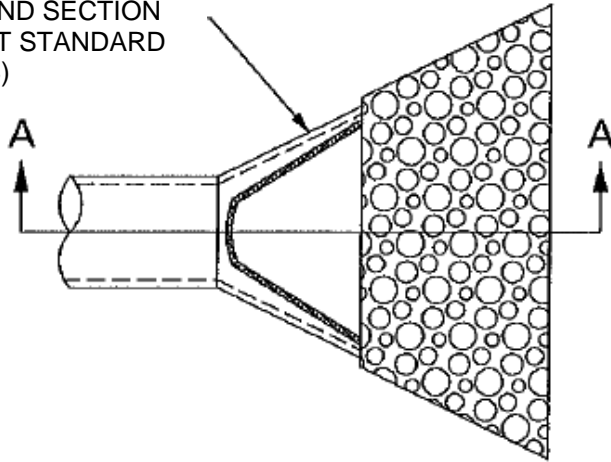
**Inspections and
Maintenance
(Continued)**

potential and possible damage to down-slope areas.

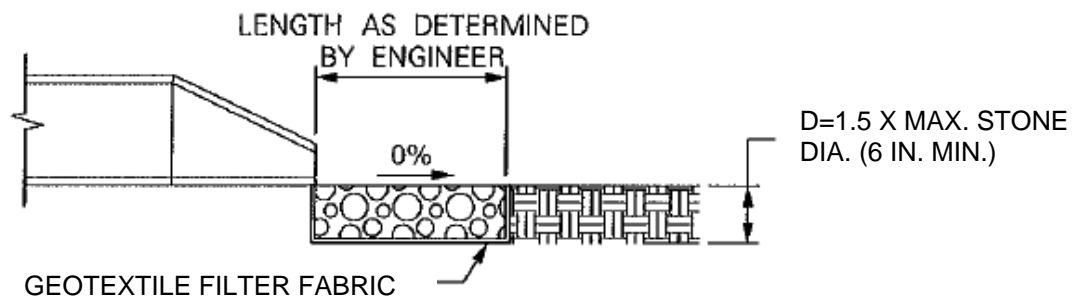
Flared culvert End Sections

EC-4

FLARED END SECTION
(SEE HDOT STANDARD
PLAN H-18)



PLAN
NTS

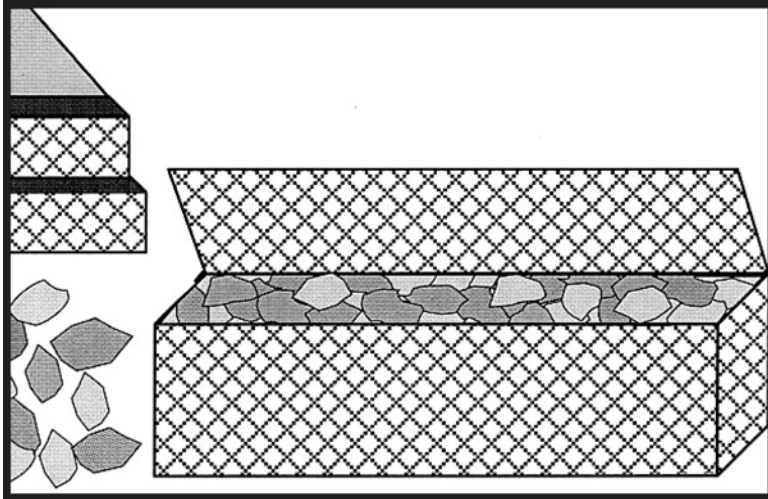


SECTION A-A
NTS

FLARED CULVERT END SECTION

Rip-Rap & Gabion Inflow Protection

SC-3



Source: Knoxville BMP Manual, 2003.

Description

Lined drainageway to stabilize the flow channel along steep slopes.

Applications

- Use of rip-rap inflow protection applies to slopes between 10:1 and 4:1 (H:V).
- Use of gabion inflow protection applies to slopes exceeding 4:1 (H:V).

Installation and Implementation Requirements

RIP-RAP

- 2:1 (H:V) side slopes, 3 feet minimum bottom width, and 1 foot minimum depth.
- Line channel with 4 to 12 inches rip-rap at a depth of 18 inches.
- Install geotextile filter fabric under all rip-rap.
- Blend rip-rap into existing ground.
- Refer to Rip-rap Inflow Protection detail for installation of entrances and exits.
- Gabion inflow protection may be used in lieu of rip-rap inflow protection, see below.

GABION

- Construct 2:1 (H:V) side slopes, 3 feet bottom width, and 1 foot deep from 9' x 3' x 9" gabion baskets.
- Install geotextile filter fabric under all gabion baskets.
- Fill gabion baskets with 4" to 7" stone.
- Install gabions in accordance with manufacturer's recommendations.

Rip-Rap & Gabion Inflow Protection

SC-3

Limitations

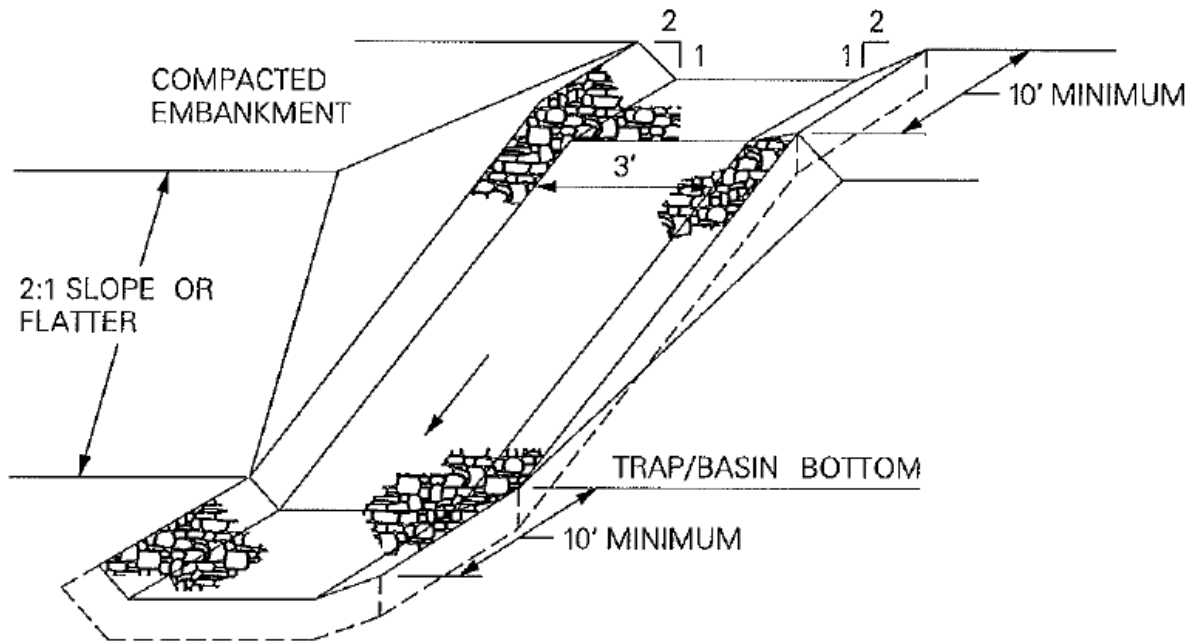
None

**Inspections and
Maintenance**

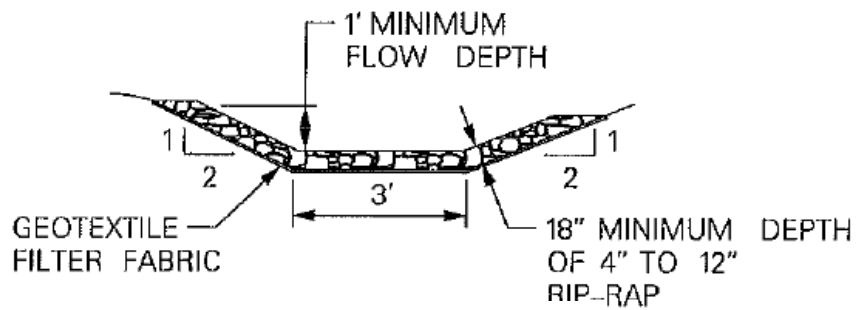
- Inspect weekly during dry periods as well as within 24 hours of any rainfall of 0.5 inch or greater which occurs in a 24-hour period and daily during periods of prolonged rainfall.
- Remove accumulated sediment at inlet structure.

Rip-rap Gabion Inflow Protection

SC-3



PERSPECTIVE VIEW
NTS



CROSS SECTION
NTS

RIP-RAP INFLOW PROTECTION NTS

Source: Maryland Standards and Specifications for Soil Erosion and Sediment Control, 1994.

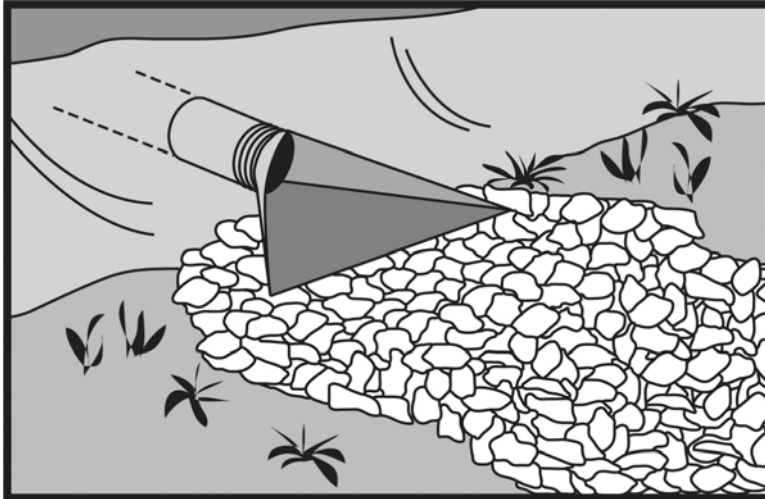
SC-3



January 2008

Outlet Protection and Velocity Dissipation Devices

SC-4



Source: Knoxville BMP Manual, 2003.

Description	Devices placed at outlets of pipes and channels to prevent or minimize scouring and erosion resulting from the high velocity of storm water flows.
Applications	<ul style="list-style-type: none">• Outlets with continuous flows.• Outlets located at the bottom of slopes.• Outlets subject to short, intense flows.• Discharge points from lined conveyances to unlined conveyances.
Installation and Implementation Requirements	<ul style="list-style-type: none">• Apron length shall be determined by outlet flow rate and tailwater level.• Align apron with direction of flow and avoid curves in apron. If a curve is necessary, place it in the upper section of the apron.• Protect the underlying geotextile filter fabric with a 4 inches minimum rock blanket if the rip-rap is 12 inches or larger.
Limitations	<ul style="list-style-type: none">• Potential for stones to wash away.• Break up of grouted rip-rap resulting from hydrostatic pressure caused by water accumulation.
Inspections and Maintenance	<ul style="list-style-type: none">• Establish an inspection schedule for all structures.• Inspect beneath the rip-rap and around the outlet for scour. Immediately repair damaged slopes or underlying geotextile filter fabric with priorities based on highway safety and protection of Class AA and Class 1 waters, followed by erosion potential and possible damage to down-slope areas.

Outlet Protection and Velocity Dissipation Devices

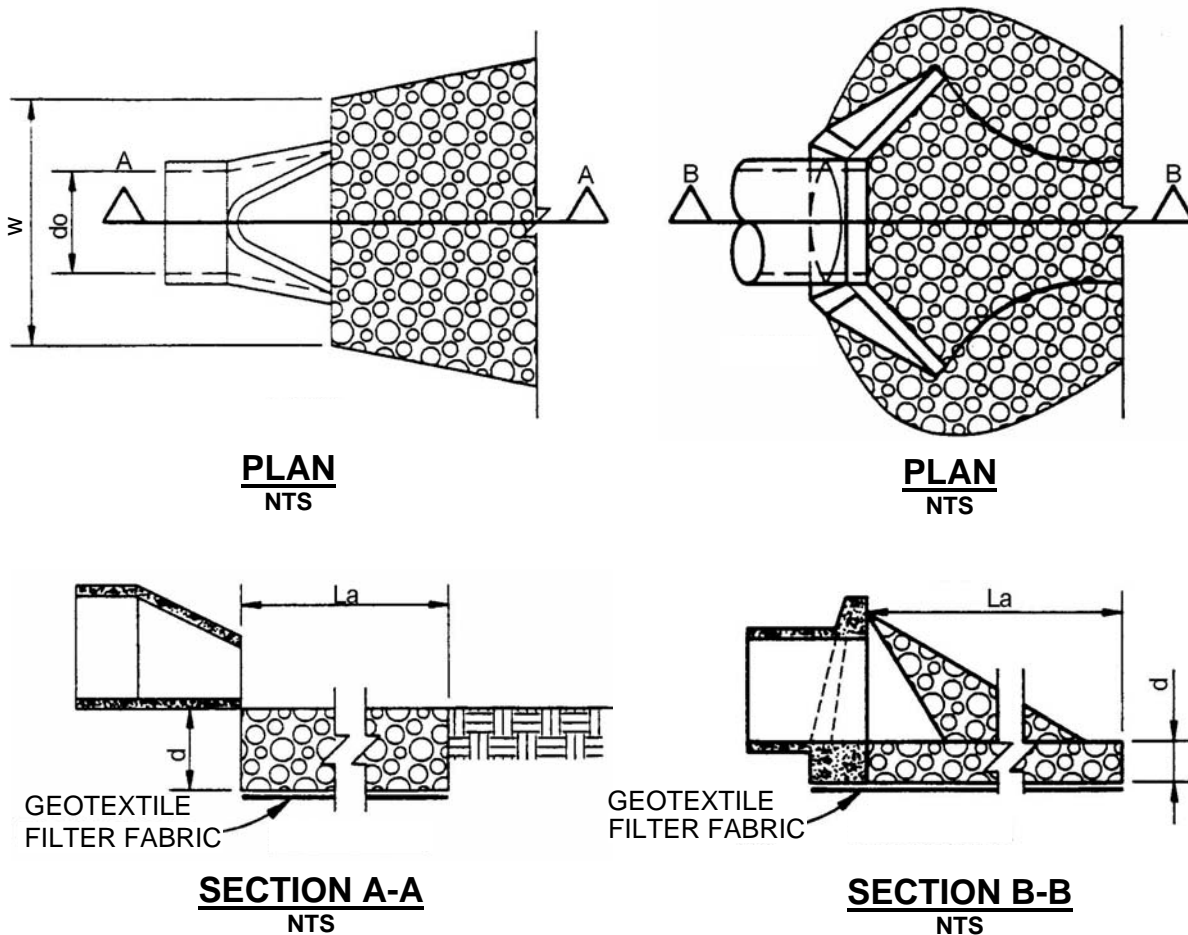
SC-4

**Inspections and
Maintenance
(Continued)**

- Inspect apron for damage to underlying geotextile filter fabric or dislodged rip-rap. Report any damage exceeding 10% of the apron surface area for evaluation by the HWY-OM Engineer or Highway Design Section, as appropriate.

Outlet Protection and Velocity Dissipation Devices

SC-4

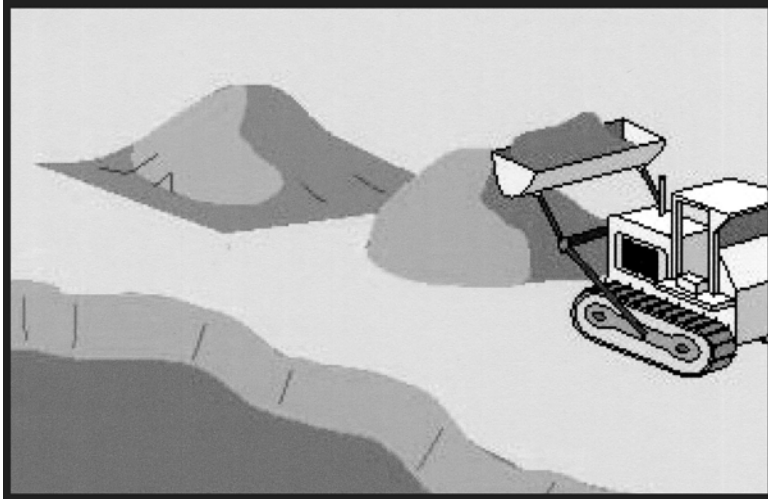


NOTES:

1. APRON LINING MAY BE RIP-RAP, GROUTED RIP-RAP, OR CONCRETE.
2. PIPE DIAMETER, APRON DIMENSIONS, AND AVERAGE ROCK SIZE FOR RIP-RAP ARE BASED ON THE DESIGN FLOW RATE AND VELOCITY. L_a AND ROCK SIZE MUST BE SET TO SLOW THE FLOW TO NON-EROSIVE VELOCITIES (e.g. LESS THAN 10 fps).
3. $d=1.5$ TIMES THE MAXIMUM ROCK SIZE DIAMETER BUT NOT LESS THAN 6 INCHES.

PIPE OUTLET CONDITIONS

Source: CCH Best Management Practices Manual for Construction Sites in Honolulu, 1999.



Source: Truckee Meadows Construction Best Management Practices Handbook, 2003.

Description

Reuse of native topsoil and other selected materials during revegetation activities. Salvaging, stockpiling, and reapplication of native topsoil are integral to successful revegetation efforts, especially for the reestablishment of native vegetation.

Applications

- Reestablishment of areas where vegetation with native plant species is desirable.
- Appropriate for sensitive habitat areas, floodplains, wetlands, and stream banks.

Installation and Implementation Requirements

- Conduct a site-specific soil survey of the area prior to soil disturbing activities to assess the location, depth, and amount of soils suitable for salvaging.
- Salvage and stockpile all suitable topsoil and other material for future use during revegetation of the area. Stockpile material in an area free of contamination from demolition or construction activities.
- Refer to SM-4 (Protection of Stockpiles) in this manual when stockpiling salvaged topsoil.
- Carefully remove shrubs suitable for revegetation and store with the roots covered with mulch or loose soil.
- Cover or stabilize soil stockpiles with temporary measures such as mulch or temporary vegetation.
- Apply topsoil or growth medium directly to disturbed areas when practicable.
- Soil replacement depths are determined by factors such as soil depth prior to disturbance, type of vegetation, and physical and/or chemical properties of the material to be covered. A deeper soil layer is required for soils with poor physical and chemical

Installation and Implementation Requirements (Continued)

properties. Testing (nutrients, pH, and toxicity factors) of replacement soils and material to be covered shall be completed prior to reapplication.

- Consideration of the following items is necessary when developing a topsoil management plan:
 - Quality and amount of native topsoil or growth medium;
 - Area of surface disturbance to which topsoil or growth medium will be applied and the required depth of application;
 - Methodology for salvaging topsoil or growth medium;
 - Stockpile location, duration of storage, and required erosion control measures to protect stockpile;
 - Feasibility of direct application of salvaged soils; and
 - Availability of other growth media to supplement topsoil reclamation.

Limitations

- Stockpiles may limit the area available for construction activity.
- Runoff from stockpiles may adversely impact water quality.

Inspections and Maintenance

- Regularly inspect stockpiles for erosion and stabilize as necessary.
- Inspect stockpile covers to ensure adequate protection from wind and rain.
- Adequately water plantings until they are established.