

Check Dam (CD)



Practice Description

A check dam (also referred to as a “ditch check”) is a small barrier or dam constructed across a swale, drainage ditch or other area of concentrated flow for the purpose of reducing channel erosion. Channel erosion is reduced because check dams flatten the gradient of the flow channel and slow the velocity of channel flow. Check dams can be constructed of rock, wattles (sometimes referred to as tubes or rolls), sand bags, or other materials that may be acceptable to the design professional. Contrary to popular opinion, most check dams trap an insignificant volume of sediment, as check dams usually just trap the coarser grained material leaving the turbid water to flow downstream.

This practice applies in small open channels and drainageways, including temporary and permanent swales. It is not to be used in a live stream. Situations of use include areas in need of protection during establishment of grass and areas that cannot receive a temporary or permanent non-erodible lining for an extended period of time.

Typical Components of the Practice

- Site Preparation
- Materials Installation
- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction a qualified design professional should determine the location, elevation and size of the structure to optimize flattening of channel grade. Usually, check dam dimensions are taken from a standard drawing. Check dams are typically constructed using materials specified in a contract which could be rock, wattles, sand bags, or other suitable material, including manufactured products. Most check dams are constructed of rock.

Note: Construction with rock is the only check dam material covered in this edition of the handbook.

Site Preparation

Determine location of any underground utilities.

Locate and mark the site for each check dam in strategic locations (to avoid utilities and optimize effectiveness of each structure in flattening channel grade).

Remove debris and other unsuitable material which would interfere with proper placement of the check dam materials.

In highly erosive soil conditions it may be specified to excavate a shallow keyway (12"-24" deep and at least 12" wide) across the channel and into each abutment for each check dam. For other soils, geotextile alone without a keyway is often used between the soil and rock.

Materials Installation

As specified, install a keyway and/or non-woven geotextile fabric

Construct the dam with a minimum 2:1 side slopes and securely embed the dam into the channel banks. Position rock to form a parabolic top, perpendicular to channel flow, with the center portion at the elevation shown in the design so that the flow goes over the structure and not around the structure. Small graded aggregate and geotextile may be specified on the upstream face of the rock check dam to increase the sediment trapping efficiency.

Erosion and Sediment Control

Install vegetation (temporary or permanent seeding) or mulching to stabilize other areas disturbed during the construction activities.

Construction Verification

Check finished size, grade and shape for compliance with standard drawings and materials list (check for compliance with specifications if included in contract specifications).

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate check dam will not function as intended. Change in plan will be needed.
- Materials specified in the plan are not available.

Maintenance

Inspect the check dam for rock displacement and abutments for erosion around the ends of the dam after each significant rainfall event. If the rock appears too small, add additional stone and use a larger size.

Inspect the channel after each significant rainfall event. If channel erosion exceeds expectations, consult with the design professional and consider adding another check dam to reduce channel flow grade.

Sediment should be removed if it reaches a depth of $\frac{1}{2}$ the original dam height. If the area behind the dam fills with sediment there is a greater likelihood that water will flow around the end of the check dam and cause the practice to fail.

Check dams may be removed when their useful life has been completed. The area where check dams are removed should be seeded and mulched immediately unless a different treatment is prescribed. In some instances check dams should be left as a permanent measure to support channel stability.

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Diversion (DV)



Practice Description

A diversion is a watercourse constructed across a slope consisting of an excavated channel, a compacted ridge or a combination of both. Most diversions are constructed by excavating a channel and using the excavated material to construct a ridge on the downslope side of the channel. Right-of-way diversions and temporary diversions are sometimes constructed by making a ridge, often called a berm, from fill material.

This practice applies to sites where stormwater runoff can be redirected to permanently protect structures or areas downslope from erosion, sediment, and excessive wetness or localized flooding. Diversions may be used to temporarily divert stormwater runoff to protect disturbed areas and slopes or to retain sediment on site during construction.

Perimeter protection is sometimes used to describe both permanent and temporary diversions used at either the upslope or downslope side of a construction area.

Right-of-way diversions, sometimes referred to as water bars, are used to shorten the flow length on a sloping right-of-way and reduce the erosion potential of the stormwater runoff.

Diversions are designed to intercept and carry excess water to a stable outlet.

Typical Components of the Practice

- Site Preparation
- Grading
- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction, diversions should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process. A diversion should be built according to planned alignment, grade and cross section. Typically, a diversion is constructed with the following activities.

Site Preparation

Determine exact location of any underground utilities.

Locate and mark the alignment of the diversion as shown on the plans. Minor adjustments to the grade and alignment may be required to meet site conditions. The alignment should maintain a positive grade towards the outlet and end in a stable outlet or an area that can be stabilized.

Clear the construction area of trees, stumps, brush, sod and other unsuitable material which would interfere with compaction of the ridge.

Disk or scarify the area where the ridge is to be installed before placing the fill.

Clean out and refill with compacted earth fill all ditches, swales or gullies to be crossed.

Apply gravel or hard surface protection at vehicle crossings to prevent rutting.

Install stable outlets prior to construction. Adequate vegetation should be established in the outlet channel. If vegetation cannot be established use Lined Swale, Rip-rap Lined Swale, Drop Structure, Sediment Basin or Stormwater Detention Basin .

Grading

Excavate, fill and shape the diversion to planned alignment, grade and cross section. The channel should have a positive grade toward the outlet to avoid ponding. Where possible, blend diversion into the surrounding landscape.

Overfill and compact the ridge, allowing for 10% settlement. Fill should be placed in lifts of no more than 6" to 8" in depth. Compaction may be achieved

by driving wheeled equipment along the ridge as lifts are added. The settled ridge top must be at or above design elevation at all points.

All earth removed and not needed for the practice should be spread or disposed of so that it will not interfere with the functioning of the diversion.

Erosion and Sediment Control

Control sediment along grading limits with sediment control measures.

Leave sufficient area adjacent to the diversion to permit clean out and regrading.

Immediately after installation install vegetation treatment or other means to stabilize the diversion in accordance with plans.

Install gravel or hard surface protection at vehicle crossings.

Stabilize diversion outlets in accordance with plans.

Construction Verification

Check finished grades and cross section of diversions to eliminate constrictions to flow. Check all ridges for low spots and stability.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate diversion will not function as intended. Changes in plans will be needed.
- Design specifications for seed variety or seeding cannot be met. Substitutions not approved by the design professional could result in erosion and lead to diversion failure.
- Seepage is encountered during construction. It may be necessary to install drains.

Maintenance

Inspect weekly and following each storm event for erosion until the diversion is vegetated.

Remove debris and sediment from the channel, and rebuild the ridge to design elevation where needed.

Check diversion outlet for erosion and repair if area becomes unstable. Maintain vegetation with periodic fertilization and mowing to keep vegetation in a vigorous, healthy condition. Mow for weed and brush control during the first

year and as needed to prevent brush and trees seedlings from becoming established after the first year of installation.

When the work area has been stabilized, remove temporary diversions, sediment barriers and traps and repair bare or damaged areas in the vegetation by planting and mulching or sodding.

Stabilize all eroded, rutted or disturbed areas as soon as possible with vegetation or synthetic erosion control measures as specified in the design.

Drop Structure (DS)



Practice Description

A drop structure is an erosion control structure created by construction of a barrier across a drainageway or installing a permanent manufactured product down a slope. The purpose of a drop structure is to convey concentrated flow storm runoff from the top to the bottom of a slope or to lower water from a grassed swale into an open channel such as an intermittent or perennial stream. This practice applies where other erosion control measures are insufficient to prevent excessive erosion and off-site sedimentation.

Typical Components of the Practice

- Site Preparation
- Principal Spillway
- Embankment
- Emergency Spillway
- Erosion Control
- Construction Verification

Construction

Prior to the start of construction, drop structures should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process. The drop structure should be built according to planned grades and dimensions.

Note: Construction of an embankment with spillways is the only type of drop structure covered in this edition of the handbook.

Consider the following guidance as construction proceeds

Site Preparation

Locate all utilities at the site to ensure avoidance.

Clear, grub and strip the dam foundation and emergency spillway area, removing all woody vegetation, rocks and other objectionable material. Dispose of trees, limbs, logs and other debris in designated disposal areas.

Stockpile surface soil for use later during topsoiling.

Clear the sediment pool to facilitate sediment clean out and dispose of trees, limbs, logs and other debris in designated disposal areas.

Principal Spillway

Prepare the pipe bedding and situate the spillway barrel (pipe) on a firm, even foundation.

Install anti-seep collars, or sand drainage diaphragm with filter compatible outlet according to the design plan.

Place around the barrel 4" layers of moist, clayey, workable soil (not pervious material such as sand, gravel or silt), and compact with hand tampers to at least the density of the foundation soil. (Do not raise the pipe from the foundation when compacting under the pipe haunches.)

At the pipe inlet, install Inlet Protection according to the design plan.

At the pipe outlet, install Outlet Protection according to the design plan (if not specific, use a riprap apron at least 5 feet wide to a stable grade).

Embankment

Scarify the foundation of the dam before placing fill.

Use fill from predetermined borrow areas. It should be clean, stable soil free of roots, woody vegetation, rocks and other debris; and must be wet enough to form a ball without crumbling, yet not so wet that water can be squeezed out.

Place the most permeable soil in the downstream toe and the least permeable in the center portion of the dam.

Protect the spillway barrel with 2 feet of fill that has been compacted with hand tampers before traversing over the pipe with equipment.

Compact the fill material in 6" to 8" continuous layers over the length of the embankment. One way is by routing construction equipment so that each layer is traversed by at least one wheel of the equipment.

Construct and compact the embankment to an elevation 10% above the design height to allow for settling. The embankment should have a minimum 8 feet top width and 3:1 side slopes, but the design may specify additional width and gentler side slopes.

Emergency Spillway

Construct the spillway at the site located by the qualified design professional according to the plan design (in undisturbed soil around one end of the embankment on natural ground, and so that any flow will return to the receiving channel without damaging the embankment).

Erosion Control

Minimize the size of all disturbed areas.

Use temporary diversions to prevent surface water from running onto disturbed areas.

Vegetate and stabilize the embankment, the emergency spillway and all disturbed areas immediately after construction.

Construction Verification

Check the finished grades and configuration for all earthwork. Check elevations and dimensions of all pipes and structures.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate drop structure will not function as intended.
- Seepage is encountered during construction; it may be necessary to install drains.
- Design specifications for fill, pipe, seed variety or seeding dates cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect the drop structure after each storm event until it is completely stabilized with vegetation.

Periodically check the embankment, emergency spillway and outlet for erosion damage, piping, settling, seepage or slumping along the toe or around the barrel and repair immediately.

Grass Swale (GS)



Practice Description

A grass swale is a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff without causing damage to the channel by erosion. This practice applies to sites where concentrated runoff will cause erosion damage, a vegetative lining provides sufficient stability for the channel as designed, and space is available for a relatively large cross section. Typical situations where concentrated flow areas are addressed with a grass swale include roadside ditches, channels at property boundaries, outlets for diversions and other concentrated flow areas subject to channel erosion. Grass swales are generally considered permanent structures but may be used as a temporary measure.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Constructing
- Construction Verification
- Vegetating

Installation

Prior to start of construction, grass swale channels should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process to ensure that the channel has planned alignment, grade and cross section.

Scheduling

Schedule construction during a period of relatively low rainfall and runoff events if practical. Consider, also, the establishment period (planting dates) for the planned species that will be used for long-term vegetative cover.

Site Preparation

Determine exact location of underground utilities.

Install any structures required to stabilize the swale outlet or to provide drainage along the swale prior to beginning installation of the swale. Refer to design for structures to be installed.

Remove brush, trees and other debris from the construction area and dispose of properly.

Constructing

Excavate and shape the channel to dimensions shown in the design specifications, removing and properly disposing of excess soil so surface water can enter the channel freely. The typical features of a grass swale are shown in Figure GS-1 and listed below, but may be different in the design for a specific site.

Cross Section: trapezoidal or parabolic.

Side Slopes: 3:1 or flatter for trapezoidal channels.

Outlet: Channel should empty into a stable outlet, sediment traps, or detention/retention basins.

Subsurface Drain: Use in areas with seasonally high water tables or seepage problems.

Topsoil: Provide topsoil as needed to grow grass on areas disturbed by construction.

Protect all concentrated inflow points along the channel with erosion resistant linings, such as riprap, sod, mulch, erosion control blankets, turf reinforcement mats or other appropriate practices as specified in the design plan.

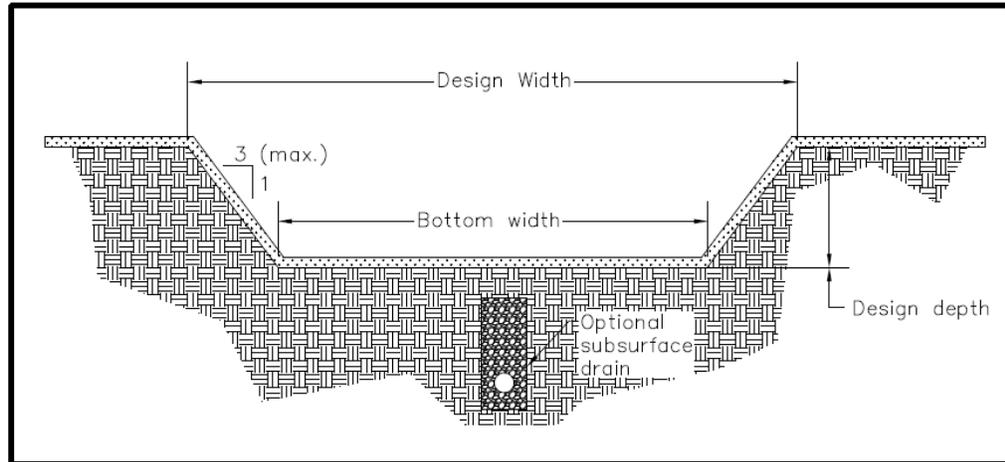


Figure GS-1 Typical Trapezoidal Grass-lined Channel

Construction Verification

Check finished grade and cross section of channel throughout the length of the watercourse. Verify channel cross sections at several locations to avoid constrictions to flow.

Vegetating

Prepare seedbed and apply lime, fertilizer and seed or sod in the swale immediately after grading and protect with erosion control blankets, turf reinforcement mats or mulch according to the design plan. If not specified in a plan, select lime, fertilizer, variety and mulching components from related practices – permanent seeding or temporary seeding, erosion control blanket or sodding.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate practice will not function as intended.
- Changes in plan may be needed.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitution may be required.

- Erosion occurs in channel before vegetation is fully established.
- Erosion occurs at channel outlet before vegetation is fully established.
- Sediment is deposited at channel outlet before vegetation is fully established.

Maintenance

Inspect the channel following storm events both during and after grass cover is established; make needed repairs immediately.

Check the channel outlet and road crossings for blockage, ponding, sediment, and bank instability, breaks and eroded areas; remove any blockage, and make repairs immediately to maintain design cross section and grade.

Lined Swale (LS)



Practice Description

A lined swale is a constructed channel with a permanent lining designed to carry concentrated runoff to a stable outlet. This practice applies where grass swales are unsuitable because of conditions such as steep channel grades, prolonged flow areas, soils that are too erodible or not suitable to support vegetation or insufficient space and where riprap-lined swales are not desired. The purpose of a lined swale is to conduct stormwater runoff without causing erosion problems in the area of channel flow.

The material that provides the permanent lining may be concrete, manufactured concrete products, or turf reinforcement mat (TRM).

Typical Components of the Practice

- Site Preparation
- Material Placement
- Stabilization
- Construction Verification

Construction

Prior to start of construction, lined swales should be designed by a qualified design professional and specifications should be available to field personnel.

Plans and specifications should be referred to by field personnel throughout the construction process.

Note: Concrete lined channel is the only lining method that is covered in this edition of the handbook. There are numerous permanent erosion control blankets (TRMs) and manufactured concrete products available with similar applications and their unique installation procedures should be obtained from the manufacturer of the product being used. In addition, Riprap-lined Swale is covered in this handbook as a separate practice.

Site Preparation

Determine exact location of underground utilities.

Remove brush, trees and other debris from the channel and spoil areas, and dispose of properly.

Grade or excavate cross section to the lines and grades shown in design for the concrete subgrade.

Remove soft sections and unsuitable material and replace with suitable material. The subgrade should be thoroughly compacted and shaped to a smooth, uniform surface.

Material Placement

Place forms to meet the specific plan design for the project and place concrete of the designed mix into the forms according to construction specifications.

Construction and expansion joints should be used where swale length exceeds 10 feet. Construction joints should be spaced at 10 feet intervals and expansion points at intervals not to exceed 20 feet.

The subgrade should be moist at the time the concrete is placed.

Place concrete for the lined channel to the thickness shown on the plans and finish it in a workmanlike manner.

Coat the concrete with an approved curing compound as soon as finish work is complete and the free water has disappeared from the surface.

Provisions should be made to protect the freshly poured concrete from extreme temperatures to ensure proper curing.

Stabilization

Stabilize channel inlet and outlet points according to the design plan.

Stabilize adjacent disturbed areas after construction is completed with a vegetation treatment (permanent or temporary seeding) and mulching. Provide topsoil, lime and fertilizer as needed to grow grass on areas disturbed by

construction. Many design plans specify a row of sod at the edges of the concrete channel.

If not specified in a plan, select lime, fertilizer, seed variety and mulching components from related practices – Permanent Seeding or Temporary Seeding and Mulching, Erosion Control Blankets or Sodding.

Construction Verification

Check finished grades and cross sections throughout the length of the channel. Verify channel cross section dimensions at several locations to avoid flow constrictions.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate practice will not function as intended; changes in plan may be needed.
- Design specifications cannot be met; substitution may be required. Unapproved substitutions could result in failure of the practice.

Maintenance

Inspect lined channel at regular intervals and after storm events. Check for erosion adjacent to the channel, at inlets and outlets and underneath the lined channel.

Give special attention to the channel inlet and outlet and repair eroded areas promptly.

Inspect for erosion in the entire swale and repair with appropriate vegetative treatment (permanent or temporary seeding and mulching).

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Outlet Protection (OP)



Practice Description

This practice is designed to prevent erosion at the outlet of a channel or conduit by reducing the velocity of flow and dissipating the energy. Outlet protection measures usually consist of a riprap-lined apron, a reinforced concrete flume with concrete baffles a reinforced concrete box with chambers or baffles and possibly pre-manufactured products. This practice applies wherever high velocity discharge must be released on erodible material.

Typical Components of the Practice

- Site Preparation
- Installation of Riprap Structures
- Installation of Concrete Structures
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, the practice should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

The structure should conform to the dimensions, grades and alignments shown on the plans and specifications.

Site Preparation

Completely remove stumps, roots and other debris from the construction area. Fill depressions caused by clearing and grubbing operations with clean, non-organic soil. Grade the site to the lines and grades shown on the plans. Compact any fill required in the subgrade to the density of the surrounding undisturbed material.

If possible, the alignment should be straight throughout its length. If a curve is required, it should be located in the upstream section of the outlet.

Riprap Structures

Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.

Geotextile fabric must meet design requirements and be properly protected from puncturing or tearing during installation. Repair any damage by removing the riprap and placing another piece of fabric over the damaged area. All connecting joints should overlap a minimum of 1.5 feet with the upstream edge over the downstream edge. If the damage is extensive, replace the entire geotextile fabric.

Riprap may be placed by equipment. Care should be taken to avoid damaging the fabric.

Construct the apron on zero grade with no overfall at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.

Concrete Structures

Reinforcing steel welded wire fabric should be placed in strict accordance with the design plans and maintained in the proper position during the pouring of concrete. Concrete should be placed in horizontal layers not exceeding 24" in thickness or as specified in the design, and consolidated by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

Concrete should be placed in sturdy wood or metal forms, adequately supported to prevent deformation. Forms should be oiled with form release agent prior to placement to prevent bonding between concrete and forms.

If possible, concrete should not be placed during inclement weather or periods of temperature extremes. If temperature extremes cannot be avoided, American Concrete Institute (ACI) guidelines for placement of concrete during such extremes should be consulted.

Concrete should be allowed to cure as required by the plans and specifications.

Typically, the surface should be kept wet during curing by covering it with wet burlap sacks or other means. Design strengths should be confirmed by laboratory

tests on representative cylinders made during concrete placement. Form work should not be removed prior to the specified time.

Erosion Control

Immediately after construction, stabilize all disturbed areas with vegetation.

Construction Verification

Check finished structures for conformance with design specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate measure will not function as intended.
- Design specifications for riprap, filter fabric, concrete, reinforcing steel or backfill cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Problems with the structure develop during or after installation.

Maintenance

Inspect riprap outlet structures after heavy rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Check concrete structures for cracks and movement. Immediately make all needed repairs to prevent further damage.

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Riprap-lined Swale (RS)



Practice Description

A riprap-lined swale is a natural or constructed channel with an erosion-resistant rock lining designed to carry concentrated runoff to a stable outlet. This practice applies where grass swales are unsuitable because of conditions such as steep channel grades, prolonged flow areas, soils that are too erodible or not suitable to support vegetation or insufficient space.

Typical Components of the Practice

- Site Preparation
- Foundation Stabilization
- Rock Placement
- Outlet Stabilization
- Construction Verification

Construction

Prior to start of construction, riprap-lined swales should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities.

Remove brush, trees and other debris from the channel and spoil areas, and dispose of properly.

Grade or excavate cross section to the lines and grades shown in design. Over-excavate to allow for thickness of riprap and filter material. Foundation excavation not deep enough or wide enough may cause riprap to restrict channel flow and result in overflow and erosion. Side slopes are usually 2:1 or flatter.

Foundation Stabilization

Install geotextile fabric or aggregate in the excavated channel as a foundation for the riprap. Anchor fabric in accordance with design specifications. If the fabric is omitted or damaged during stone placement there may be settlement failure and bank instability.

Installation

As soon as the foundation is prepared, place the riprap to the thickness, depth and elevations shown in the design specifications. It should be a dense, uniform and well-graded mass with few voids. Riprap should consist of a well-graded mixture of stone (size and gradation as shown in design specifications) that is hard, angular, and highly chemical and weather resistant. Larger stone should predominate, with sufficient smaller sizes to fill the voids between the stones. The diameter of the largest stone size should be not greater than 1.5 times the d_{50} size. Minimum thickness of riprap liner should be 1.5 times the maximum stone diameter.

Blend the finished rock surface with the surrounding land surface so there are no overfalls, channel constrictions or obstructions to flow.

Outlet Stabilization

Stabilize channel inlet and outlet points. Extend riprap as needed.

Stabilize adjacent disturbed areas after construction is completed.

Construction Verification

Check finished grades and cross sections throughout the length of the channel.

Verify channel cross section dimensions at several locations to avoid flow constrictions.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate channel will not function as intended; changes in plan may be needed.
- Design specifications for riprap sizing, geotextile fabric or aggregate filter cannot be met; substitution may be required. Unapproved substitutions could result in channel erosion.

Maintenance

Inspect channels at regular intervals and after storm events. Check for rock stability, sediment accumulation, piping, and scour holes throughout the length of the channel.

Look for erosion at inlets and outlets.

When stones have been displaced, remove any debris and replace the stones in such a way as to not restrict the flow of water.

Give special attention to outlets and points where concentrated flow enters the channel and repair eroded areas promptly by extending the riprap as needed.

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Subsurface Drain (SD)



Practice Description

A subsurface drain is a perforated pipe or continuous layer of porous material installed below the ground surface that intercepts, collects and carries excessive groundwater to a stable outlet. Subsurface drains by themselves do not provide erosion control. The purpose of a subsurface drain is to improve soil moisture conditions, vegetation growth and ground stability. Subsurface drains may reduce wet ground from interfering with construction activities. Drains may be constructed using a gravel-filled trench, perforated pipe in gravel bedding or manufactured drain panel products. This practice applies where groundwater is at or near the ground surface or where adequate drainage cannot be provided for surface runoff.

Typical Components of the Practice

- Site Preparation
- Trench Excavation
- Installation of Drain Pipe, Bedding Material and Filter Cloth
- Backfill Installation
- Installation of Clean-Out Device
- Outlet Installation
- Stabilization
- Safety
- Construction Verification

Construction

Prior to start of construction, subsurface drains should be designed by a qualified design professional. Materials such as sand, gravel, geotextile filter cloth and pipe must be properly designed in order for the subsurface drain system to function properly. Plans and specifications should be available to field personnel.

Site Preparation

Determine exact location of underground utilities. At least 3 days prior to construction, request Alabama Line Location Center (dial 811) to mark all underground utilities within the project area.

Locate and mark the alignment of the drains as shown on the design plans.

Clear installation area of debris and obstacles, such as trees and stumps, that might hinder grading and installation of the subsurface drain.

Trench Excavation

Excavate the trench to the specified depth and grade shown in the design plan. To accommodate the gravel bedding or filter material, excavate the trench to at least 3” below the design bottom elevation of the pipe (or as shown on the design plans).

Place materials excavated from the trench on the up gradient side of the trench to prevent water from entering the trench during construction.

Grade the trench to prevent siltation into the drain.

Installation of Drain Pipe, Bedding Material and Geotextile Filter Cloth

Line trench with filter cloth (if specified), providing enough material to overlap over the top of the finished gravel bedding. This helps prevent movement of soil into the gravel.

Spread bedding material specified in the design plan, usually 3” of gravel, to fill the over-excavated bottom of the trench.

Lay pipe on the design grade and elevation avoiding reverse grade or low spots after checking to ensure the pipe meets specifications.

Cap the upper end of each drain with a standard cap made for this purpose or with concrete or other suitable material to prevent soil from entering the open end.

Place bedding material around pipe, on all sides, with the amount shown in the design plan.

Fold filter cloth over the top of the gravel bedding.

Backfill Installation

Backfill immediately after placement of the pipe and bedding. Ensure that the material does not contain rocks or other sharp objects and place it in the trench in a manner that will not damage or displace the pipe. Overfill the trench slightly to allow for settlement.

Installation of Clean-Out Device

Install clean-outs for maintenance of the subsurface drain in the locations shown on design plan.

Outlet Installation

Construct the outlet of the subsurface drain at the elevation in the design plan. The outlet section of the drain should be at least 10 feet of non-perforated corrugated metal, cast iron, steel or heavy-duty plastic pipe. Cover at least half of the pipe length with well-compacted soil. Place a suitable animal guard securely over the pipe outlet to keep out rodents.

Stabilization

Keep the settled fill over the pipe outlet slightly higher than the surrounding ground to prevent erosion, rills and gullies.

Stabilize all bare areas of the trench with temporary seeding and mulching unless construction will disturb the area within 13 days.

Safety

Narrow trenches are subject to collapse and can be a safety hazard to persons in the trench. No person should enter a trench without shoring protection or properly sloping the sides of the trench.

Construction Verification

Verify the dimensions during construction with those shown on the plans for location, length, depth and cross section of trench.

Verify the dimensions and specifications of the aggregate used in the bedding and manufactured materials such as pipe, tile or panel drain.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on-site indicate subsurface drains will not function as intended or originally designed.
- Design specifications for aggregate or manufactured products cannot be met; substitutions may be required. Unapproved substitutions could result in failure of the drain to function as intended.
- Pipe is crushed by construction traffic.

Maintenance

Check subsurface drains periodically to ensure that they are free-flowing and not clogged with sediment.

Keep outlet clean and free of debris.

Keep surface inlets open and free of sediment and other debris.

Where drains are crossed by heavy vehicles, check the pipe to ensure that it is not crushed.

Temporary Slope Drain (TSD)



Photo courtesy of CPESC, Inc.

Practice Description

A temporary slope drain is a pipe or other conduit designed to convey concentrated runoff down the face of a cut or fill slope without causing erosion. This practice applies wherever concentrated stormwater runoff must be conveyed down a steep slope.

Typical Components of the Practice

- Site Preparation
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, temporary slope drains should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities.

Place temporary slope drain on undisturbed soil or well-compacted fill at locations and elevations shown on the plans.

Grade the diversion channel at the top of the slope toward the temporary slope drain according to the design plan. Provide positive grade in the pipe under the ridge.

Hand tamp the soil under and around the pipe in lifts not to exceed 6".

Ensure that the fill over the drain pipe at the top of the slope is placed to the dimensions shown on the design plan.

Ensure that all slope drain connections are secure and watertight.

Ensure that all fill material is well-compacted. Securely anchor the exposed section of the drain according to the design.

Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion.

Make the settled, compacted diversion ridge no less than 1 foot above the top of the pipe at every point.

Erosion Control

Compaction of earthfill around the pipe in the vicinity of the ridge is extremely important to avoid piping failure and blowouts.

Immediately stabilize all disturbed areas following construction according to the design plan (with vegetation or other appropriate means of protection).

Construction Verification

Verify that materials, elevations and installation procedures meet design specifications.

Joints should be carefully inspected for separations or looseness.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate temporary slope drains will not function as intended.

- Pipe separates or is displaced.
- Animals are going into the pipe outlet.

Maintenance

Inspect slope drains and supporting diversions once a week and after every storm event.

Check the inlet for sediment or trash accumulation; clear and restore to proper condition.

Check the fill over the pipe for settlement, cracking or piping holes; repair immediately.

Check for holes where the pipe emerges from the ridge; repair immediately.

Check the conduit for evidence of leaks or inadequate anchoring; repair immediately.

Check the outlet for erosion or sedimentation; clean and repair, or extend if necessary.

Once slopes have been stabilized, remove the temporary diversions and slope drains so that runoff water no longer concentrates but flows uniformly over the protected slope. Stabilize the diversion and slope drain areas.

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