Chapter 4

Runoff Conveyance

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Check Dam (CD)

Description

A small temporary dam constructed across an area of concentrated flow to pond and slow the water to reduce channel erosion. Check dams (also referred to as “ditch checks”) trap only small amounts of sediment and are not sediment control devices. Check dams are to be used on internal drainage ditches, not in “live” streams. Check dams can be constructed of rock, wattles (sometimes referred to as tubes or rolls), sand bags, silt fence, or other materials acceptable to the design professional. Since check dams are to be installed to intercept concentrated flows, proper installation is absolutely paramount for the check dam to function properly and not fail structurally.

Installation (rock check dam)

- Space the check dams so that the center of each dam is approximately the same elevation as the back toe of the upstream dam (Figure CD-2).
- Remove debris and other unsuitable material from the check dam location.
- Install an 8 oz. non-woven geotextile underlayment that extends at least 3 feet upstream and downstream beyond the rock check dam. Bury and pin the upstream edge of the geotextile and pin all edges securely with staples every 10 inches on-center.
- Ensure the proper gradation of riprap is used.
- Construct the dam with side slopes of 2:1 or flatter.

- Construct the dam with a parabolic top with the center portion 6 to 12” lower in elevation than the outer edges so that the flow goes over the structure and not around the structure.
- If specified, place geotextile on the upstream face of the dam to increase impoundment efficiency for low-flow conditions.
- Check finished size, grade and shape for compliance with standard drawings and materials list or with specifications, if included in contract specifications.
- Stabilize the disturbed area with vegetation.

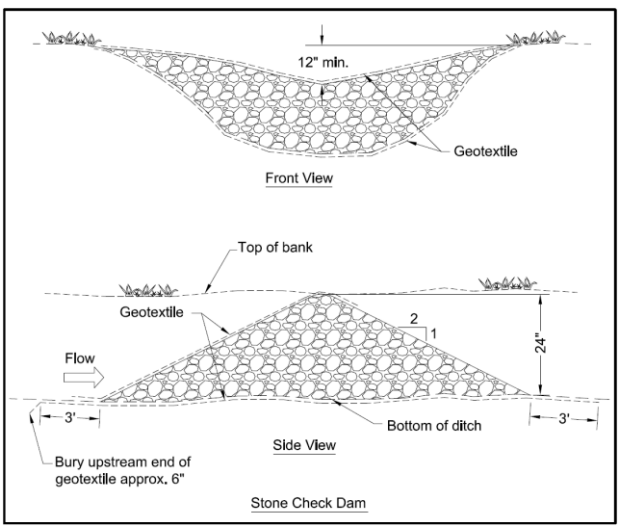

Figure CD-1 Views of a Typical Rock Check Dam

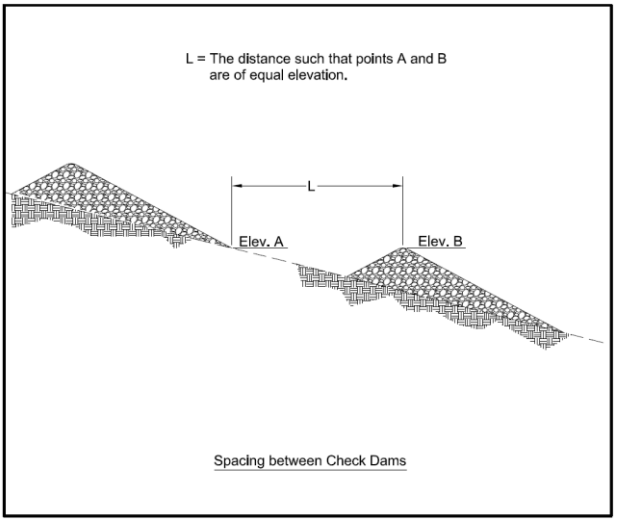

Figure CD-2 Profile of Typical Rock Check Dam

Installation (wattle check dam)

- Install an 8 oz. non-woven geotextile underlayment that extends at least 3 feet upstream and downstream beyond the wattle check dam. Bury and pin the upstream edge of the geotextile and pin all edges securely with staples every 10 inches on-center.
- Place the wattle in a "U" shape as shown in Figure CD-3.
- Staple the bottom of the wattle on 10-inch centers on each side of the wattle to keep it from floating during storm events.
- Place wooden stakes in a "t-pee" non-destructive fashion.

- If two wattles are needed to reach across the entire width of the channel, overlap the wattles at least 18 inches.

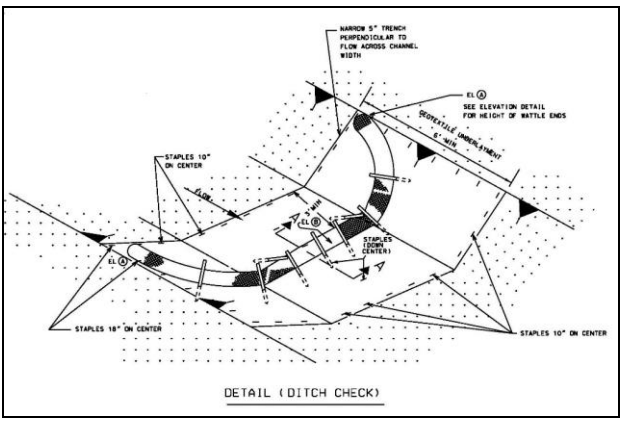

Figure CD-3 Wattle Check Dam

Figure CD-4 Wattle Check Dam
Photo courtesy of AU-ESCTF

Installation (silt fence check dam)

- Install an 8 oz. non-woven geotextile underlayment that extends at least 3 feet upstream and downstream beyond the silt fence check dam. Bury and pin the upstream edge of the geotextile and pin all edges securely with staples every 10 inches on-center.
- Install the silt fence in a "V" configuration with a notch in the fabric to ensure the maximum depth of flow is no greater than the depth of the channel.

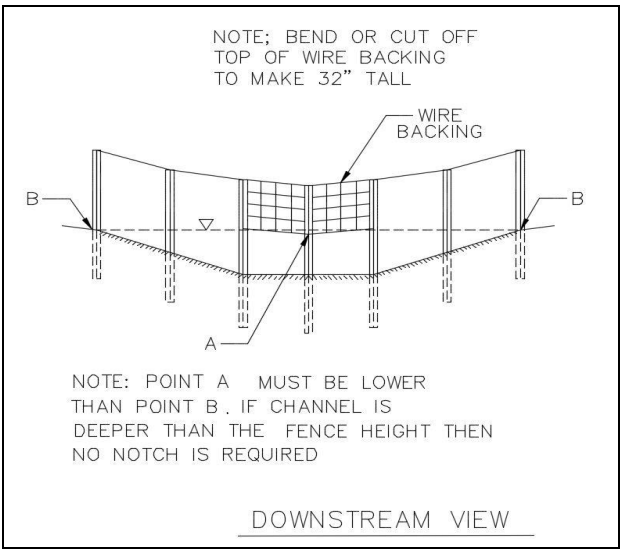

Figure CD-5 Silt Fence Check Dam Cross-Section

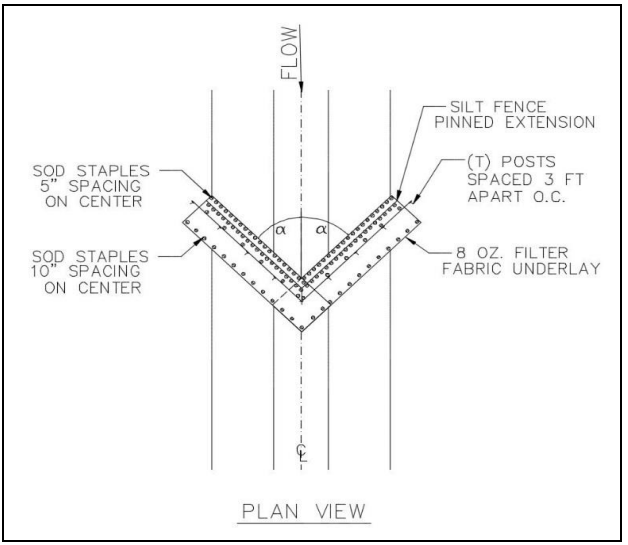

Figure CD-6 Silt Fence Check Dam Plan View

Figure CD-7 Silt Fence Check Dam

Installation (sand bag check dam)

- Install an 8 oz. non-woven geotextile underlayment that extends at least 3 feet upstream and downstream beyond the sand bag check dam. Bury and pin the upstream edge of the geotextile and pin all edges securely with staples every 10 inches on-center.
- Ensure the sand bags are properly oriented in an alternating stacking pattern.

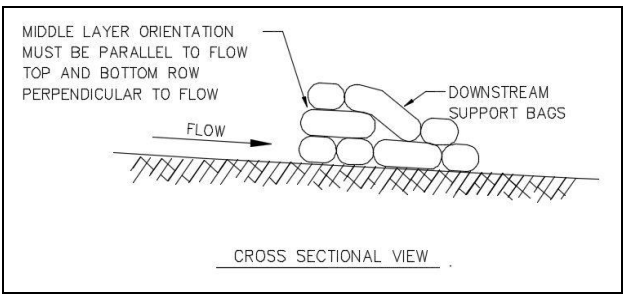

Figure CD-8 Sand Bag Check Dam Cross-Section

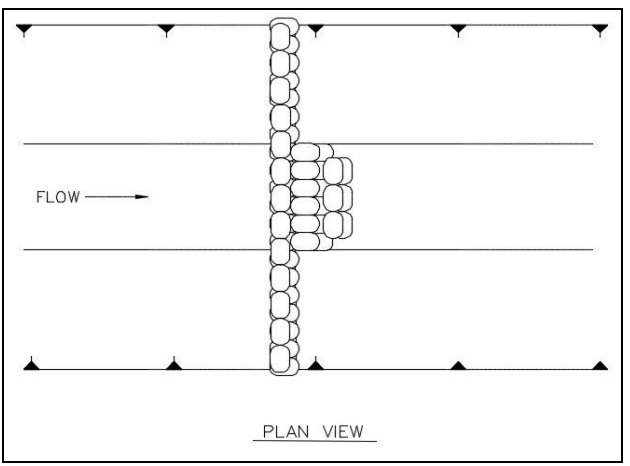

Figure CD-9 Sand Bag Check Dam Plan View

Maintenance

- After rainfall events check the practice and channel for displacement and erosion and make repairs as needed.
- If channel erosion exceeds expectations, consult with a qualified design professional.
- Remove sediment before it reaches a depth of ½ the original dam height.
- Remove check dams when their useful life has been completed. Stabilize the area where check dams are removed with vegetation.

Diversion (DV)

Description

A temporary or permanent ridge and channel constructed on a stable grade and stabilized with vegetation. The practice is used to protect a downslope area by intercepting and carrying excess water to a stable outlet

Installation

- Begin by ensuring that the diversion outlet is stable.
- Layout the diversion from the outlet according to the design grade and planned location.
- Construct the diversion ridge by compacting earthfill in 6" to 8" lifts, overbuilding 10% for settlement.
- Check to ensure design dimensions are obtained.
- Stabilize the diversion with vegetation.

Maintenance

- Inspect after runoff events.
- Remove debris and sediment buildups in the diversion channel and repair erosion in the channel bottom.
- Rebuild the ridge to design elevation where needed.
- Check outlet for damage and repair if needed.
- Mow and fertilize vegetation.
- Remove temporary diversions after service and stabilize the area with permanent vegetation.

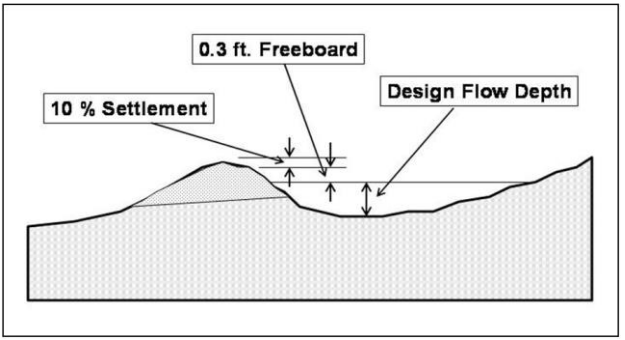

Figure DV-1 Typical Parabolic Diversion

Figure DV-2 Grassed Diversion

Grass Swale (GS)

Description

An earthen channel constructed on a stable grade and stabilized with vegetation. The practice is used to provide an area for non-erosive concentrated flow after runoff events while carrying the water to a stable outlet.

Installation

- Ensure that the grass swale outlet is stable.
- Layout the grass swale from the outlet according to the planned location and the design grade limitations.
- Ensure that lateral surface drainage into the grass swale is not blocked.
- Ensure design dimensions are obtained. Most grass swales have a parabolic cross-section but may be designed to be triangular or trapezoidal.
- Stabilize the grass swale with prescribed vegetation prior to large runoff events.
- Swales may require the use of an erosion control blanket or turf reinforcement mat to aid in establishing vegetation.

Maintenance

- Permanent water in a grass swale will destroy the vegetation and other conveyance measures may be required.
- Inspect after runoff events.

- Remove debris and sediment buildups in the swale, and repair erosion, low spots, and breaches.
- Check outlet for damage and repair if needed.
- Mow and fertilize vegetation.

Figure GS-1 Grass Swale in a Highway Median.

Lined Swale (LS)

Description

A constructed channel with a permanent lining designed to carry concentrated runoff to a stable outlet. A lined swale is used when vegetation cannot control erosion and riprap is undesirable. The lining may consist of concrete, manufactured concrete products, or turf reinforcement mat (TRM).

Installation

Concrete-lined swale is the only lined swale covered in this edition of the Field Guide. Refer to plans and specifications or manufacturer's requirements for installation of other linings.

- Layout the lined swale according to plans and as close to a linear alignment as possible.
- Prepare the location for the concrete-lined swale by removing debris and obstructions.
- Remove soft sections or unsuitable materials from foundation and replace with suitable material.
- Compact foundation soil and excavate cutoff walls to the required subgrade dimensions.
- Construct concrete forms for swale, inlet, and outlet according to plans.
- Utilize construction joints every 10 ft. and expansion joints at least every 20 ft.
- Moisten subgrade prior to concrete placement.
- Refer to plans and specifications or ACI standards for concrete placement procedures during weather extremes.

- Place concrete (minimum 3,000 psi) to thickness required on plans (minimum 4 inches) utilizing surface vibration.
- As soon as finishing work is complete, cover surface of concrete with curing compound.
- Remove forms when specified.
- Stabilize areas adjacent to lined swale with permanent vegetation.

Maintenance

- Inspect at regular intervals and after storm events.
- Check for erosion adjacent to the channel, at inlets and outlets and underneath the lined channel.
- Remove debris and sediment buildups in the swale and repair any damaged areas.

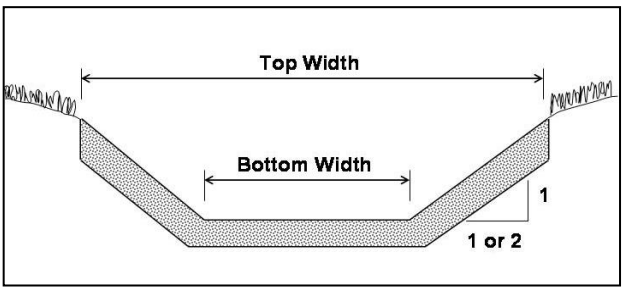

Figure LS-1 Concrete Lined Swale

Outlet Protection (OP)

Description

Measures installed to prevent erosion at the outlet of a channel or conduit by reducing the velocity and dissipating the energy. Outlet protection measures can be riprap-lined aprons, reinforced concrete flumes with concrete baffles, or reinforced concrete boxes with chambers or baffles. Some outlet protection devices are pre-manufactured.

Installation

- Prepare subgrade for structure by removing organic material and debris from work area.
- Fill low spots with clean non-organic fill, compact to density equal to surrounding material, and grade to lines and grades in plans.
- Maintain a straight alignment, if possible, or construct any curve needed in the upstream section of the structure.
- For riprap structures, install non-woven geotextile meeting specifications over the completed subgrade. Bury edges of geotextile to ensure water cannot flow under the fabric.
- Avoid damage to the geotextile when placing riprap with equipment.
- Construct the riprap apron on zero grade, with no overfall at the outlet end.
- For concrete structures, install steel reinforcement at the position shown in the plans.

- Place concrete in sturdy wood or metal forms, properly supported to prevent deformation.
- Consolidate concrete using mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
- Avoid concrete placement in inclement weather and temperature extremes. If extremes cannot be avoided, follow ACI guidelines for concrete placement in extreme temperatures.
- Cure concrete according to specifications.
- Do not remove forms prior to the specified curing time.
- Immediately after construction, stabilize disturbed area adjacent to the structure with vegetation.
- Check finished structures for conformance with designed lines, grades, and quality.

Maintenance

- After storm events, check riprap structures for erosion around and beneath the riprap and for rock displacement. Repair and replace the riprap as needed.
- Check concrete structures for structural cracks and movement. Repair as needed.
- Remove excessive vegetation, sediment, or debris.

Riprap-Lined Swale (RS)

Description

A natural or constructed channel with an erosion-resistant rock lining designed to carry concentrated runoff to a stable outlet.

Installation

- Remove brush, trees and other debris from the channel area.
- Excavate the subgrade for the riprap lining to the designed lines and grades.
- Install geotextile fabric or gravel for a filter between the subgrade and riprap. Fabric or gravel should conform to specifications.
- Place riprap to the thickness, depth and elevations shown in the design.
- Use only stone meeting the gradation and quality specified in the plan.
- Blend the finished rock surface with the surrounding ground to prevent overfalls, channel constrictions or obstructions to flow.
- Stabilize channel inlet and outlets.
- Stabilize surrounding disturbed areas using vegetation after construction is completed.
- Check finished grades and cross sections throughout channel length, verifying dimensions to avoid flow constrictions.

Maintenance

- Check channels after storm events for rock displacement, sediment accumulations, and erosion beneath the rock.
- Check for erosion at the inlet and outlet of channel.
- Check side inlets for erosion.
- Repair and replace riprap as needed.

Figure RS-1 Hand Placing Riprap.

Temporary Slope Drain (TSD)

Description

A pipe used to carry concentrated runoff water down a slope without causing erosion. The pipes are used when runoff water from an upper site needs to be temporarily conveyed down a slope before the permanent drainage structures can be installed.

Installation

- Remember that pipes are sized according to the drainage area. If not included in the plans, use the following table for pipe sizes:

Table TSD-1 Temporary Slope Drain Pipe Sizes

Maximum Drainage Area (Acres)	Pipe Diameter (D) (Inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

- It is best to install the pipe before runoff water is conveyed to the pipe.
- Install the pipe with the specified watertight joints and with a flared inlet section.
- Make sure the inlet section is low enough in elevation to ensure that surface water can be directed to the inlet.

- Ensure the pipe is securely anchored to the slope according to plans or by using a “t-pee” staking.
- Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion.
- Install rock or other appropriate outlet protection (see Outlet Protection Practice).
- Construct the diversion at the top of the slope according to plans so that surface runoff can be directed into the pipe. Provide positive grade in the pipe under the ridge.
- Good compaction of the diversion around the pipe is essential to avoid piping failure and blowouts.
- Establish temporary vegetation.

Maintenance

- Inspect the pipes after runoff events. Remove debris, repair erosion, and repair pipe as needed.
- Check conduit for evidence of leaks or inadequate anchoring.
- Check the outlet for erosion and sedimentation.
- Make sure that runoff is not bypassing the inlet.
- Check for evidence of overtopping, piping or uplift.
- Check for bends in conduit. Re-anchor as needed.
- Remove slope drains when they are no longer needed and stabilize the area with vegetation.

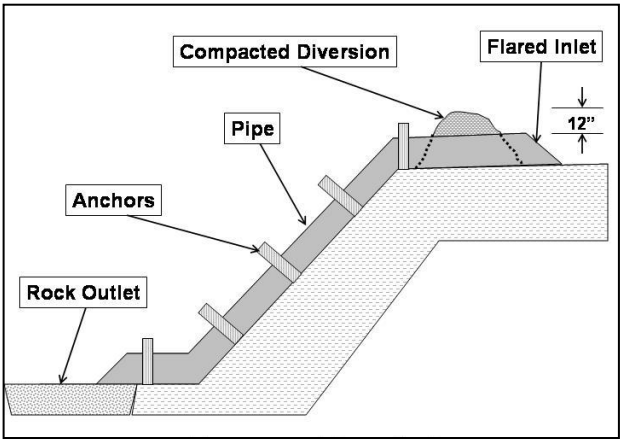

Figure TSD-1 Temporary Slope Drain

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