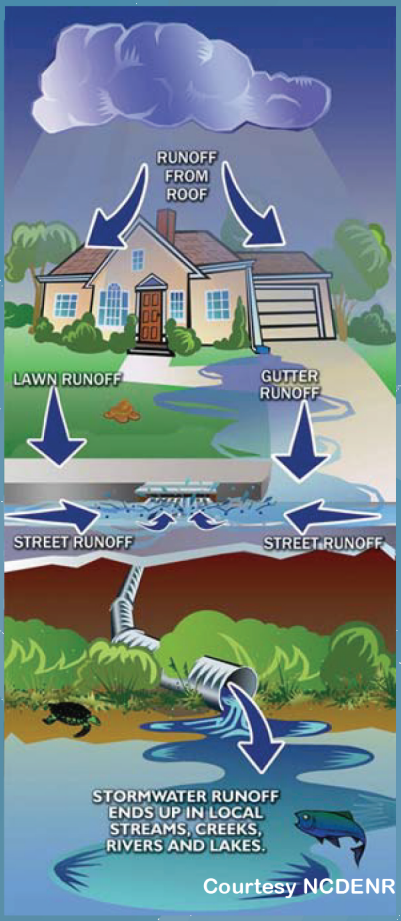
Preventing Stormwater Pollution at Construction Sites

About Stormwater

Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not seep or permeate into the ground.



Courtesy NCDENR

It's Important

As the runoff flows over the land or impervious surfaces (paved streets, parking lots, building rooftops, etc.), it accumulates debris, chemicals, sediment, or other pollutants that cause damaging water quality problems. In Texas, stormwater runoff is not treated or cleaned before it is discharged into local creeks, ponds, streams, rivers, and lakes.

Because these preventable pollutants are caused by human activity, certain activities with higher potential to pollute are regulated by the Texas Pollutant Discharge Elimination System (TPDES). The TPDES requires selected industries, such as the construction industry, to control stormwater discharges through the use of Best Management Practices, or BMPs. In addition, a Stormwater Pollution Prevention Plan (SWPPP) is required for TPDES-regulated construction sites.

Construction Site BMPs

Sediment, debris, trash, and chemicals are common examples of the types of pollutants associated with stormwater runoff from construction sites.

A variety of BMPs should be employed that:

- reduce soil erosion
- reduce sediment loss from the site
- manage construction-generated waste
- manage construction-related hazardous materials

About this Guide

This guide is intended to equip the construction site superintendent with the knowledge and resources necessary to help keep the site compliant and protect water quality from stormwater pollution due to soil loss and mismanagement of materials and waste. It provides basic information of common BMPs used at construction sites related to:

- installation
- maintenance
- advantages and disadvantages or limitations
- examples of good and bad uses

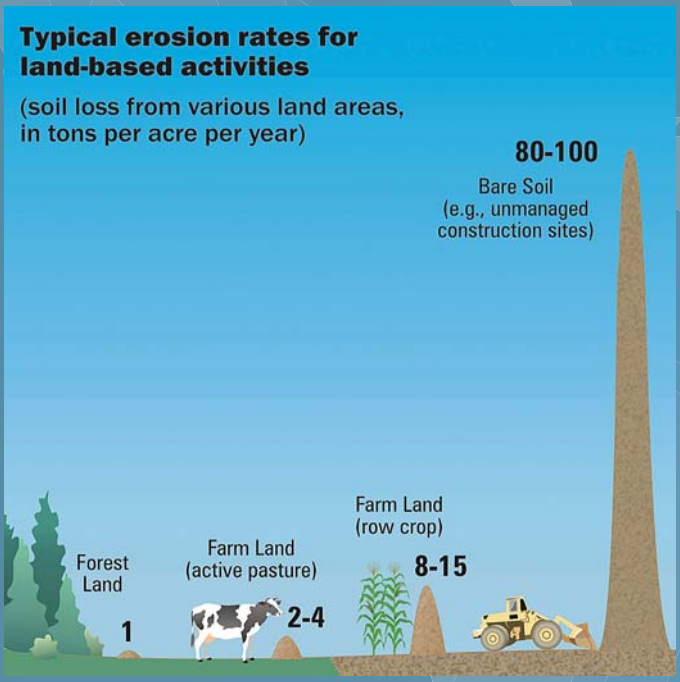
Also included is a brief description of good overall practices and basic requirements.

An Overview of BMPs

This guide focuses on a variety of common BMPs that fall into three main categories:

- reduce soil erosion
- reduce sediment loss
- manage materials and waste

The majority of BMPs discussed address the loss of soil from construction sites. Soil loss in the form of erosion of sediment due to storm events and wind, constitutes the majority of pollution generated from construction sites.



BMPs to Reduce Soil Erosion

BMPs that help reduce soil erosion are the measures and techniques used to retain soil in place. They are installed upstream of the site to limit flow across disturbed areas and within the site to provide protective covering of disturbed areas that are not actively being worked. Erosion controls reduce the amount of soil removed and transported by stormwater runoff. Preventing erosion is the most effective method—and normally the most cost effective—to reduce soil loss from a tract of land.

The BMPs discussed in this guide to reduce soil erosion include:

- vegetation
- mulching
- erosion control blankets
- check dams

BMPs to Reduce Sediment Loss

Since soil is highly mobile once disturbed, it is important to plan for soil loss. BMPs that help reduce sediment loss are temporary structures or devices that capture soil transported by wind or water through settlement, filtration, or chemical treatment of the runoff. They are often used to trap sediment before it leaves the construction site. All construction activities will require areas in which soil is disturbed, and so BMPs that reduce soil erosion should not be the only line of defense. Regardless of which BMPs are used to reduce sediment loss, all should be designed and installed to allow the safe overflow or by-pass of excessive runoff.

The BMPs discussed in this guide to reduce sediment loss include:

- silt fence
- organic filter tubes
- inlet protection
- stabilized construction exits

BMPs to Manage Materials and Waste

BMPs that help manage materials and waste are an important component of pollution prevention at a construction site due to their general purpose of reducing the discharge of pollutants from construction activities. They form the basis of good housekeeping procedures that should be followed during construction. The techniques are essential to preventing the discharge of pollutants other than sediment from a construction site.

The BMPs discussed in this guide to manage materials and waste include:

- debris and trash management
- chemical management
- concrete washouts

BMPs to Reduce Soil Erosion

Vegetation

Leaving existing vegetation, where possible, should be given a priority. No other form of erosion control is as effective. Replacement vegetation, used as an erosion control, is the sowing or sodding of grasses, small grains, or legumes to provide temporary and final vegetative stabilization for disturbed areas, and can also be used as slope and channel protection.

Sod provides immediate protection around storm drain inlets, on slopes, and other areas.

Replacement vegetation is being used effectively as a temporary control.

Poor seed establishment on slope. Use seeding in combination with other BMPs (e.g. erosion control blankets) when slopes are steep.

Installation

- Prepare the soil surface before seeding or sodding
- Minimum of 4 to 6 inches of top soil required, depending on subsurface conditions
- Determine the need for soil amendments depending on soil conditions
- Select seed or sod species appropriate for the climate, season, and soil
- Application criteria specific to type of seed

Maintenance

- Inspect regularly for growth, uniformity, or soil failure under vegetation
- Protect newly seeded areas from excessive runoff, high velocity flow, and traffic until vegetation is established
- Water and fertilize until vegetation is established
- Reseed and/or provide mulch or another control for bare spots
- Rake accumulations of sediment from the vegetation

Advantages

- ✓ More effective and easier to maintain than sediment controls during a long construction period
- ✓ May be used for temporary or final stabilization

Disadvantages

- × Not appropriate for areas with heavy pedestrian, vehicular traffic, or concentrated, high velocity flow
- × May require days to weeks for adequate establishment
- × May require significant soil amendment and water to grow effectively
- × Alternate erosion control is needed until vegetation is established

Mulching

Mulching is the application of a uniform layer of organic material over barren areas to reduce the effects of erosion from rainfall. Types of mulch include compost mixtures, straw, wood chips, bark, or other fibers.

Mulch is applied with seeding for final stabilization.

Mulch is applied to reduce sediment runoff. Mulch needs to be applied regularly in high traffic areas to maintain uniform thickness.

Mulch was applied in an area of concentrated flow and is washing away. Mulch should be applied evenly and uniformly and at an appropriate thickness.

Installation

- Apply evenly and uniformly
- Thickness of 1 to 2 inches, depending on application
- Application criteria specific to type of mulch
- Anchor mulch on slopes of 3:1 to 1.5:1
- Do not use mulch on slopes steeper than 1.5:1
- Do not use in channel bottoms or areas of high flow

Maintenance

- Inspect regularly for soil failure under mulch or wash out of material
- Replace regularly in high traffic areas to maintain uniform thickness
- Maintain a stockpile of excess mulch at the site to repair problem spots

Advantages

- ✓ Provides immediate protection of bare areas
- ✓ May be used with seeding for final stabilization
- ✓ Decreases soil moisture loss
- ✓ Decreases amount of runoff
- ✓ Can be tilled into soil as part of amendment for final stabilization
- ✓ Helps to increase soil moisture retention, reducing runoff flows

Disadvantages

- × Can be blown or washed away by wind or water
- × Results in lower soil temperature, which may yield longer seed germination periods
- × Should not be used in the bottom of drainage channels where it will be washed away by flowing water

Erosion Control Blankets

Erosion control blankets (ECBs) are temporary, degradable, rolled erosion control products that reduce soil erosion and assist in the establishment and growth of vegetation. ECBs, also known as soil retention blankets, are composed primarily of processed, natural, or organic materials that are woven, glued, or structurally bound together with natural fiber netting or mesh on one or both sides.

Excellent slope protection. ECBs are correctly installed on this long slope (vertically) and should be installed horizontally on short slopes.

Inadequate ECB to protect this area of exposed soil; additional BMPs are needed. ECB is not trenched or anchored correctly as indicated by sediment at the curb. Spoil piles should also be better protected.

Piles of sediment are inappropriately placed on top of ECBs in the process of digging for utility/water lines.

Installation

- Select based on slope, flow rate, and length of service
- Prepare soil surface to ensure uniform contact with blanket
- Install and anchor according to manufacturer's recommendations

Maintenance

- Inspect regularly for loose blankets, soil failure under material, damage to material, or soil accumulation on material
- Replace or re-anchor loosened blankets
- If sediment is deposited on blankets, additional controls may be needed or site practices may need to be evaluated

Advantages

- ✓ Holds seed and soil in place until vegetation is established
- ✓ Effective for slopes, embankments, and small channels
- ✓ Some blankets degrade over time, so there may not be a cost for disposal

Disadvantages

- ✗ Not for use on slopes greater than 2:1 or in channels with high velocity flows
- ✗ Cannot be used in areas with heavy pedestrian or vehicular traffic

Check Dams

Check dams are a series of small barriers consisting of loose rock, rock bags, or organic filter tubes placed across a drainage swale or ditch. They reduce the velocity of small concentrated flows, provide a limited barrier for sediment, and reduce the potential for erosion of the swale or ditch.

Check dam consisting of organic filter tube effectively reduces the velocity of this flow as indicated by pooled water.

Check dam is effectively removing sediment; however, debris should be removed from the dam. Outer edges at channel sides must be higher than the center overflow point.

Loose rock check dam is installed incorrectly and erosion of the bank due to flow bypass around the dam has occurred. Check dam must be placed across the entire ditch and partially up the banks.

Installation

- Height of check dams should be between 9 inches and 36 inches
- Outer edges at the channel sides must be higher than the center of the dam
- Top of the downstream dam should be at the same elevation as the toe of the upstream dam

Maintenance

- Inspect regularly for soil failure under dam material, soil accumulation, or flow bypass around check dams
- Remove silt when it reaches approximately 1/3 the height of the dam or 12 inches, whichever is less

Advantages

- ✓ Reduced velocities in long drainage swales or ditches
- ✓ May be used with other channel protection measures
- ✓ Provides some sediment removal
- ✓ Can be designed to be a permanent part of drainage infrastructure, otherwise rock can be cleaned and reused

Disadvantages

- ✗ Cannot be used in live stream channels
- ✗ Minor ponding upstream of the check dams
- ✗ Extensive maintenance or replacement of the dams required after heavy flows
- ✗ Mowing hazard from loose rocks if all rock is not removed at end of construction

BMPs to Reduce Sediment Loss

Silt Fence

A silt fence consists of geotextile fabric supported by wire mesh netting or other backing stretched between metal posts with the lower edge of the fabric securely embedded six inches in the soil. The fence is typically located downstream of disturbed areas to intercept runoff in the form of sheet flow. A silt fence provides both filtration and time for sediment settling by reducing the velocity of the runoff.

Silt fence is properly installed and is used to reduce runoff velocity and filter sediment before exiting site.

Silt fence is not properly trenched. The lower edge of the fabric must be securely embedded 6 inches in soil.

Silt fence is inappropriately installed in an area subject to concentrated flows. A check dam would be more suitable here. There is no wire mesh backing to reinforce the silt fence and wood posts are being used instead of metal.

Installation

- Maximum drainage area of 1/4 acre per 100 linear feet of silt fence
- Maximum 200 feet between beginning of flow to first line of silt fence; 50 feet if slope exceeds 10 percent
- Minimum fabric overlap of 3 feet at adjoining ends; join fabric to prevent leakage
- Turn end of silt fence line upslope a minimum of 10 feet
- Install stone overflow structure at low points or spaced at approximately 300 feet if no apparent low point

Maintenance

- Inspect regularly for holes or tears, failure under fence, breaching, soil accumulation >50 percent of the height of the fence, or soil bypass
- Repair undercutting, sags, and other fence failures
- Remove sediment before it reaches half the height of the fence
- Repair or replace damaged or clogged filter fabric

Advantages

- ✓ Economical means to treat shallow overland sheet flow
- ✓ Most effective with coarse to silty soil types

Disadvantages

- × Limited effectiveness with clay soils due to clogging
- × Burying toe of structure requires weakening the soil at the structure
- × Localized flooding due to minor ponding at the upslope side of the silt fence
- × Not for use as check dams in swales or low areas subject to concentrated flow
- × Not for use where soil conditions prevent a minimum toe-in depth of 6 inches or installation of support posts to a depth of 12 inches
- × Can fail structurally under heavy storm flows, creating maintenance problems and reducing effectiveness

Organic Filter Tubes

Organic filter tubes are comprised of an open weave, mesh tube that is filled with a filter material (compost, wood chips, straw, coir, aspen fiber, or a mixture of materials). The tube may be constructed of geosynthetic material, plastic, or natural materials. Organic filter tubes are also called wattles, fiber rolls, fiber logs, mulch socks, and/or coir rolls. Filter tubes detain flow and capture sediment as linear controls along the contours of a slope or as a perimeter control down-slope of a disturbed area.

Organic filter tubes are used with other BMPs to protect an area that may prevent the embedment of other controls.

Appropriate use of a series of organic filter tubes to protect a slope; however, accumulated sediment must be removed.

Inadequate organic filter tubes to protect this area of exposed soil; additional BMPs are needed. Tubes need to be re-aligned at the curb and appropriately embedded into the soil.

Installation

- Ensure tube diameter and embedment in soil meets size specified on plans
- 18 inch minimum overlap at ends of tubes
- Space rows of tubes based on drainage area and slope
- Must be staked to the ground on soil or secured with rockbags on pavement
- Turn ends of tube lines upslope a minimum of 10 feet

Maintenance

- Inspect regularly for soil failure under material, damage to material, soil accumulation >50 percent, or soil bypass
- Repair eroded areas underneath the organic filter tubes
- Re-align and stake tubes that are dislodged by flow
- Remove sediment before it reaches half the height of the exposed tube

Advantages

- ✓ Effective means to treat shallow overland sheet flow over a short distance
- ✓ Relatively easy to install
- ✓ May be used on steep slopes
- ✓ Can provide perimeter control on paved surfaces or where soil type prevents embedment of other controls
- ✓ Easy to lift and replace for materials delivery
- ✓ Netting can be cut and removed, with organic filler material worked into soil

Disadvantages

- × Difficult to remove when wet and/or filled with sediment
- × Relatively small effective areas for sediment capture

Inlet Protection

Inlet protection consists of a variety of methods to intercept sediment at low point inlets through the use of depressed grading, filter stone, filter fabric, inlet inserts, organic filter tubes, and other materials. The protection devices are placed around or across the inlet openings to provide localized detention or filtration of sediment and floatable materials in stormwater.

Note that paved surfaces connected to the storm sewer system are part of the storm sewer system and must be treated as such. Sediment discharges to paved surfaces are a violation of the TPDES permitting system. Inlet protection may be used as a secondary form of protection, but never as an acceptable primary means of compliance with a TPDES permit.

Excellent use of filter fabric with wire mesh backing and rocks enclosed in wire mesh to protect the storm drain. Protection is secured at top with rock bags to keep in place. Overflow gap allows water from a rain event to enter the storm drain, which prevents flooding of travel lanes.

Poor management of filter fabric and wire mesh to protect the storm drain. Protection is bent and is not flush with the storm drain to properly pond runoff and filter out sediment. Maintenance is not being performed as needed.

Good application of organic filter tubes to protect the storm drain; however, they are not staked or properly embedded in the soil.

Installation

- Evaluate drainage patterns to ensure inlet protection will not cause flooding of roadway, property, or structures
- Never block entire inlet opening
- Size according to drainage area and flow rates
- Include flow bypass for clogged controls and large storm events

Maintenance

- Inspect regularly for damage to material, soil accumulation >50 percent, or flow bypass
- Check for and remove blockage of inlet after every storm event
- Remove sediment before it reaches half the design height or volume of the inlet protection, more frequently for curb inlets
- Repair or replace damaged materials
- Clean or replace filter stone and organic filter tubes when clogged with sediment

Advantages

- ✓ May be the only feasible sediment control for some phases of construction when all work is located within the right-of-way
- ✓ Some types can be cleaned and reused

Disadvantages

- × Limited effectiveness and reliability
- × High maintenance requirements
- × Has potential to flood roadway travel lanes and/or adjacent properties

Stabilized Construction Exits

A stabilized construction exit is a pad of crushed stone, recycled concrete, or other rock material placed on geotextile filter cloth to dislodge soil and other debris from construction equipment and vehicle tires prior to exiting the construction site. The object is to minimize the tracking of soil onto public roadways connected to storm sewer systems.

Crushed stone is being used to protect site's exit, allowing for easy access for delivering materials, minimizing tracking, and protecting other BMPs. Note the appropriate placement of sand—on the other side of the BMP.

Good application of stabilized construction exit; however, offsite tracking is still occurring. Voids between stones may be filled with sediment. Fabric and rock should be extended to orange barrel to better transition to paved surface. Good use of barriers to ensure stabilized exit is used.

Rock material and geotextile filter cloth are missing. Offsite tracking and sediment loss is occurring. Exit should also be sloped away from the paved surface.

Installation

- Try to slope exit away from offsite paved surface, where possible
- Minimum width and length dependent on size of disturbed area, which correlates to traffic volume, and type of vehicles accessing site
- Place stone 6 inches minimum thickness on top of geotextile fabric
- Use minimum size stone of 3 to 5 inches in size
- Add a wheel cleaning system when inspections reveal the stabilized exit does not prevent tracking

Maintenance

- Inspect regularly for failures (e.g. tracking offsite) or soil accumulation on surface
- Replace rock when sediment in the void area between the rocks is visible on the surface
- Periodically re-grade and top dress with additional stone to maintain efficiency

Advantages

- ✓ Reduces tracking of soil onto public streets
- ✓ Directs traffic to a controlled access point
- ✓ Protects other sediment controls by limiting the area disturbed

Disadvantages

- ✗ Effectiveness dependent on limiting access to and from the stabilized exit
- ✗ A wheel washing system may also be required to remove clay soil from tires, particularly in wet conditions

BMPs to Manage Materials and Waste

Debris and Trash Management

Large volumes of debris and trash are often generated at construction sites, including packaging, pallets, wood waste, personal trash, scrap material, and a variety of other wastes. The objective of debris and trash management is to minimize the potential of stormwater contamination from solid waste through appropriate storage and disposal practices. Construction debris recycling is encouraged to reduce the volume of material to be disposed of and associated costs of disposal.

Good use of disposal receptacle; however, it is nearly full and should be emptied and disposed of properly. Materials should be recycled where possible.

Debris and trash nearly clogging the storm drain is one of many problems with this picture. Trash receptacles should be placed throughout the site and a trash management education and awareness program should be implemented.

Debris and trash are not being managed through appropriate practices. Disposal receptacles and education about proper use must be provided.

Installation

- Implement a job-site waste handling and disposal education and awareness program
- Provide sufficient and appropriate waste storage containers
- Provide timely removal of stored solid waste materials
- Train workers and monitor compliance

Maintenance

- Inspect regularly for debris on and around the site
- Empty waste containers regularly
- Clean up loose trash and debris daily
- Verify procedures are being followed
- Train new employees and regularly re-train all employees

Limitations

- Only addresses non-hazardous solid waste
- One part of a comprehensive construction site waste management program

Chemical Management

The objective of chemical management is to minimize the potential of stormwater contamination from chemicals being used or stored on a construction site through appropriate recognition, handling, storage, and disposal practices.

Portable toilets are placed behind BMPs and away from the street or drainage ways should a spill or leak occur.

Chemical storage container is inappropriately discarded, and there is evidence of a spill. Chemicals should be properly stored and disposed of and spills cleaned up immediately.

Inappropriate management of chemicals and other hazardous materials. Gas tanks need secondary containment that is 110 percent of the container. Other chemicals should be stored in an appropriate enclosure to minimize potential of stormwater contamination.

Installation

- Designate a person responsible for chemical management
- Minimize the amount of chemicals and waste stored onsite
- Provide secondary containment that is 110 percent of the largest container in the containment
- Label all containers
- Prohibit the discharge of washout water
- Train workers in proper procedures
- Provide timely removal of waste materials

Maintenance

- Inspect regularly for proper storage and evidence of leaks and spills
- Make sure all containers are labeled
- Check waste containers and dispose of the waste when 90 percent full
- Verify procedures are being followed
- Train new employees and regularly re-train all employees

Limitations

- Not intended to address site-assessment and pre-existing contamination
- Does not address demolition activities and potential pre-existing materials, such as lead and asbestos
- Does not address contaminated soils
- Does not address spill and leak response procedures
- Does not address chemicals associated with vehicle and equipment management

Concrete Washouts

Concrete washouts are used to contain concrete and liquids when the chutes of concrete mixers and hoppers of concrete pumps are rinsed out after delivery. The washout facilities consolidate solids for easier disposal and prevent runoff of liquids. Concrete washouts may consist of an approved build structure or a prefabricated container.

Signage is used properly to identify the concrete washout area.

Silt fence, orange fence, and signage are appropriately used to manage concrete waste; however, rock should be placed at the entrance to prevent offsite tracking.

A washout area has been designated; however, the waste is being managed inappropriately. BMPs surrounding the washout area are damaged and the area is full and concrete should be removed and disposed of properly (recycle where possible). BMPs are absent to protect against offsite tracking and runoff.

Installation

- Do not place within 50 feet of storm drains, open ditches, or water bodies or in low areas
- Place for convenient access for concrete trucks (e.g. next to construction entrance/exit), yet not in vulnerable areas
- Post signs clearly labeling the washout location
- Line washout containment area with minimum 10 mil plastic
- Locations must be shown on TPDES SWPPP site maps

Maintenance

- Inspect regularly for damage to washout areas or overfill
- Watch concrete delivery trucks and ensure proper handling procedures are followed, inspect entire area for mishandled concrete washout and remediate immediately if found
- Clean up any overflow of washout pits
- Ensure washout linings and sidewalls are not damaged or that prefabricated washout containers are not leaking
- Remove concrete when the washout has been filled to 75 percent capacity
- If stored liquids have not evaporated and the washout is nearing capacity, vacuum and dispose of them in an approved manner
- Train concrete truck drivers on proper use

Limitations

- Must be large enough to handle all wastes
- Existence of pit must be clearly communicated each time to each driver

Good Overall Practices

A clean (and compliant) construction site starts with you! Here are some good overall practices to keep in mind to help protect water quality from stormwater pollution and keep the construction site compliant:

- ✓ DO consider environmental, maintenance, replacement, and removal costs in addition to the upfront cost of a BMP when determining economical BMP choices
- ✓ DO choose the BMPs that are most appropriate for the site
- ✓ DO consider the BMPs' specifications for slope and catchment size
- ✓ DO inspect BMPs regularly for damages and failures
- ✓ DO repair or replace damaged or failing BMPs immediately and as needed
- ✓ DO remediate mishandled wastes and chemicals immediately
- ✓ DO train employees and contractors on proper use and management of BMPs
- ✓ DO remove temporary BMPs when vegetation is established

Regulatory Information

As mentioned briefly in the introduction to this guide, most stormwater discharges from construction sites in Texas require a permit under the Texas Commission on Environmental Quality's (TCEQ) Texas Pollutant Discharge Elimination System (TPDES) stormwater program. For sites that meet the permit requirements, construction site operators are required to obtain authorization to discharge stormwater under a TPDES construction stormwater permit, known as the "Construction General Permit."

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Help us improve water quality in the City of Portland

Report If You See:

- Illicit Discharges
- Illegal Dumping
- Non-compliant Construction Sites
- Other stormwater quality concerns

Report Stormwater Quality Concerns at:

www.txms4.com/PORTLAND

This publication was produced by the North Central Texas Council of Governments' Regional Stormwater Management Program. Inspiration for this guide came from the "Kentucky Erosion Prevention and Sediment Control Field Guide" developed for the Kentucky Division of Water and Division of Conservation by Tetra Tech (www.tetratech.com) and from the National Association of home Builders' "Stormwater Compliance Cards" (www.nahb.org).

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