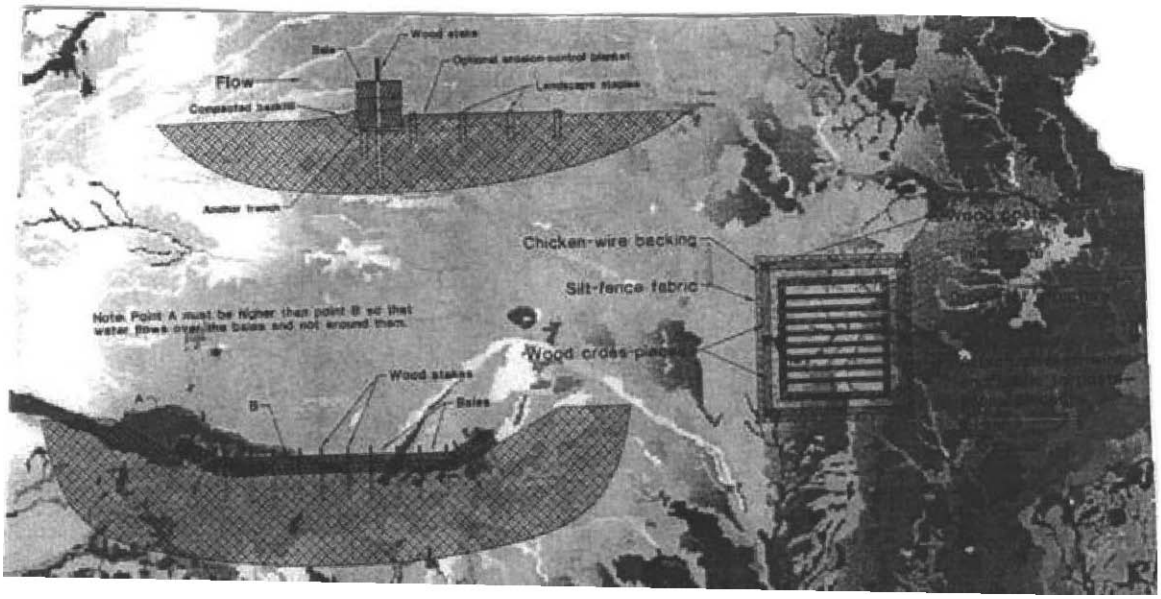
KDOT TEMPORARY EROSION - CONTROL MANUAL



A Guide for the Design, Installation, Inspection, and Maintenance of Temporary Erosion-Control Measures in Kansas

January 2007

►PURPOSE & USE OF THE MANUAL

PURPOSE

Erosion control is becoming an increasingly large part of highway design and construction. KDOT must comply with current federal and state erosion-control requirements and prepare to meet even more stringent requirements in the future. The development and implementation of an effective storm water pollution prevention plan (SWPPP) is essential.

This manual is intended to give designers, contractors, installers, and inspectors the tools they need to implement practical and efficient SWPPPs. Each chapter of this manual includes sections on design, installation, inspection and maintenance for temporary erosion-control measures (TECMs). Proper use of these devices will protect the environment while saving the user time and money.

USE

The format of this manual facilitates its use. The TECM selection process has been streamlined through the use of flowcharts. The user identifies an erosion or sedimentation condition (ditch, slope, and inlet) and then answers site-specific questions along the flowchart paths. When the end of a path is reached, TECM selection is complete. The user is then directed to specific pages in the manual. Each TECM description contains information on design, placement, material specification, installation, inspection, and maintenance. No design calculations are needed – all design data is in tabular form. If the user needs more information than is contained in this manual, a list of additional erosion-control resources is included at the end of this manual.

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► NPDES PERMITS

In an effort to limit the pollution of our nation's many streams, rivers, and lakes, the Environmental Protection Agency (EPA), directed by Congress, enacted Section 402 of the Clean Water Act, Section 402 established the National Pollutant Discharge Elimination System (NPDES) to regulate the discharge of pollutants from point sources. In 1990, the EPA published further regulations under the NPDES program which defined the term "storm water discharge associated with industrial activity" to include storm water discharges from construction activities (clearing, grading, excavation, etc.) that disturb two or more hectares of total land area. The EPA granted the responsibility of administering and enforcing NPDES permitting to the states. In May of 1996, the EPA approved the Kansas Department of Health and Environment's (KDHE) NPDES Draft for Construction Activity permits in Kansas.

An NPDES Permit authorizes a site owner to discharge storm water runoff. KDHE administers two types of NPDES permits: general and individual. To apply for a general permit, a site owner (in this case, the Kansas Department of Transportation) must file a Notice of Intent (NOI). The NOI application requires basic information about the site's location, existing condition, future use, and storm water pollution control measures. The general permit will apply to most projects. An individual permit is only required when certain pre-existing site conditions are encountered. These conditions concern proximity to one or more of the following: Indian Lands, contaminated soils, drinking water intakes, historical or archeological sites, and threatened or endangered species. Sites within one-half mile of a Critical Water Quality Management Area, Special Aquatic Life Use Waters, or an Outstanding Water Quality Management Area are also included. If any one of these site conditions is met, KDHE will investigate potential impacts and determine whether coverage under an individual permit is needed – coverage under a general permit is still a possibility.

The core of the storm water permit process is the Storm Water Pollution Prevention Plan (SWPPP). An SWPPP is a listing of all planned erosion and sediment control practices on site. The SWPPP also addresses inspection and maintenance procedures. The SWPPP is not a required attachment to the NOI; however, it is necessary to have a copy of the SWPPP on site at all times. Currently, the KDOT Environmental Services Section files the NOI for most projects (with the exception of inter-local projects). In addition to the NOI, the general contractor must complete and sign the Contractor's Certification Form. By signing this form, the contractor signifies that he understands the terms and conditions of the NPDES General Permit. This form should be kept on site with the SWPPP. KDOT has developed a standard SWPPP for all its projects. This SWPPP includes special provisions, standard drawings and specifications, inspection and maintenance report forms, the contractors site-specific erosion-control schedule, the KDOT erosion-control policy statement, and a memorandum for design and field engineers.

Upon completion of the project and stabilization of the disturbed area, the owner files the Notice of Termination (NOT). A disturbed area is considered stabilized when vegetation has been established on 70% of the area. Filing the NOT signifies that coverage under the NPDES General permit is no longer needed.

If further information is needed, consult the KDHE National Pollutant Discharge Elimination System Storm water Discharge Permit Information Packet.

► DESIGN OBJECTIVES

When developing a temporary erosion-control plan at your site, you should decide which of the following three design objectives is most feasible for your site:

- ► **Keep the soil *at* its original location.**
- ► **Keep the soil *close* to its original location.**
- ► **Keep the soil *on site.***

Keeping the soil at its original location is the preferred objective. This option causes the least amount of harm to the environment. Not only does this option protect the surrounding land and water, but it also prevents costly regarding and redressing of slopes and ditches. However keeping the soil at its original location is not always feasible due to challenging topography and other site variables. If you can't keep the soil at its original location, at least try to keep it close. This option will require some regarding and redressing of slopes and ditches. Finally, if site conditions are such that neither of the first two objectives can be met, at least try to keep the soil from leaving the site. Soil transported off-site can cause far-reaching damage to the downstream environment. Loss of soil from the site should be avoided to the extent practicable.

► SELECTION TABLE

The following table provides general guidance for the selection of the most appropriate temporary erosion-control measures. The table paths are generalized and do not represent every condition that may be encountered in the field. The selection of temporary erosion-control measures for some situations must be based on good judgment and past experience under similar conditions.

Ditches	Grade Less Than or Equal to 6%?	Bale Ditch Checks (pg. 4)
		Silt-Fence Ditch Checks (pg. 8)
		TSD Ditch Checks (pg. 12)
	Grade Greater Than 6%?	Rock Ditch Checks (pg. 15)
		Erosion-Control Blankets (pg. 33)
	High Flows Expected?	Rock Ditch Checks (pg. 34)
		Erosion-Control Blankets (pg. 33)
Slopes	Erosion Control?	Temporary Seeding (pg. 34)
		Erosion-Control Blankets (pg. 33)
	Sediment Control?	Bale Slope Barriers (pg. 18)
		Silt-Fence Slope Barriers (pg. 21)
Drop-Inlet Protection	(No Decision Needed)	Bale Drop-Inlet Barrier (pg. 24)
		Silt-Fence Drop-Inlet Barrier (pg. 27)
		TSD Drop-Inlet Barrier (pg. 30)
Sediment Basin	$\geq$ 10 acres	Sediment Basin (pg. 34)

PURPOSE & OPERATION

Bale ditch checks operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. Water exits the check by flowing over the top. For ditches with steeper slopes and/or higher flows, an erosion-control blanket on the downstream side of the ditch check can serve as a scour apron that helps prevent more erosion from this fl owing water.

DESIGN

Material Specification

- Bale ditch checks may be constructed of wheat straw, oat straw, prairie hay, or brome grass hay that is free of weeds declared noxious by the Kansas State Board of Agriculture.
- The stakes used to anchor the bales should be a hardwood material with the following minimum dimensions: 2” (50 mm) square (nominal) by 4 ft. (1.2 m) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.
- **Optional**: The downstream scour apron should be constructed of a double-netted straw erosion-control blanket at least 6 ft. (1.8 m) wide.
- **Optional**: The metal landscape staples used to anchor the erosion-control blanket should be at least 8” (200 mm) long.

Placement

- Bale ditch checks should be placed perpendicular to the flow line of the ditch.
- The ditch check should extend far enough so that the ground level at the ends of the check is higher than the top of the lowest center bale. This prevents water from flowing around the check.
- Checks should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- Bales should be placed in ditches with slopes of 6% or less. For slopes steeper than 6%, rock checks should be used.

The following table provides check spacing for a given ditch grade:

Ditch Check Spacing	
Ditch Grade (%)	***Check Spacing (ft./m)***
1.0	**200/61**
2.0	**100/30**
3.0	**65/20**
4.0	**50/15**
5.0	**40/12**
6.0	**30/10**

INSTALLATION

Proper Installation Method

- Excavate a trench perpendicular to the ditch flow line that is 6" (150 mm) deep and a bale's width wide. Extend the trench in a straight line along the entire length of the proposed ditch check. Place the soil on the upstream side of the trench – it will be used later.
- ***Optional:*** On the downstream side of the trench, roll out a length of erosion-control blanket (scour apron) equal to the length of the trench. Place the upstream edge of the erosion-control blanket along the bottom upstream edge of the trench. The erosion-control blanket should be anchored in the trench with one row of 8" (200 mm) landscape staples placed on 18" (460 mm) centers. The remainder of the erosion-control blanket (the portion that is not lying in the trench) will serve as the downstream scour apron. This section of the blanket should be anchored to the ground with 8" (200 mm) landscape staples placed around the perimeter of the blanket on 18" (460 mm) centers. The remainder of the blanket should be anchored using two evenly spaced rows of 8" (200 mm) landscape staples on 18" (460 mm) centers placed perpendicular to the flow line of the ditch.
- Place the bales in the trench, making sure that they are butted tightly. Two stakes should be driven through each bale along the centerline of the ditch check, approximately 6" to 8" (150 to 200 mm) in from the bale ends. Stakes should be driven **at least** 18" (460 mm) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the upstream side of the check and compact it. The compacted soil should be no more than 3" to 4" (75 to 100 mm) deep and extend upstream no more that 2 ft. (600 mm).

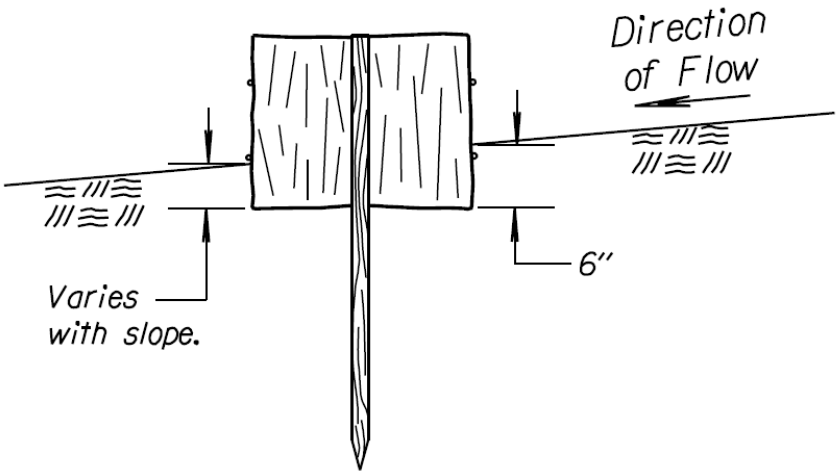


Figure 1-1: Detail of bale ditch check installation

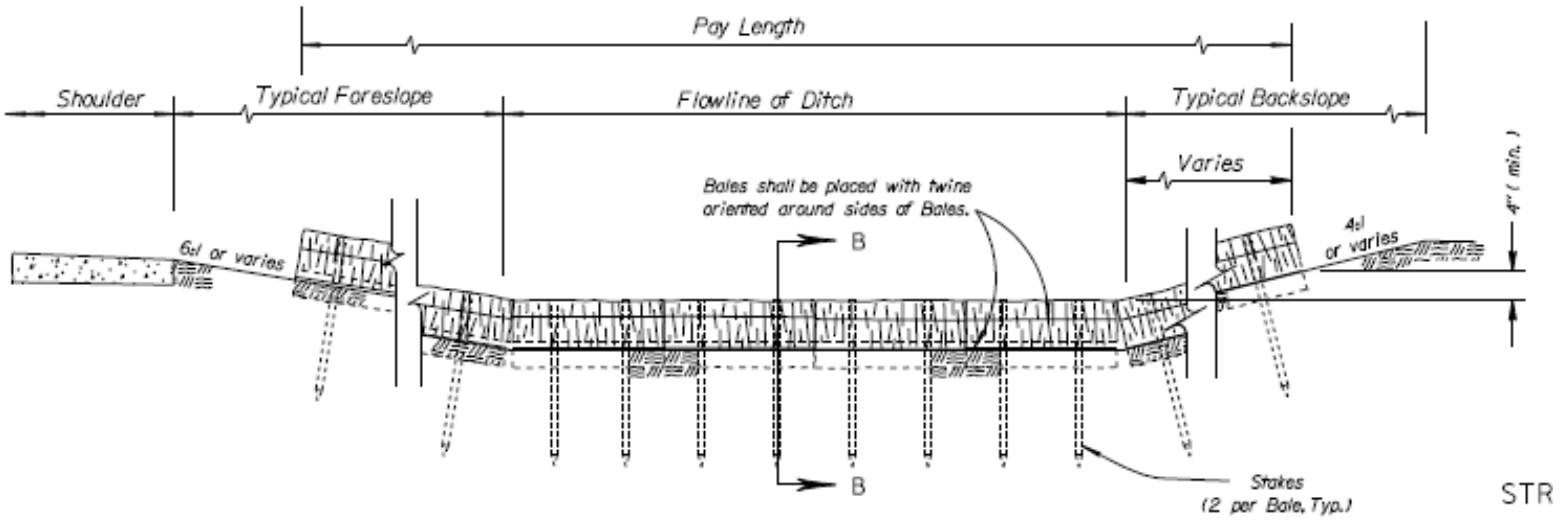


Figure 1-2: Installation of bale ditch checks

List of common placement/installation mistakes to avoid

- Do not place a bale ditch check directly in front of a culvert outlet. It will not stand up to the concentrated flow.
- Do not place bale ditch checks in ditches that will likely experience high flows. They will not stand up to concentrated flow.
- Follow prescribed ditch check spacing guidelines. If spacing guidelines are exceeded erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the check is higher than the top of the lowest center bale.

- Do not place bale ditch checks in channels with shallow soils underlain by rock. If the check is not anchored sufficiently, it will wash out.
- Bale ditch checks must be dug into the ground. Bales at ground level do not work because they allow water to flow under the check.

INSPECTION & MAINTENANCE

Bale ditch checks should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow around the ditch check?***
  This is usually caused by insufficient ditch check length. If this occurs, extend the check far enough so that the ground level at the ends of the check is higher than the top of the lowest center bale.

- ***Does water flow under the ditch check?***
  This is usually caused by not trenching in the bales deep enough (at least 6" (150 mm) or insufficient compaction of soil upstream of the check. If the problem is insufficient compaction, add more soil directly upstream of the check and recompact. If the problem is improperly trenched bales, the entire check should be removed and a new one installed, using the proper trench depth.

- ***Does water flow through spaces between abutting bales?***
  This is usually caused by not butting the bales tight enough during initial installation. Stuffing loose bale material between the bales to fill up the space can usually solve this problem.

- ***Are any bales and/or scour aprons (optional) dislodged?***
  Check to see if any bales or scour aprons have become dislodged from their original position. Dislodged bales and scour aprons should be repositioned and restaked if they are still reusable – otherwise, replace them.

- ***Are bales decomposing due to age and/or water damage?***
  Under normal conditions, the maximum useful life of a bale is normally 3 months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.

- ***Does sediment need to be removed from behind the ditch check?***
  Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check. This is why it is extremely important to inspect ditch checks within 24 hours of a large rainfall. When removing sediment from behind a bale ditch check with a bulldozer of backhoe, take care not to undermine the entrenched bales.

PURPOSE & OPERATION

Silt-fence ditch checks operate by intercepting, ponding, and filtering sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. As the ponded water percolates through the silt-fence fabric, much of the remaining suspended sediment is filtered out. Silt-fence ditch checks work well in ditches with low flows and moderate slopes.

DESIGN

Material Specification

- Silt-fence fabric should conform to the AASHTO M288 05 silt fence specification.
- The posts used to support the silt-fence fabric should be a hardwood material with the following minimum dimensions: 2" (50 mm) square (nominal) by 4 ft. (1.2 m) long.
- Silt-fence fabric should be attached to the wooden posts with staples, wire, zip ties, or nails.

Placement

- Place silt-fence in ditches where it is unlikely that it will be overtopped. Water should flow through a silt-fence ditch check - not over it. Silt-fence ditch checks often fail when overtopped.
- Silt-fence ditch checks should be placed **perpendicular** to the flow line of the ditch.
- The silt-fence should extend far enough so that the ground level at the ends of the fence is higher than the top of the low point of the fence. This prevents water from flowing around the check.
- Checks should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- Silt-fence should be placed in ditches with slopes of 6% or less. For slopes steeper than 6%, rock checks should be used.

The following table provides check spacing for a given ditch grade:

Ditch Check Spacing	
Ditch Grade (%)	***Check Spacing (ft./m)***
1.0	**200/61**
2.0	**100/30**
3.0	**65/20**
4.0	**50/15**
5.0	**40/12**
6.0	**30/10**

INSTALLATION

Proper Installation Method

- Excavate a trench perpendicular to the ditch flow line that us **at least** 6" (150 mm) deep by 4" (100 mm) wide. Extend the trench in a straight line along the entire length of the proposed ditch check. Place the soil on the upstream side of the trench for later use.
- Roll out a continuous length of silt-fence fabric on the downstream side of the trench. Place the edge of the fabric in the trench starting at the top upstream edge of the trench. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil and compact. After filling the trench, approximately 24" to 36" (600 to 900 mm) of silt-fence fabric should remain exposed.
- Lay the exposed silt-fence on the upstream side of the trench to clear an area for driving in the posts. Just downstream of the trench, drive posts into the ground to a depth of at least 24" (600 mm). Place posts no more than 4 ft. (1.2 m) apart.
- Attach the silt fence to the anchored post with staples, wire, zip ties, or nails.

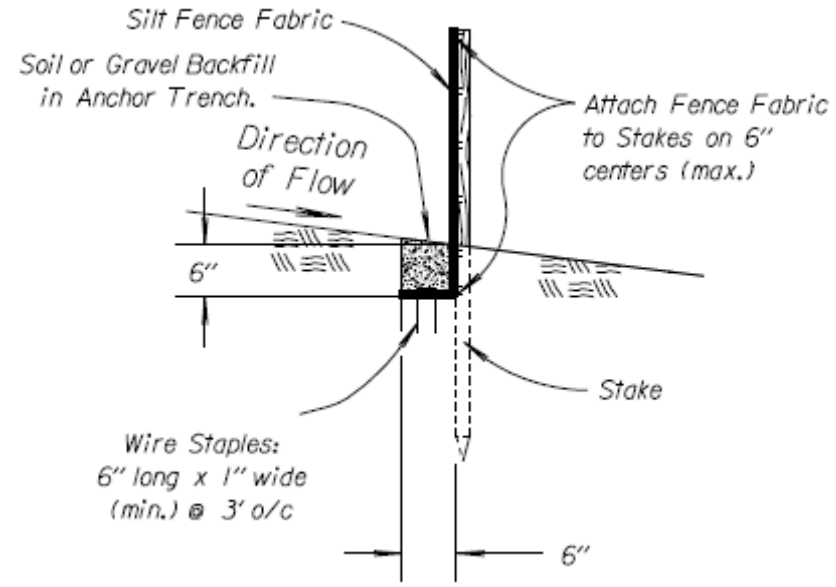


Figure 2-1: Detail of silt-fence ditch check installation

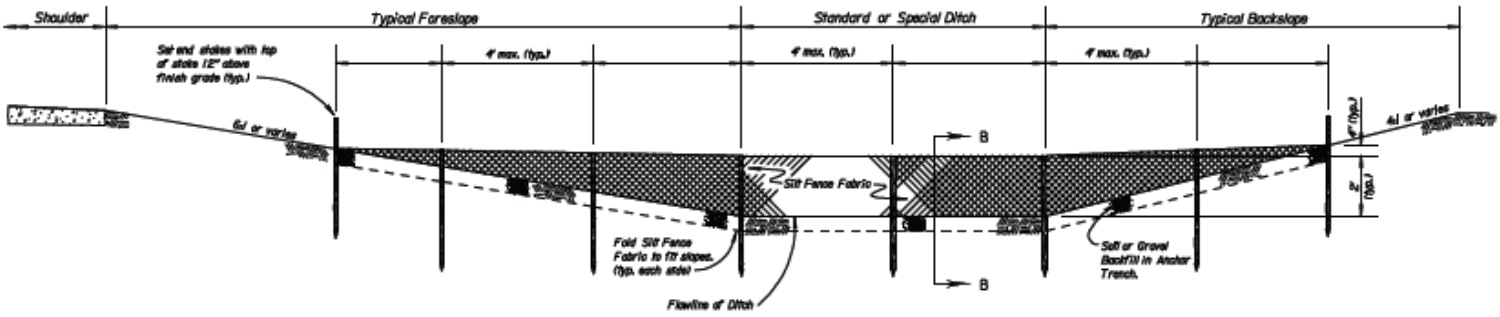


Figure 2-2: Installation of silt-fence ditch checks

List of common placement/installation mistakes to avoid.

- Water should flow through a silt-fence ditch check – not over it. Place silt-fence in ditches where it is unlikely that it will be overtopped. Silt-fence installations quickly deteriorate when water overtops them.
- Do not place silt-fence posts on the upstream side of the silt-fence fabric. In this configuration, the force of the water is not restricted by the posts, but only by the staples (wires, zip ties, nails, etc.). The silt-fence will rip and fail.
- Do not place a silt-fence ditch check directly in front of a culvert outlet. It will not stand up to the concentrated flow.
- Do not place silt-fence ditch checks in ditches that will likely experience high flows. They will not stand up to concentrated flow.
- Follow prescribed ditch-check spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the fence is higher than the low point on the top of the fence.
- Do not place silt-fence ditch checks in channels with shallow soils underlain by rock. If the check is not anchored sufficiently, it will wash out.

INSPECTION & MAINTENANCE

Silt-fence ditch checks should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow around the ditch check?***
  This is usually caused by insufficient ditch – check length. If this occurs, lengthen the check so that the ground level at the ends of the fence is higher than the low point on the **top** of the fence.

- ***Does water flow under the ditch check?***
  This can be caused by posts that are too far apart, a trench that is too shallow, or an improper burial procedure. Posts should be no more than 4 ft. (1.2 m) apart. The trench should be at least 4" (100 mm) wide by 6" (150 mm) deep. The bottom edge of the silt-

fence should be anchored securely by backfilling over the fabric in the trench with the excavated soil and then compacting. If these guidelines have not been met, the silt-fence ditch check should be reinstalled or the deficiencies should be remedied.

- ***Does the silt-fence sag excessively?***
  Sagging silt-fence is caused by excessive post spacing and/or overtopping of the silt fence. Silt-fence posts should be no more than 4 ft. (1.2 m) apart. If the post spacing exceeds 24 ft. (7.2 m), additional posts should be added to decrease spacing between posts. Water should flow through a silt-fence ditch check – not over it. Silt-fence installations deteriorate quickly when water overtops them. If a silt-fence ditch check is regularly overtopped, it has probably been placed in a location that receives flows beyond its intended capacity. In this case, discontinue the use of silt-fence in this area and try something different (e.g., bale ditch checks, TSDs, rock checks).

- ***Has the silt-fence torn or become detached from the posts?*** Silt-fence can be torn by the force of ponded water, or by winds that rip the silt-fence fabric away from the posts. If a silt-fence develops tears for any reason, it should be replaced.

- ***Does sediment need to be removed from behind the ditch check?*** Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the silt-fence. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check. This is why it is extremely important to inspect ditch checks within 24 hours of a large rainfall.

When removing sediment from behind a silt-fence ditch check with a bulldozer or backhoe, take care not to undermine the entrenched silt-fence.

PURPOSE & OPERATION

Triangular silt dikes (TSDs) work on the same principle as bale ditch checks; they intercept and pond sediment-laden runoff. Ponding the water reduces the velocity of any incoming flow and allows most of the suspended sediment to settle out. Water exits the TSD by flowing over the top. The geotextile apron on the downstream side of the dike helps prevent scour caused by this flowing water. Because TSD installations require a minimal depth for anchoring, they are well suited to ditches with shallow soils underlain by rock.

DESIGN

Material Specification

- Triangular Silt Dikes™
- The metal landscape staples used to anchor the TSDs should be at least 6" to 8" (150 to 200 mm) long.

Placement

- TSDs should be placed **perpendicular** to the flow line of the ditch.
- The TSDs should extend far enough so that the bottoms of the end dikes are higher than the top of the lowest center dike. This prevents water from flowing around the TSD.
- TSDs should not be placed in ditches where high flows are expected. Rock checks should be used instead.
- TSDs should be placed in ditches with a slope of 6% or less. For slopes steeper than 6%, rock checks should be used.

The following table provides check spacing for a given ditch grade:

Ditch Check Spacing	
Ditch Grade (%)	***Check Spacing (ft./m)***
1.0	**200/61**
2.0	**100/30**
3.0	**65/20**
4.0	**50/15**
5.0	**40/12**
6.0	**30/10**

INSTALLATION

Proper installation method

- Excavate a trench perpendicular to the ditch flow line that is at least 4" (100 mm) deep by 4" (100 mm) wide. Extend the trench in a straight line along the entire length of the proposed TSD installation. Place the soil on the upstream side of the trench for later use.

- Each TSD has two aprons: one upstream and one downstream. The upstream apron is the shorter of the two. Place one TSD on the downstream side of the trench. Conform the flexible TSD to the geometry of the ditch so that no space exists between the dike and the ditch bottom. Place the first 4" to 6" (100 to 150 mm) of the upstream apron in the trench and anchor it with one row of 6" to 8" (150 to 200 mm) landscape staples on 18" (460 mm) centers. Place an additional row of 6" to 8" (150 to 200 mm) landscape staples on 18" (460 mm) centers along the seam on the upstream side of the TSD. The downstream apron (which folds under the base of TSD) should terminate freely on the downstream side of the TSD. No trench is needed to anchor the downstream apron. This apron should be anchored with two rows of 6" to 8" (150 to 200 mm) landscape staples placed on 18" (460 mm) centers. One row should be placed where the downstream apron meets the base of the dike, and the other row should be placed at the downstream edge of the apron.
- Each TSD has an open sleeve at either end. Connect adjoining dikes with these sleeves and then **repeat the anchoring procedure in the previous step.**
- Once all the TSDs have been joined and anchored, fill in the upstream trench with soil and compact it.

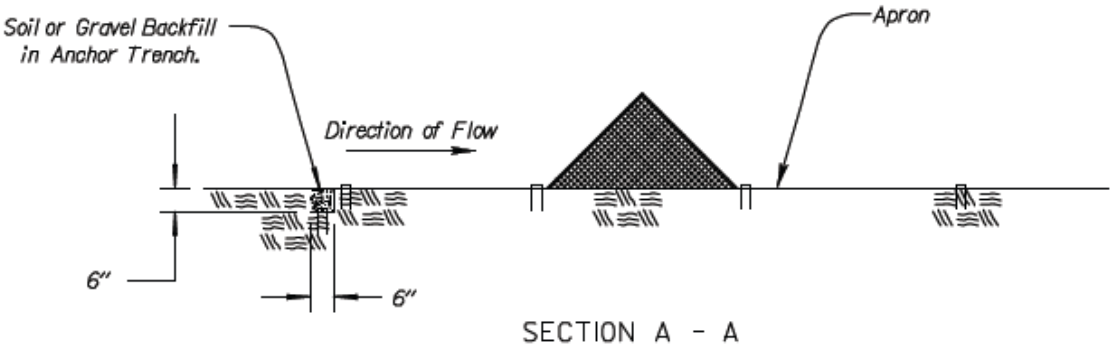


Figure 3-1: Detail of TSD ditch check installation

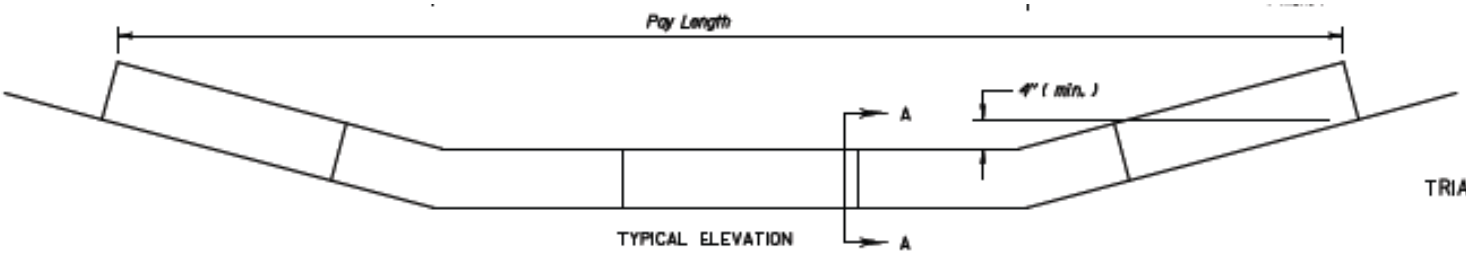


Figure 3-2: Installation of TSD ditch checks

List of common placement/installation mistakes to avoid

- Do not place TSDs directly in front of a culvert outlet. They will not stand up to the concentrated flow.
- The upstream apron of the TSD must be dug into the soil and anchored. If it is not, water will flow under the base of the check.
- Follow prescribed TSD spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.

- Do not allow water to flow around the TSD. Make sure that the dike extends far enough so that the bottoms of the end dikes are higher than the top of the lowest center dike.

INSPECTION & MAINTENANCE

TSDs should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow around the TSDs?***
  This is usually caused by insufficient dike length. If this occurs, extend the check to where the bottoms of the end dikes are higher than the top of the lowest center dike.

- ***Does water flow under the TSDs?***
  This is usually caused by not properly anchoring the TSD. Make sure that the upstream apron is trenched in and that an adequate number of staples have been used.

- ***Does water flow through spaces between abutting TSDs?***
  This is usually caused by poor connections between adjoining dikes. Dikes should be connected at their ends with the connecting sleeves. If spaces exist between adjoining dikes, they should be reconnected properly.

- ***Does sediment need to be removed from behind the TSDs?***
  Sediment accumulated behind the TSDs should be removed when it reaches one-half of the dike height. Allowing too much sediment to accumulate behind a TSD check drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check. This is why it is extremely important to inspect ditch checks within 24 hours of a large rainfall.

  When removing sediment from behind a TSD with a bulldozer or backhoe, make sure not to hook the upstream apron with the blade. This will damage the check and it will have to be replaced.

PURPOSE & OPERATION

Rock ditch checks operate by intercepting and ponding sediment-laden runoff. Ponding the water dissipates the energy of any incoming flow and allows a large portion of the suspended sediment to settle out. Water exits the ditch check by flowing over its crest. Rock ditch checks are ideal for ditches that will eventually have a riprap lining. Upon completion of the project, the rock ditch checks can be spread out to form the riprap channel lining.

DESIGN

Material Specification

- Rock ditch checks should be constructed of stone that complies with Section 1116.02(d) of KDOT's Standard Specifications.

Placement

- Rock ditch checks should be placed **perpendicular** to the flow line of the ditch.
- Rock ditches must be designed so that water can flow over them – not around them. The ditch check should extend far enough so that the ground level at the ends of the check is higher than the low point on the crest of the check.
- Rock ditch checks are best located in ditches that will eventually be lined with riprap so that the rock won't have to be removed at the completion of construction.

The following table provides check spacing for a given ditch grade:

Ditch Check Spacing	
Ditch Grade (%)	***Check Spacing (ft./m)***
1.0	**200/61**
2.0	**100/30**
3.0	**65/20**
4.0	**50/15**
5.0	**40/12**
6.0	**30/10**

INSTALLATION

Proper installation method

- Using approved stone, construct a rock ditch check perpendicular to the ditch flow line. The ditch check should be 18" to 24" (460 to 600 mm) high and have side slopes no steeper than 1:1. The rock ditch check must be constructed so that water can **flow over the top** – not around the ends (i.e. the ground level at the ends of the check must be higher than the low point on the crest of the check).

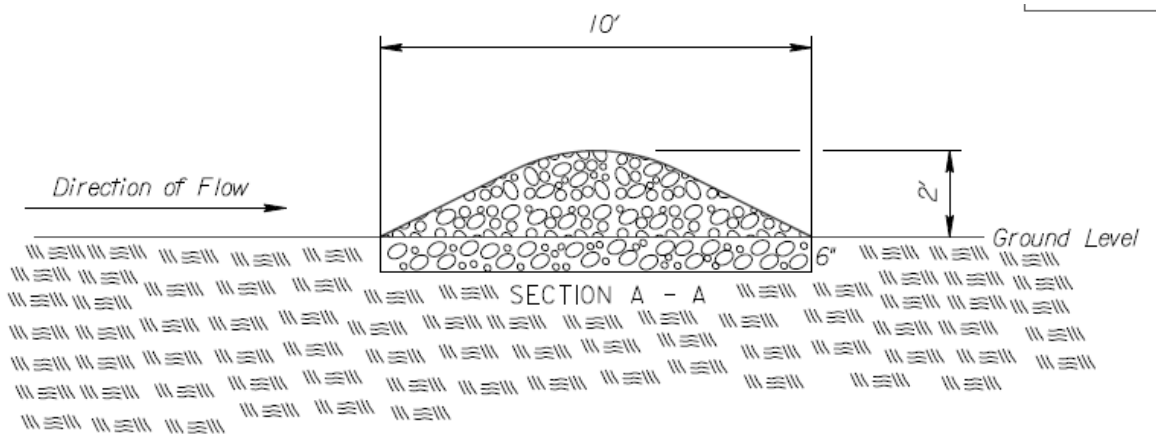


Figure 4-1: Detail of rock ditch check installation

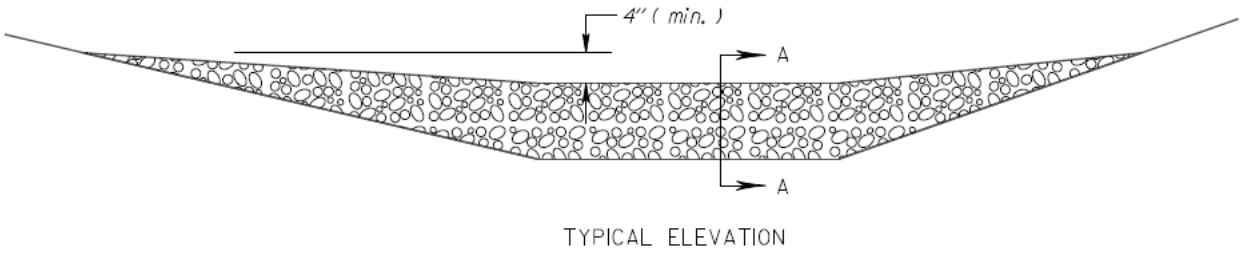


Figure 4-2: Installation of rock ditch checks

List of common placement/installation mistakes to avoid

- Follow prescribed ditch check spacing guidelines. If spacing guidelines are exceeded, erosion will occur between the ditch checks.
- Do not allow water to flow around the ditch check. Make sure that the ditch check is long enough so that the ground level at the ends of the check is higher than the low point on the crest of the check.

INSPECTION & MAINTENANCE

Rock ditch checks should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during **each** inspection:

- ***Does water flow around the ditch check?***
  This is usually caused by insufficient ditch check length. If this occurs, extend the check a sufficient length so that the ground level at the ends of the check is higher than the low point on the crest of the check.

- ***Have high-velocity flows displaced any stones from the check?***
  Sometimes high-velocity flows can carry away portions of a rock ditch check. After a

large rainstorm, inspect the rock ditch check for any displaced stones. If a large portion of a rock ditch check has washed away, fill in the void with new stone immediately.

- ***Does sediment need to be removed from behind the ditch check?***
  Sediment accumulated behind the ditch check should be removed when it reaches one-half of the original exposed height of the rock ditch check. Allowing too much sediment to accumulate behind a ditch check drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the ditch check. This is why it is extremely important to inspect ditch checks within 24 hours of a large rainfall.

The easiest way to remove sediment from behind a rock ditch check is with a bulldozer or backhoe.

PURPOSE & OPERATION

Bale slope barriers operate by intercepting and ponding sediment-laden slope runoff. Ponding the water dissipates the energy of the incoming flow and allows much of the suspended sediment to settle out. Water exits the bale slope barrier by flowing over the bales.

DESIGN

Material Specification

- Bale slope barriers may be constructed of wheat straw, oat straw, prairie hay, or brome grass hay that is free of weeds declared noxious by the Kansas State Board of Agriculture.
- The stakes used to anchor the bales should be a hardwood material with the following minimum dimensions: 2" (50 mm) square (nominal) by 4 ft. (1.2 m) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.

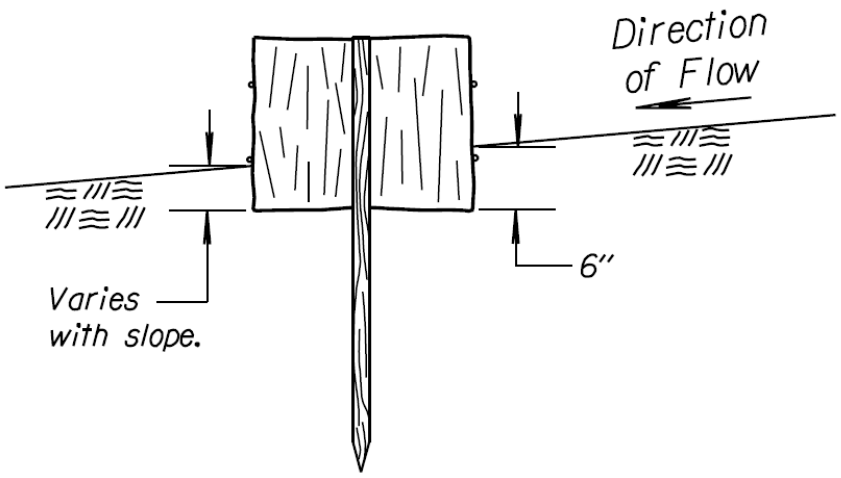
Placement

- A slope barrier should be used at the toe of a slope when a ditch does not exist. The slope barrier should be placed in nearly level ground 5 ft. to 10 ft. (1.5 to 3 m) away from the toe of a slope. The barrier is placed away from the toe of the slope to provide adequate storage for settling out sediment.
- When practicable, bale slope barriers should be placed along contours to avoid a concentration of flow.
- Bale slope barriers can also be placed along right-of-way fence lines to keep sediment from crossing onto adjacent property. When placed in this manner, the slope barrier will not likely follow contours.

INSTALLATION

Proper installation method

- Excavate a trench the length of the planned slope barrier that is 6" (150 mm) deep and a bale's width wide. Make sure that the trench is excavated along a single contour. **When practicable, slope barriers should be placed along contours to avoid a concentration of flow.** Place the soil on the upslope side of the trench for later use.
- Place the bales in the trench, making sure that they are butted tightly. Two stakes should be driven through each bale along the centerline of the ditch check, approximately 6" to 8" (150 to 200 mm) in from the bale ends. Stakes should be driven **at least** 18" (460 mm) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the upslope side of the check and compact it. The compacted soil should be no more than 3" to 4" (75 to 100 mm) deep.



List of common placement/installation mistakes to avoid

- When practicable, do not place bale slope barriers across contours. **Slope barriers should be placed along contours to avoid a concentration of flow.** Concentrated flow over a slope barrier creates a scour hole on the down slope side of the barrier. The scour hole eventually undermines the bales and the barrier fails.
- Do not place bale slope barriers in areas with shallow soils underlain by rock. If the barrier is not anchored sufficiently, it will wash out.
- Bale slope barriers must be dug into the ground. Bales at ground level do not work because they allow water to flow under the barrier.

INSPECTION & MAINTENANCE

Bale slope barriers should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Are there any points along the slope barrier where water is concentrating?***
  When slope barriers are not placed along contours, water concentrates at low points of the slope barrier. This concentrated flow usually causes a failure of the slope barrier. Even if the barrier does not fail, the concentration of flow drastically reduces the overall storage capacity of the slope barrier. The only solution to this problem is reinstalling the slope barrier (or sections of it) so that it is level.

- ***Does water flow under the slope barrier?***
  This is usually caused by not trenching the bales deep enough (at least 6" (150 mm)) or by insufficient compaction of soil against the upslope side of the check. If the problem is insufficient compaction, add more soil to the upslope side of the check and recompact. If the problem is improperly trenched bales, the entire slope barrier should be removed and a new one installed using the proper trench depth.

- ***Does water flow through spaces between abutting bales?***
  This is usually caused by not butting the bales tight enough during initial installation. Stuffing loose bale material between the bales to fill up the space can usually solve this problem.
- ***Are any bales dislodged?***
  Check to see if any bales have become dislodged from their original position. Dislodged bales should be repositioned and restaked if they are still reusable – otherwise, replace them.

- ***Are bales decomposing due to age and/or water damage?***
  Under normal conditions, the maximum useful life of a bale is normally 3 months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.

- ***Does sediment need to be removed from behind the slope barrier?***
  Sediment accumulated behind the slope barrier should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a slope barrier drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill up the space behind the slope barrier. This is why it is extremely important to inspect slope barriers within 24 hours of a large rainfall.

When removing sediment from behind a bale slope barrier with a bulldozer or backhoe, take care not to undermine the entrenched bales.

PURPOSE & OPERATION

Silt-fence slope barriers operate by intercepting and ponding sediment-laden slope runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. Water exits the silt-fence slope barrier by percolating through the silt-fence.

DESIGN

Material Specification

- Silt-fence fabric should conform to the AASHTO M288 05 silt-fence specification.
- The posts used to support the silt-fence fabric should be a hardwood material with the following minimum dimensions: 2" (50 mm) square (nominal) by 4 ft. (1.2 m) long.
- Silt-fence fabric should be attached to the wooden posts with staples, wire, zip ties, or nails.

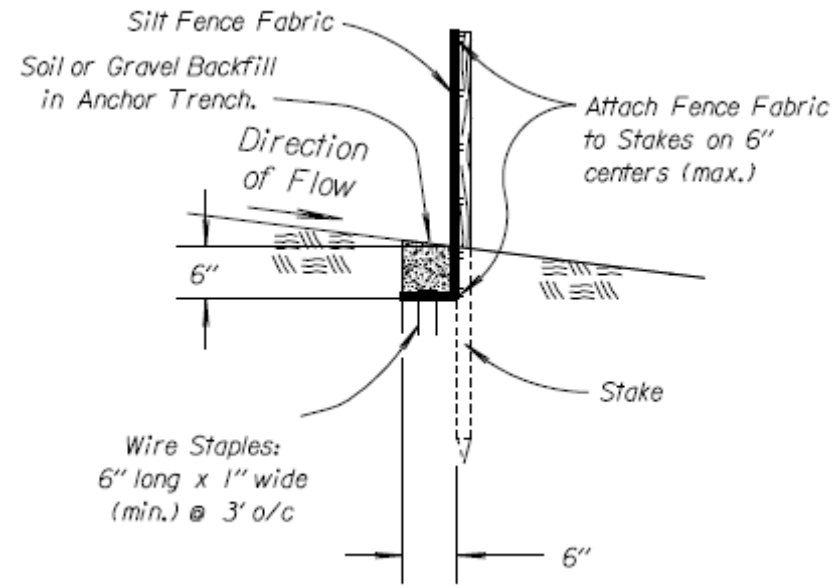
Placement

- A slope barrier should be used at the toe of a slope when a ditch does not exist. The slope barrier should be placed on nearly level ground 5 ft. to 10 ft. (1.5 to 3 m) away from the toe of a slope. The barrier is placed away from the toe of the slope to provide adequate storage for settling out settlement.
- When practicable, silt-fence slope barriers should be placed along contours to avoid a concentration of flow.
- Silt-fence slope barriers can also be placed along right-of-way fence lines to keep sediment from crossing onto adjacent property. When placed in this manner, the slope barrier will not likely follow contours.

INSTALLATION

Proper installation method

- Excavate a trench the length of the planned slope barrier that is 6" (150 mm) deep by 4" (100 mm) wide. Make sure that the trench is excavated along a single contour. **When practicable slope barriers should be placed along contours to avoid a concentration of flow.** Place the soil on the upslope side of the trench for later use.
- Roll out a continuous length of silt-fence fabric on the down slope side of the trench. Place the edge of the fabric in the trench starting at the top upslope edge. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil and compact. After filling the trench, approximately 24" to 36" (600 to 900 mm) of silt-fence fabric should remain exposed.
- Lay the exposed silt-fence upslope of the trench to clear an area for driving in the posts. Just down slope of the trench, drive posts into the ground to a depth of at least 24" (600 mm). Place posts no more than 4 ft (1.2 m) apart.
- Attach the silt-fence to the anchored post with staples, wire, zip ties, or nails.



List of common placement/installation mistakes to avoid

- When practicable, do not place silt-fence slope barriers across contours. **Slope barriers should be placed along contours to avoid a concentration of flow.** When the flow concentrates, it overtops the barrier and the silt-fence slope barrier quickly deteriorates.
- Do not place silt-fence posts on the upslope side of the silt-fence fabric. In this configuration, the force of the water us not restricted by the posts, but only by the staples (wire, zip ties, nails, etc.). The silt-fence will rip and fail.
- Do not place silt-fence slope barriers in areas with shallow soils underlain by rock. If the barrier is not sufficiently anchored, it will wash out.
- Silt-fence slope barriers must be dug into the ground – silt-fence at ground level does not work because water will flow underneath.

INSPECTION & MAINTENANCE

Silt-fence slope barriers should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Are there any points along the slope barrier where water is concentrating?***
  When slope barriers are not placed along contours, water concentrates at low points of the slope barrier. This concentrated flow usually causes a failure of the slope barrier. Even if the barrier does not fail, the concentration of flow drastically reduces the overall storage capacity of the slope barrier. The only solution to this problem is reinstalling the slope barrier (or sections of it) so that it is level.

- ***Does water flow under the slope barrier?***
  This can be caused by posts that are too far apart, a trench that is too shallow, or an improper burial procedure. Posts should be no more than 4 ft. (1.2 m) apart. The trench should be at least 4" (100 mm) wide by 5" (150 mm) deep. The bottom edge of the silt fence should be anchored securely by backfilling over the fabric in the trench with the excavated soil and then compacting. If these guidelines have not been met, the silt-fence slope barrier should be reinstalled or the deficiencies should be remedied.

- ***Does the silt-fence sag excessively?***
  Sagging silt-fence is caused by excessive post spacing and/or overtopping of the silt-fence. Silt-fence posts should be no more than 4 ft. (1.2 m) apart. If the post spacing exceeds 4 ft. (1.2 m), additional posts should be added to decrease spacing between posts. Water should flow through a silt-fence slope barrier – not over it. Silt-fence installations quickly deteriorate when water overtops them. If a silt-fence slope barrier is regularly overtopped, it has probably been placed in a location that receives flows beyond its intended capacity. If this is the case, discontinue the use the silt-fence in this area and try something different (e.g., bale slope barriers).

- ***Has the silt-fence torn or become detached from the posts?***
  Silt-fence can be torn by the force of ponded water, or by winds that rip the silt-fence fabric away from the posts. If a silt-fence develops tears for any reason, it should be replaced.

- ***Does sediment need to be removed from behind the slope barrier?***
  Sediment accumulated behind the slope barrier, should be removed when it reaches one-half of the original exposed height of the silt-fence. Allowing too much sediment to accumulate behind a slope barrier drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill up the space behind the slope barrier. That is why it is extremely important to inspect slope barriers within 24 hours of a large rainfall.

When removing sediment from behind a silt-fence slope barrier with a bulldozer or backhoe, take care not to undermine the entrenched silt-fence.

► SECTION 7 Bale Drop-Inlet Barriers

PURPOSE & OPERATION

Bale drop-inlet barriers operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. When the pond height reached the top of the barrier, water flows over the bales and into the drop inlet.

DESIGN

Material Specification

- Bale drop-inlet barriers should be constructed of wheat straw, oat straw, prairie hay, or brome grass hay that is free of weeds declared noxious by the Kansas State Board of Agriculture.
- The stakes used to anchor the bales should be a hardwood material with the following minimum dimensions: 2" (50 mm) square (nominal) by 4 ft (1.2 m) long.
- Twine should be used to bind bales. The use of wire binding is prohibited because it does not biodegrade readily.

Placement

- Bale drop-inlet barriers should be placed directly around the perimeter of a drop inlet.
- When a bale drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

INSTALLATION

Proper installation method

- Excavate a trench around the perimeter of the drop inlet that is at least 6" (150 mm) deep by a bale's width wide.
- Place the bales in the trench, making sure that they are butted tightly. Some bales may need to be shortened to fit into the trench around the drop-inlet. Two stakes should be driven through each bale, approximately 6" to 8" (150 to 200 mm) in from the bale ends. Stakes should be driven at **least** 18" (460 mm) into the ground.
- Once all the bales have been installed and anchored, place the excavated soil against the receiving side of the barrier and compact it. The compacted soil should be no more than 3" to 4" (75 to 100 mm) deep.
- **Note:** When a bale drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway causing a hazardous condition.

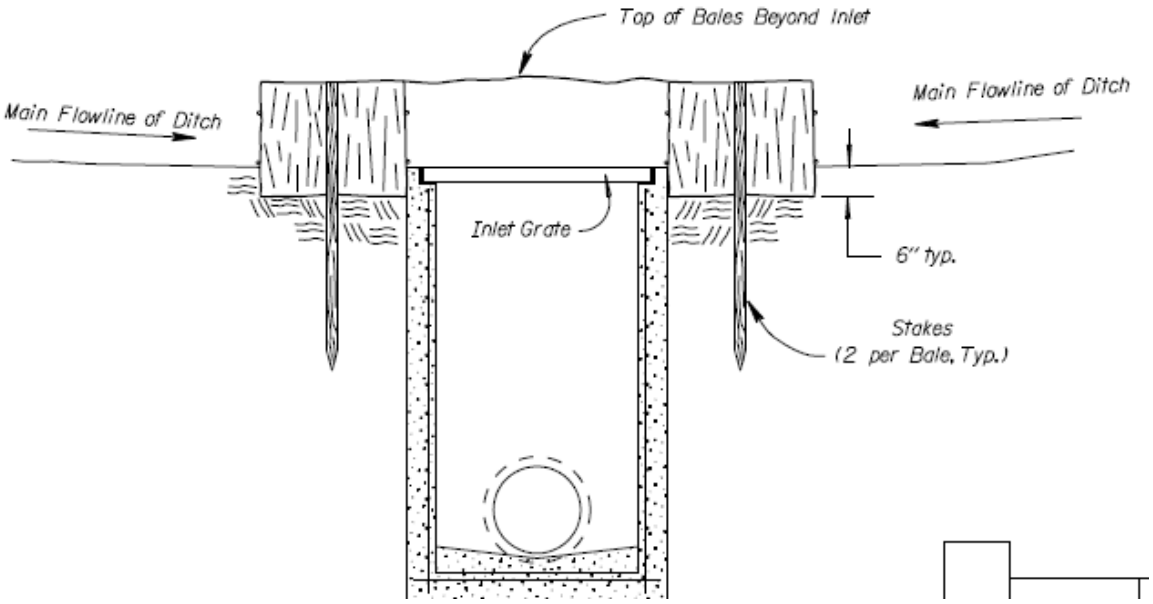


Figure 7-1: Detail of bale-inlet barrier installation

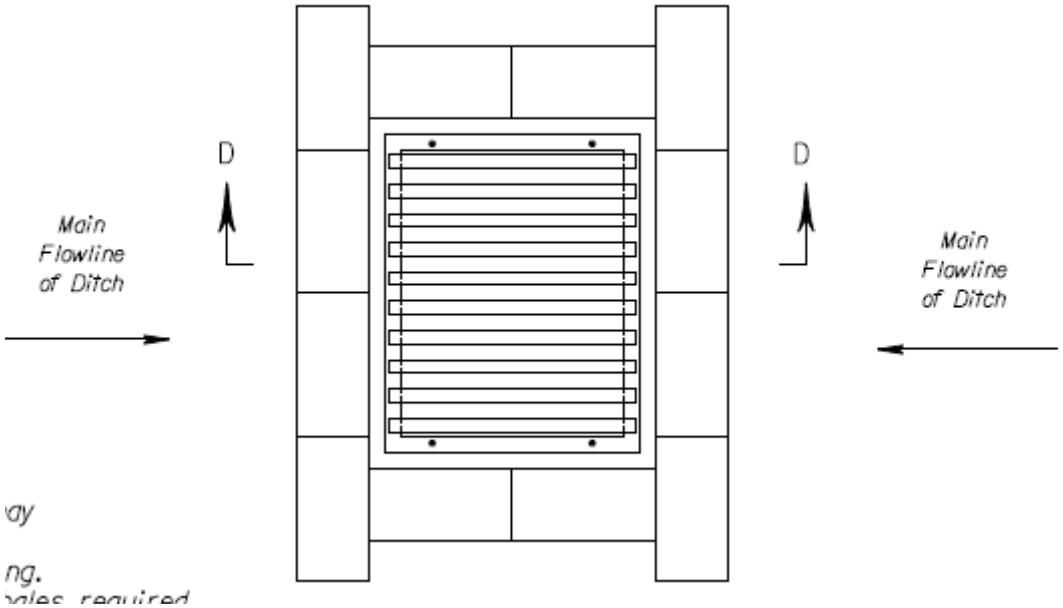


Figure 7-2: Plan view of bale-inlet barrier installation

List of common placement/installation mistakes to avoid

- Bales should be placed directly against the perimeter of the drop-inlet. This allows overtopping water to flow directly into the inlet instead on onto nearby soil causing scour.
- Bale drop-inlet barriers must be dug into the ground. Bales at ground level do not work because they allow water to flow under the barrier.

INSPECTION & MAINTENANCE

Bale drop-inlet barriers should be inspected every 7 days and within 24 hours of a rainfall ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow under the drop-inlet barrier?***
  This is usually caused by not trenching in the bales deep enough (at least 6" (150 mm)) or insufficient compaction of soil around the barrier. If the problem is insufficient compaction, add more soil around the base of the barrier and recompact. If the problem is improperly trenched bales, the drop-inlet barrier should be removed and a new one installed using the proper trench depth.

- ***Does water flow through spaces between abutting bales?***
  This is usually caused by not butting the bales tight enough during initial installation. Stuffing loose bale material between the bales to fill up the space can usually solve this problem.

- ***Are any bales dislodged?***
  Check to see if any bales have become dislodged from their original position. Dislodged bales should be repositioned and restaked if they are still reusable – otherwise replace them.

  A dislodged bale should be repaired immediately because it has the potential to create a bigger problem: **flooding.** If a bale falls over onto a drop-inlet during a storm, the inlet can become blocked, causing flooding of the roadway.

- ***Are bales decomposing due to age and/or water damage?***
  Under normal conditions, the maximum useful life of a bale is normally 3 months (but may be longer during prolonged dry periods). Inspect the bales for signs of decomposition and replace as necessary.

- ***Does sediment need to be removed from behind the drop-inlet barrier?***
  Sediment accumulated behind the drop-inlet barrier should be removed when it reaches one-half of the original exposed height of the bales. Allowing too much sediment to accumulate behind a drop-inlet barrier drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from the drainage basin to completely fill the space behind the drop-inlet barrier. This is why it is extremely important to inspect drop-inlet barriers within 24 hours of a large rainfall.

  When removing sediment from behind a bale drop-inlet barrier with a bulldozer or backhoe, take care not to undermine the entrenched bales.

►SECTION 8 Silt-Fence Drop-Inlet Barriers

PURPOSE & OPERATION

Silt-fence drop-inlet barriers works just like a ditch check or a slope barrier: the silt-fence intercepts, ponds, and filters sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. As the ponded water percolates through the silt-fence fabric, much of the remaining suspended sediment is filtered out.

DESIGN

Material Specification

- Silt-fence fabric should conform to the AASHTO M288 05 silt-fence specification.
- The wire or polymeric mesh backing used to help support the silt-fence fabric should conform to the AASHTO M288 05 silt-fence specification.
- The posts used to support the silt-fence fabric should be a hardwood material with the following minimum dimensions: 2” (50 mm) square (nominal) by 4 ft. (1.2 m) long.
- The material used to frame the tops of the posts should be 2” (50 mm) by 4” (100 mm) boards.
- Silt-fence fabric and support backing should be attached to the wooden posts and frame with staples, wire, zip ties, or nails.

Placement

- Place a silt-fence drop-inlet barrier in a location where it is unlikely to be overtopped. Water should flow through silt-fence – not over it. Silt-fence drop-inlet barriers often fail when repeatedly overtopped.
- When used as a drop-inlet barrier, silt-fence fabric and posts must be supported at the top by a wooden frame.
- When a silt-fence drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

INSTALLATION

Proper installation method

- Excavate a trench around the perimeter of the drop-inlet that is **at least** 6” (150 mm) deep by 4” (100 mm) wide.
- Drive posts to a depth of at least 24” (600 mm) around the perimeter of the drop-inlet. The distance between posts should be 4 ft. (1.2 m) or less. If the distance between two adjacent corner posts is more than 4 ft. (1.2 m), add another post(s) between them.
- Connect the tops of all the posts with a wooden frame made of 2” (50 mm) by 4” (100 mm) boards. Use nails or screws for fastening.
- Attach the wire or polymeric-mesh backing to the **outside** of the post/frame structure with staples, wire, zip ties, or nails.

- Roll out a continuous length of silt-fence fabric long enough to wrap around the perimeter if the drop-inlet. Add more length for overlapping the fabric joint. Place the edge of the fabric in the trench, starting at the outside edge of the trench. Line all three sides of the trench with the fabric. Backfill over the fabric in the trench with the excavated soil and compact. After filling the trench, approximately 24" to 36" (600 to 900 mm) of silt-fence fabric should remain exposed.
- Attach the silt-fence to the **outside** of the post/frame structure with staples, wire, zip ties, or nails. The joint should be overlapped to the next post.
- **Note:** When a silt-fence drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway, causing a hazardous condition.

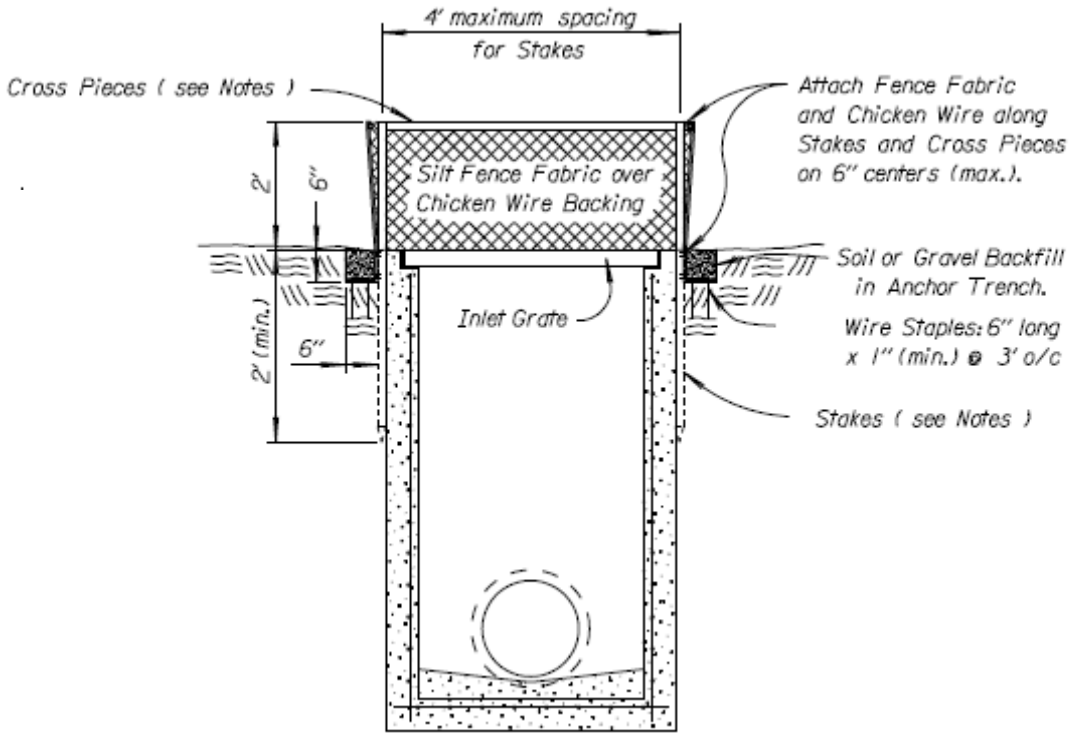


Figure 8-1: Detail of silt-fence drop-inlet barrier installation

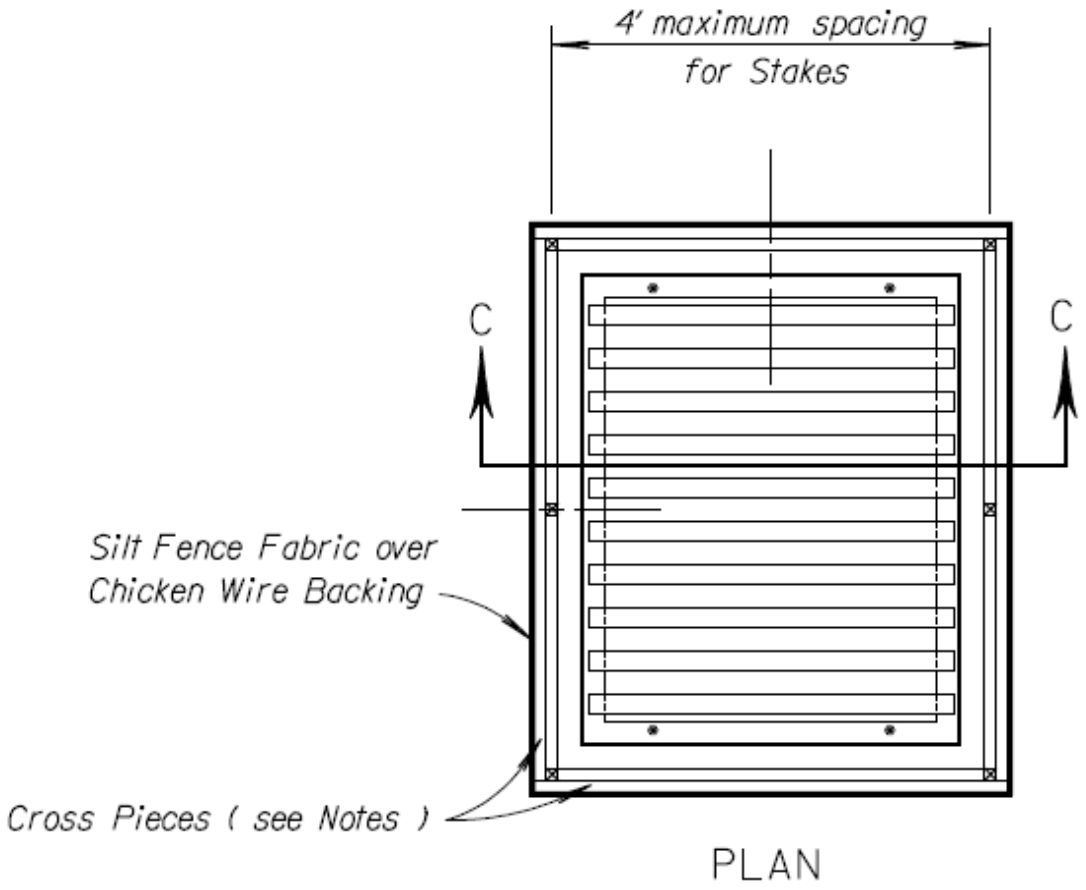


Figure 8-2: Plan view of silt-fence drop-inlet barrier installation

List of common placement/installation mistakes to avoid

- Water should flow through a silt-fence drop-inlet barrier – not over it. Place a silt-fence drop-inlet barrier in a location where it is unlikely to be overtopped. Silt-fence drop-inlet barriers often fail when repeatedly overtopped.
- Do not place posts on the outside of the silt-fence drop-inlet barrier. In this configuration, the force of the water is not resisted by the posts, but only by the staples (wire, zip-ties, nails, etc.). The silt-fence will rip and fail.
- Do not install silt-fence drop-inlet barriers without framing the top of the posts. The corner posts around drop inlets are stressed in two directions whereas a normal silt-fence is only stressed in one direction. This added stress requires more support.

INSPECTION & MAINTENANCE

Silt-fence drop-inlet barriers should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow under the silt-fence?***
  This can be caused by posts that are too far apart, a trench that is too shallow, or an improper burial procedure. Posts should be no more than 4 ft. (1.2 m) apart. The trench should be at least 4" (100 mm) wide by 6" (150 mm) deep. The bottom edge of the silt-fence should be anchored securely by backfilling over the fabric in the trench with the excavated soil and then compacting. If these guidelines have not been met, the silt-fence drop-inlet barrier should be reinstalled or the deficiencies should be remedied.

- ***Does the silt-fence sag excessively?***
  Sagging silt-fence is caused by excessive post spacing or the lack of a frame connecting the posts. Silt-fence posts should be no more than 4 ft. (1.2 m) apart. If the post spacing exceeds 4 ft. (1.2 m), additional posts should be added to decrease spacing between posts. If no post frame exists, one should be added.

  A sagging silt-fence should be repaired immediately because it has the potential to create a bigger problem: **flooding**. If a silt-fence falls over onto a drop-inlet during a storm, the inlet can become blocked, causing flooding of the roadway.

- ***Has the silt-fence torn or become detached from the posts?***
  Silt-fence can be torn by the force of ponded water, or by winds that rip the silt-fence fabric away from the posts. If a silt-fence develops tears for any reason, it should be replaced.

- ***Does sediment need to be removed from behind the drop-inlet barrier?***
  Sediment accumulated behind the drop-inlet barrier should be removed when it reaches one-half of the original exposed height of the silt-fence. Allowing too much sediment to accumulate behind a drop-inlet barrier drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from the drainage basin to completely fill the space behind the drop-inlet barrier. This is why it is extremely important to inspect drop-inlet barriers within 24 hours of a large rainfall.

  When removing sediment from behind a silt-fence drop-inlet barrier with a bulldozer or backhoe, take care not to undermine the entrenched silt-fence.

► SECTION 9 Triangular Silt Dike™ Drop-Inlet Barriers

PURPOSE & OPERATION

Triangular Silt Dike (TSD) drop-inlet barriers operate by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. When the pond height reached the top of the barrier, water flows over the TSDs and into the drop-inlet.

DESIGN

Material Specification

- Triangular Silt Dikes™
- The metal landscape staples used to anchor the TSDs should be at least 6" to 8" (150 to 200 mm) long.

Placement

- TSD drop-inlet barriers should be placed directly around the perimeter of a drop-inlet.
- When a TSD drop-inlet barrier is located near an inlet that has steep approach slopes, the storage capacity behind the barrier is drastically reduced. Timely removal of sediment must occur for a barrier to operate properly in this location.

INSTALLATION

Note: The orientation of the TSD when installed as a drop-inlet barrier differs from installation as a ditch check.

Proper installation method

- For a drop-inlet barrier installation, orient the TSD so that the side bordering the drop-inlet is vertical. Orient the TSD aprons so that the shorter of the two aprons lies beneath the longer one. Neither apron should be under the foam portion of the TSD.
- Place two full sections (approximately 7 ft. (2.1 m) long each) of TSD against opposite sides of the drop-inlet. These sections should extend beyond the edges of the drop sides of the drop-inlet – do not cut these to fit. Excavate trenches that are at least 4" (100 mm) deep by 4" (100 mm) wide near the ends of the TSD apron so that the outer 8" to 10' (200 to 260 mm) of the apron can be buried. Lay the outer 8" to 10" (200 to 260 mm) of apron into the trench and anchor it with 6" to 8" (150 to 200 mm) landscape staples on 18" (460 mm) centers. Backfill the trench with the excavated soil and compact. Anchor the remainder of the apron with a row of 6" to 8" (150 to 200 mm) landscape staples on 18" (460 mm) centers along the seam of the TSD.
- In the spaces where the TSDs extend beyond the edges of the drop-inlet, cut new TSDs to fit. Make sure that a tight fit is achieved between the cut TSDs and the existing TSDs. These cut sections should be oriented and anchored in the same manner as the initial sections.
- **Note:** When a TSD drop-inlet barrier is placed in a shallow median ditch, make sure that the top of the barrier is not higher than the paved road. In this configuration, water may spread onto the roadway causing a hazardous condition.

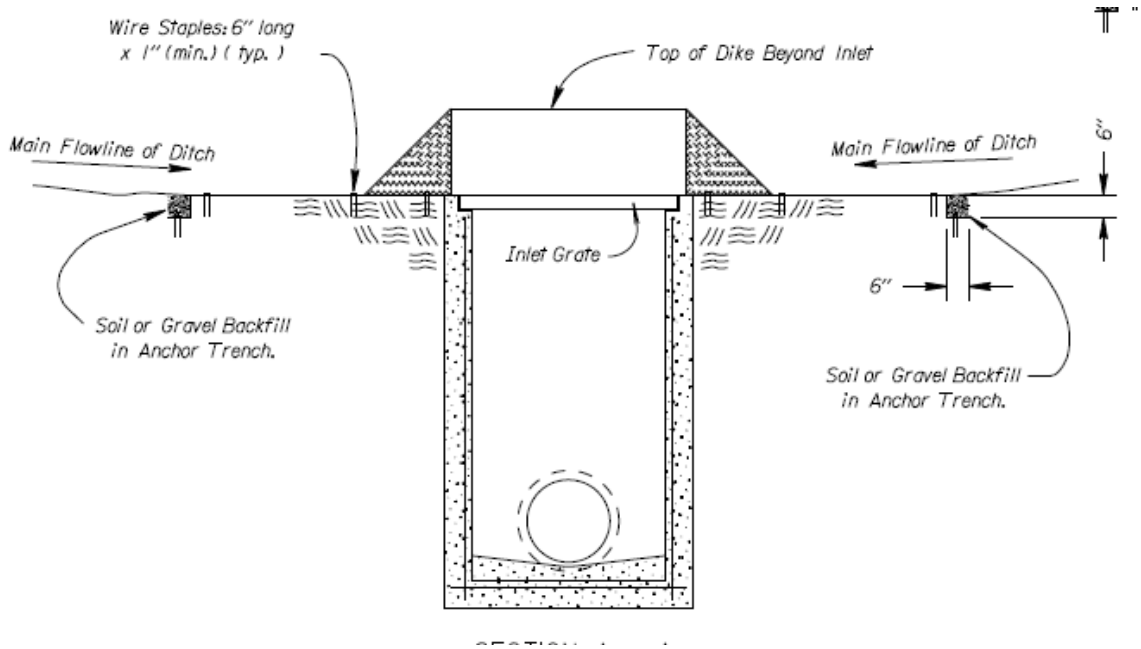


Figure 9-1: Detail of TSD drop-inlet barrier installation

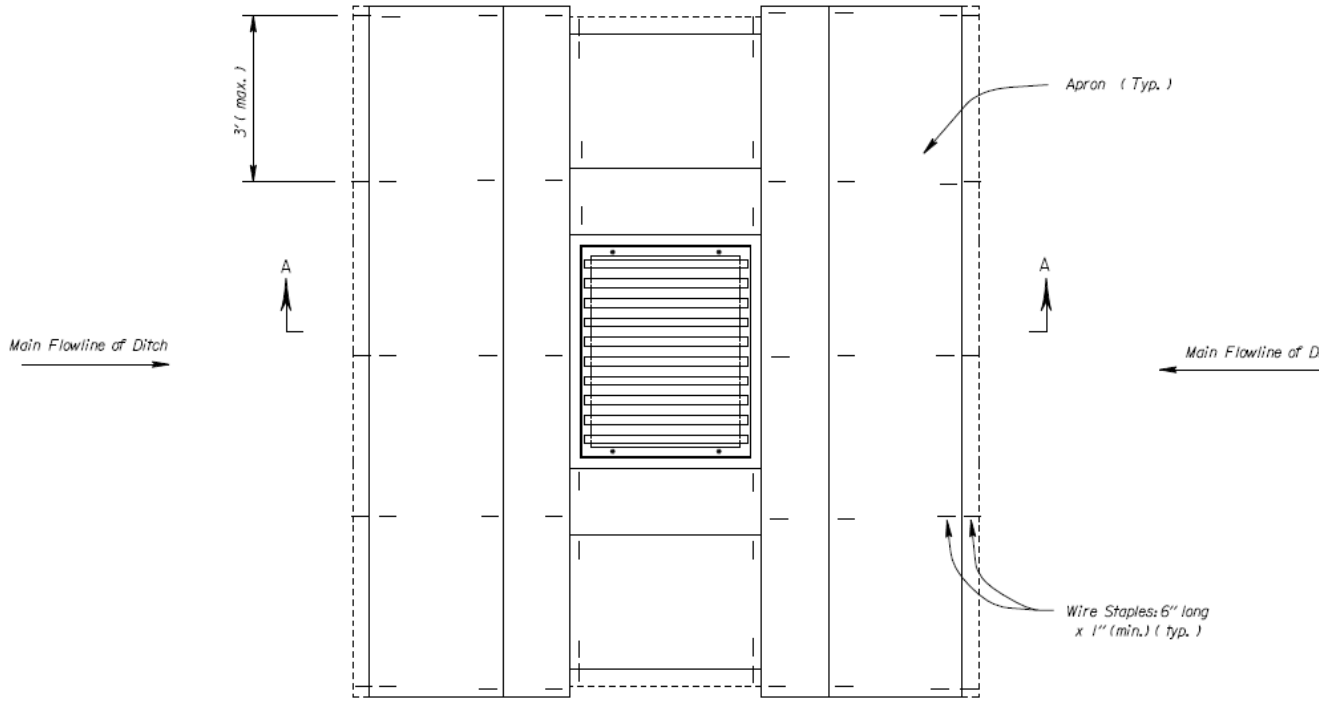


Figure 9-2: Plan view of TSD drop-inlet barrier installation

List of common placement/installation mistakes to avoid

- TSDs should be placed directly against the perimeter of the drop-inlet. This allows overtopping water to flow directly into the inlet instead of onto nearby soil, causing scour.
- Make sure to orient the TSD properly. The side in contact with the drop-inlet should be vertical and the shorter apron should lie beneath the longer one.
- If the receiving apron of a TSD is not dug into the ground, water will flow underneath.

INSPECTION & MAINTENANCE

TSD drop-inlet barriers should be inspected every 7 days and within 24 hours of a rainfall of ½" (10 mm) or more. The following is a list of questions that should be addressed during each inspection:

- ***Does water flow under the TSDs?***
  This is usually caused by not properly anchoring the TSD. Make sure that the receiving apron is trenched in and that an adequate number of staples have been used.

- ***Does water flow through spaces between abutting TSDs?***
  This is usually caused by incorrect sizing of the cut sections. If the cut sections are too small, re-cut new sections so that they fi t properly.

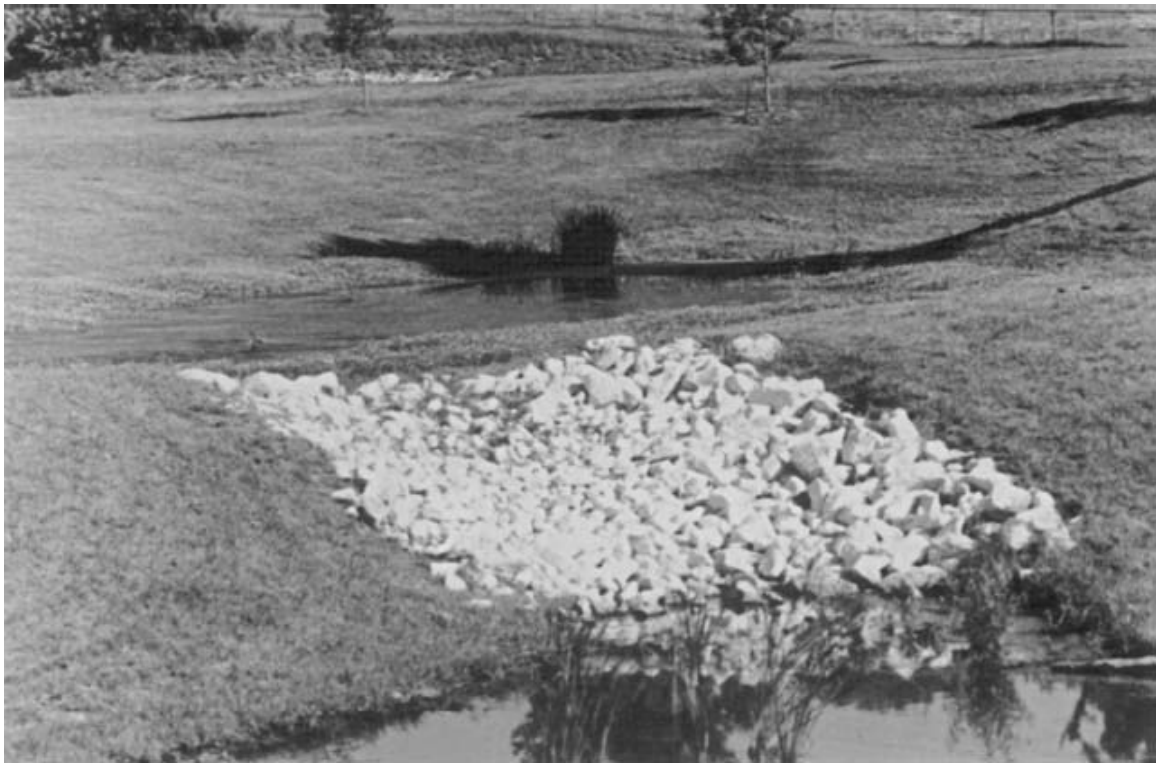
- ***Does sediment need to be removed from behind the TSDs?***
  Sediment accumulated behind the TSDs should be removed when it reaches one-half of the dike height. Allowing too much sediment to accumulate behind a TSD barrier drastically reduces its effectiveness. One high-intensity rainfall can dislodge enough sediment from surrounding slopes to completely fill the space behind the drop-inlet barrier. This is why it is extremely important to inspect drop-inlet barriers within 24 hours of a large rainfall.

  When removing sediment from behind a TSD with a bulldozer or backhoe, make sure not to hook the receiving apron with the blade. This will damage the barrier and it will have to be replaced.

This section was prepared by the St. Charles County Soil & Water Conservation District, St. Charles, Missouri, & the Dam and Reservoir Safety Program, Division of Geology and Land Survey, Missouri Department of Natural Resources, Rolla, Missouri Revised by: The Mid America Association of Conservation Districts (MAACD), Kansas City, Missouri, to include Kansas and Missouri.

PURPOSE & OPERATION

A barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted earth fill across a drainageway.
This practice applies where erosion control measures are insufficient to prevent off-site sedimentation. The purpose of a sediment basin is to detain sediment-laden runoff from disturbed areas in "wet" or "dry" storage long enough for most of the sediment to settle out.



A sediment basin is suitable for small drainageways and can be used to pretreat sediment-laden water before it enters a permanent pool. A rock chute was used to drop the water to a lower elevation.

Recommended Minimum Requirements
Prior to the start of construction, sediment basins should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process.
The sediment basin should be built according to planned grades and dimensions.
Dam height: 10 feet or less
Contributing drainage area: 20 acres or less

Structure life: Limited to 10 years
Detention: At least 24 hours
Sediment storage: Minimum of 3600 feet^3 per disturbed acre. (If space is limited, contact KDHE for reduction in storage capacity).
Trap efficiency: The length to width ratio of the basin should be 2:1 or greater; 5:1 is optimal to capture fine sediments. The inlet should be located as far as possible upstream from the outlet.
Embankment:
Top Width: At least 6 feet
Side Slopes: 2.5:1 or flatter; 3:1 where maintained by tractor or other equipment
Settlement: Allow for at least 10%
Fill material: Stable moist soil compacted in lifts less than 8 inches
Anti-seep devices: Either of the following is recommended:
At least two watertight anti-seep collars should be used around the outlet conduit; collars should project 1 to 3 feet from the pipe, or a sand diaphragm
Risers: Should be held in place with an anchor or large foundation, to keep them from becoming buoyant.
Emergency Spillway: Constructed in undisturbed soil in a location that will not erode the dam
Cross Section: Trapezoidal-shaped with side slopes of 3:1 or flatter
Control Section: Level, straight and at least 20 feet long. The spillway should have a minimum width of 10 feet.

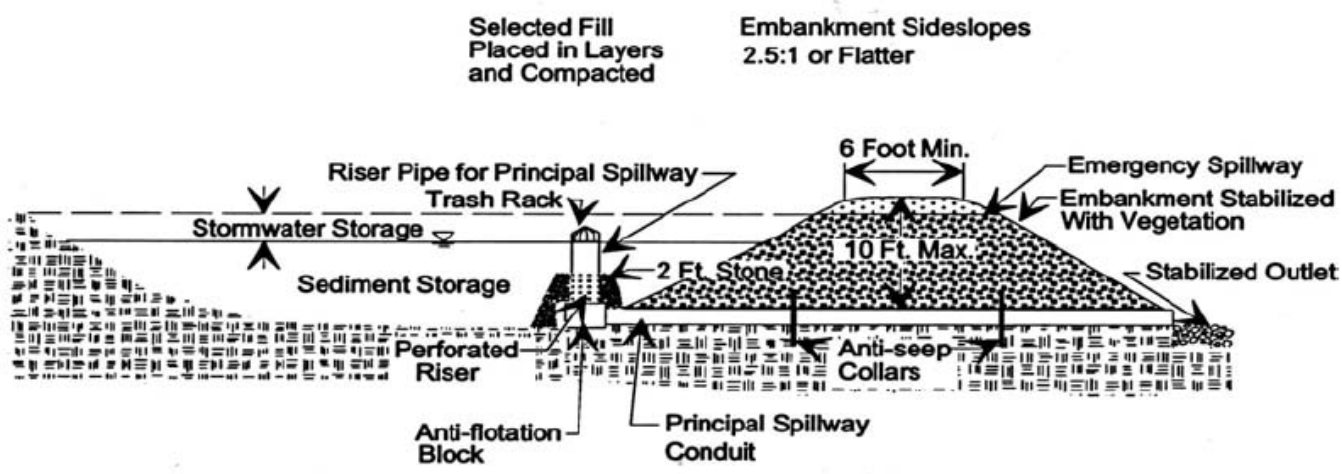


Figure 10-1: Typical Sediment Basin

Construction
Locate the sediment basin as close to the sediment source as possible, considering soil type, pool area, dam length and spillway conditions.
Site Preparation
Locate all utilities at the site.
Follow all federal, state and local requirements on impoundments.
Clear, grub and strip the dam foundation, removing all woody vegetation, rocks and other objectionable material.
Dispose of trees, limbs, logs and other debris in designated disposal areas.
Excavate the foundation (outlet apron first), stockpiling any surface soil having high amounts of organic matter for later use.

Principal Spillway

Clear the sediment pool to facilitate sediment clean out.

Situate the spillway barrel (pipe) and riser on a firm, even foundation.

Prepare the pipe bedding.

Place around the barrel a 4-inch layer 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. (Don't raise the pipe from the foundation when compacting under the pipe haunches.)

Perforate the lower half of the riser with 1/2-inch diameter holes spaced 3 inches apart (or use a manufactured perforated riser).

Embed the riser at least 12 inches into concrete (which serves as an anti-flotation block). The weight of the concrete should balance the buoyant force acting on the riser.

Buoyant Force = Volume of Riser x 62.4 lbs/ft^3

Surround the riser with 2 feet of clean, uniformly graded stone.

Place a steel trash rack around the riser inlet. Trash rack openings should be 4- to 6-inches square.

At the pipe outlet, install a riprap apron at least 5 feet wide and 10 feet long 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.

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

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

Construct and compact the dam to an elevation 10% above the design height to allow for settling.

Place a reference stake at the sediment clean out elevation (50% of design elevation).

Emergency Spillway

Construct the spillway in undisturbed soil around one end of the embankment, and locate it so that any flow will return to the receiving channel without damaging the embankment.

Stabilize the spillway as soon as grading is complete with vegetation or erosion control blankets; install paving material to finished grade if the spillway is not to be vegetated.

Erosion Control

Minimize the size of all disturbed areas. Vegetate and stabilize as soon as construction is complete.

Divert runoff from undisturbed areas away from the basin.

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

Divert sediment-laden water to the upper end of the sediment pool to improve trap effectiveness.

Direct all runoff into the basin at a low velocity (channel slope less than 1%).

Vegetate and stabilize all disturbed areas (except the lower one-half of the sediment basin) immediately after construction.

Safety

Because sediment basins that impound water are hazardous:

● Avoid steep slopes; slopes around the sediment basin should be 2.5:1 or flatter; 3:1 where maintained by tractor or other equipment.

● Fence area and post warning signs if trespassing is likely.

● Drain the basin between storm events.

Construction Verification

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

Troubleshooting

Consult with registered design professional if any of the following occur:

● Seepage is encountered during construction; it may be necessary to install drains.

● Variations in topography on site indicate sediment basin will not function as intended.

● 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 sediment basin after each storm event.

Remove and properly dispose of sediment when it accumulates to one-half the design volume.

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.

Remove trash and other debris from the riser, emergency spillway and pool area.

Clean or replace the gravel around the riser if the sediment pool does not drain properly.

Remove the basin after the drainage area has been permanently stabilized, inspected and approved. Do so by draining any water, removing the sediment to a designated disposal area, smoothing the site to blend with the surrounding area; then stabilize.

Common Problems

Improper compaction, omission of anti-seep collar, leaking pipe joints or use of unsuitable soil; resulting in piping failure along conduit— repair embankment using proper construction methods and materials.

Inadequate vegetation or improper grading and sloping; resulting in erosion of spillway or embankment slopes—repair using proper grades and slopes; establish adequate vegetation promptly.

Lack of trash guard; resulting in the riser and barrel being blocked with debris—remove debris and install trash guard.

Principal and emergency spillway elevations too high relative to top of dam; results in overtopping—repair erosion damage and reevaluate spillway design.

Sediment disposal area not designated on design plans; resulting in improper disposal of accumulated sediment—designate appropriate disposal area on design.

Drainage system clogged by gravel; resulting in safety and/or health hazard from pond water—clean out dewatering system regularly and after major storms.

Principal spillway too small; resulting in frequent operation of emergency spillway and increased erosion potential—install larger principal spillway or supplemental spillway.

Inadequate compaction and/or use of unsuitable soil; resulting in slumping and/or settling of embankment—repair damage with suitable, well compacted material.

Slopes too steep; resulting in slumping failure—flatten slopes.

Inadequate outlet protection; resulting in severe erosion below principal spillway—install adequate outlet protection.

Basin not located properly for access; resulting in difficult and costly maintenance—relocate basin or improve access to site.

Sediment not properly removed; resulting in inadequate storage capacity—remove sediment more frequently and after major storms.

Lack of anti-flotation; resulting in riser damage from uplift—install anti-flotation on riser.

►SECTION 11 Temporary Erosion-Control Blankets

PURPOSE & OPERATION

Erosion-control blankets are used to help limit erosion and establish vegetation on slopes and in ditches where conventional seeding and/or structural methods would be inadequate. By reducing the negative effects of rainfall impact and runoff, erosion-control blankets prevent erosion and provide slopes and ditches with a temporary, stable environment for seed to germinate.

Temporary erosion-control blankets are constructed of a variety of materials. These include straw, wood excelsior, coconut, or some combination thereof. These materials are then usually stitched or glued to some type of synthetic or natural fiber netting. This netting is either biodegradable or photodegradable (broken down by light).

PLACEMENT & INSTALLATION

To determine which project areas require the use of temporary erosion-control blankets, consult the KDOT Road Design Manual. Installation details vary between products. General guidelines for the installation of erosion-control blankets can be found in the KDOT Standard Specifications, Division 900, Erosion and Pollution Control and the appropriate Standard Drawings.

PURPOSE & OPERATION

Temporary seeding is by far the most efficient and cost-effective method for controlling on-site erosion. The key to controlling erosion with temporary seeding is the timeliness of the application. Temporary seeding should be initiated within 14 days after grading activities have temporarily or permanently ceased on a portion of the project site. On-site erosion and off-site sedimentation will continue to occur as long as a section of exposed earth remains open.

PLACEMENT & INSTALLATION

Specific project plans outline the amount and type of seed to be used. Consult the Kansas Department of Transportation's Standard Specifications, Division 900, Erosion and Pollution Control and the appropriate Standard Drawings for information on areas of the project that should be seeded, when seeding should take place, soil preparation, and mulching requirements.

►ADDITIONAL RESOURCES

If you wish to learn more about temporary erosion control and the NPDES permitting process, the following resources may be helpful.

TEMPORARY EROSION CONTROL

- ***Protecting Water Quality.*** A copy of this publication can be obtained by contacting Betty Keehart, Missouri Department of Natural Resources, at 573-751-7144.
- ***Best Management Practices for Erosion and Sediment Control.*** Report No. FHWA-FLP-94-005. A copy of this publication can be obtained from FHWA at:

  U.S. Department of Transportation
  Federal Highway Administration
  Federal Lands Highway Program
  Washington DC 20590

- ***Volume III: AASHTO Guidelines for Erosion and Sediment Control in Highway Construction.***

NPDES PERMITS

- ***KDHE National Pollutant Discharge Elimination System Storm water Discharge Permit Information Packet.*** A copy of this packet can be obtained from KDHE at:

  Kansas Department of Health and Environment
  Bureau of Water
  1000 SW Jackson
  Topeka, KS 66612
  785-296-5509

- Federal Register: ***September 9, 1992 – Final NPDES General Permits for Storm Water Discharges From Construction Sites; Permit Language (57 FR 41209).***
- Federal Register: ***September 9, 1992 – Final NPDES General Permits for Storm Water Discharges From Construction Site; Fact Sheet (57 FR 41176).***

► NOTES

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