OUTLET PROTECTION

Outlet protection practices prevent scour erosion immediately downstream of pipe and channel outlets that discharge water from construction sites. They fall into the following two general categories:

- **Energy dissipation devices** │ These structural devices are placed downstream of outlets, in the path of concentrated flows, in order to interrupt flows, reduce water velocities and thereby lessen the potential for scour. Examples of common energy dissipating devices include check dams, wattles and baffle blocks (Figure B1-12). Level spreaders are also applied to dissipate energy and reduce water erosivity by forcing water to leave the outlet area as sheet flow.

- **Surface hardening / ground covers** │ Creating a more erosion-resistant surface is another important way to prevent scour from concentrated flows downstream of outlets. The greater and more concentrated the flow being discharged from the outlet, the more resilient the surface cover should be. Surface covers downstream of outlets can range from a soft-armored natural cover (e.g. RECP-reinforced vegetated area, thick and matted vegetative cover) to harder manufactured structures (e.g. concrete headwalls, riprap lining, flexible rubber mats).

Figure B1-12: Erosion blanket in an outlet area (top) and baffle blocks for energy dissipation (bottom)

Application

- At the base of any stormwater outlet releasing concentrated flow, including but not limited to: drainage tiles, detention facility outfalls, and piped or channel conveyance systems.
- Applied to mitigate scour erosion resulting from discharge ***leaving*** the site as well as discharges related to ***water movement within the active construction area*** (e.g. slope drain outlets, pumping and watercourse diversions).
- Need for outlet protection is greatest where flows are high and concentrated, and where discharge is being conveyed directly off the site and into a natural feature. In these cases, outlet protection is the last line of defense protecting the natural feature from erosion and sediment deposition.

Design and Installation

- Outlet protection measures should be designed to blend in with the surrounding natural environment as much as possible, incorporating vegetation and stone to create scour resistant surfaces. Where manufactured support structures are necessary due to high flow rates, they should be integrated with vegetation if possible.
- Providing adequate protection against scour at stormwater outlets typically requires at least some hard armoring, typically incorporating riprap. Riprap stone should be underlain with a geotextile (or graded aggregate filter), covered with a stone base, and be sized to resist the tractive forces of the flow from the outfall and, where applicable, the lateral flow of the receiving channel. Typically the minimum diameter of riprap stone should be 300 mm.

- Where stone (sub-angular recommended) is used for protection below an outlet in a natural feature, geotextile liners should not be installed below the stone, as this compromises the stream bed as a habitat for aquatic organisms.
- For outlets discharging to a flowing receiving channel, pipes and structures must be aligned to avoid erosion caused by lateral flows in the vicinity of the exposed structure.

A manufactured scour prevention and flow dissipation device that has been integrated with vegetation. The pictures depict the same area immediately following installation (left) and after vegetation has become established (right).

- Energy dissipation in the form of structural stilling basins, baffle (chute) blocks or other structural flow interrupters are often required for stormwater discharge velocities ≥ 3 m/s.
- Where the outlet discharges to a grass-lined ditches/channels, flow velocities should not exceed 1.2 m/s. Flows above this threshold will typically cause the channel to erode. If discharge velocities cannot be reduced or some of the flow diverted to a different outlet, then energy dissipation measures should be employed in the channel to slow down the water as it moves into and through the channel.
- Where level spreaders are applied they must be installed so that they are completely level, otherwise flows will concentrate at the low point instead of flowing uniformly over the spreader.
- Protection measures must be in place prior to any conveyance of runoff through the outlet structure.

Inspection and Maintenance

DISSIPATE AND DISPERSE

For temporary pipe outlets used during pumping and dewatering activities, consider using a ***sediment bag*** to ***dissipate*** and ***disperse concentrated discharge***.

- Inspect all stormwater outlets weekly, and before and after significant rainfall (see definition in Section 10.1.2) or snowmelt events, and keep a record of the inspection. Prioritize inspection and maintenance of outlets that discharge directly to natural features.
- Look for evidence of erosion downstream of the outlet and recommend options for either reinforcing/hardening the surface, dissipating energy through flow interruption, reducing flow from the outlet, or a combination of these solutions.
- Assess the degree of sediment accumulation behind energy dissipation devices. Sediment accumulated behind flow interrupters like baffle blocks, check dams, filter socks and wattles/logs should be removed when it has reached approximately 30% of the height of the device, or sooner if there is evidence that sediment is being re-suspended.
- If a sediment bag has been used to dissipate and disperse flow from an outlet, inspect the sediment bag to determine whether it requires changing or is damaged in any way. Additional guidance on sediment (dewatering) bags is provided in Appendix B2
- Assess whether there has been any shifting of structural components or structural damage to hard or soft armored surfaces downstream of outlets, and recommend the necessary maintenance and/or repairs.

- Any repair or maintenance needs identified should be repaired within 48 hours or sooner if natural receptors are at imminent and foreseeable risk of adverse impact.

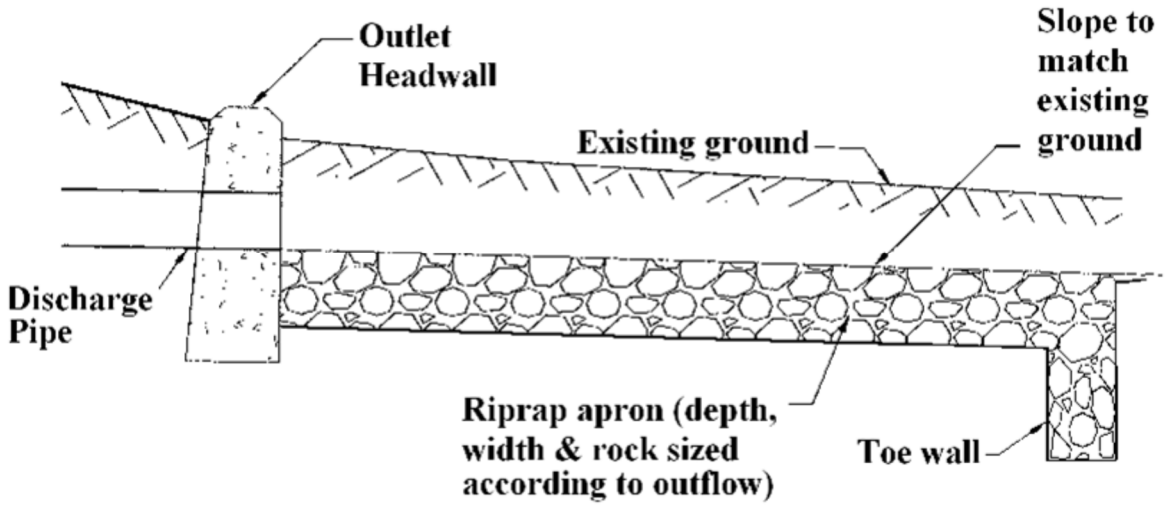

Figure B1-13: Storm drain outfall protection. Source: *Sediment & Erosion Control on Construction Sites – Field Guide* (University of Virgin Islands, 2003).