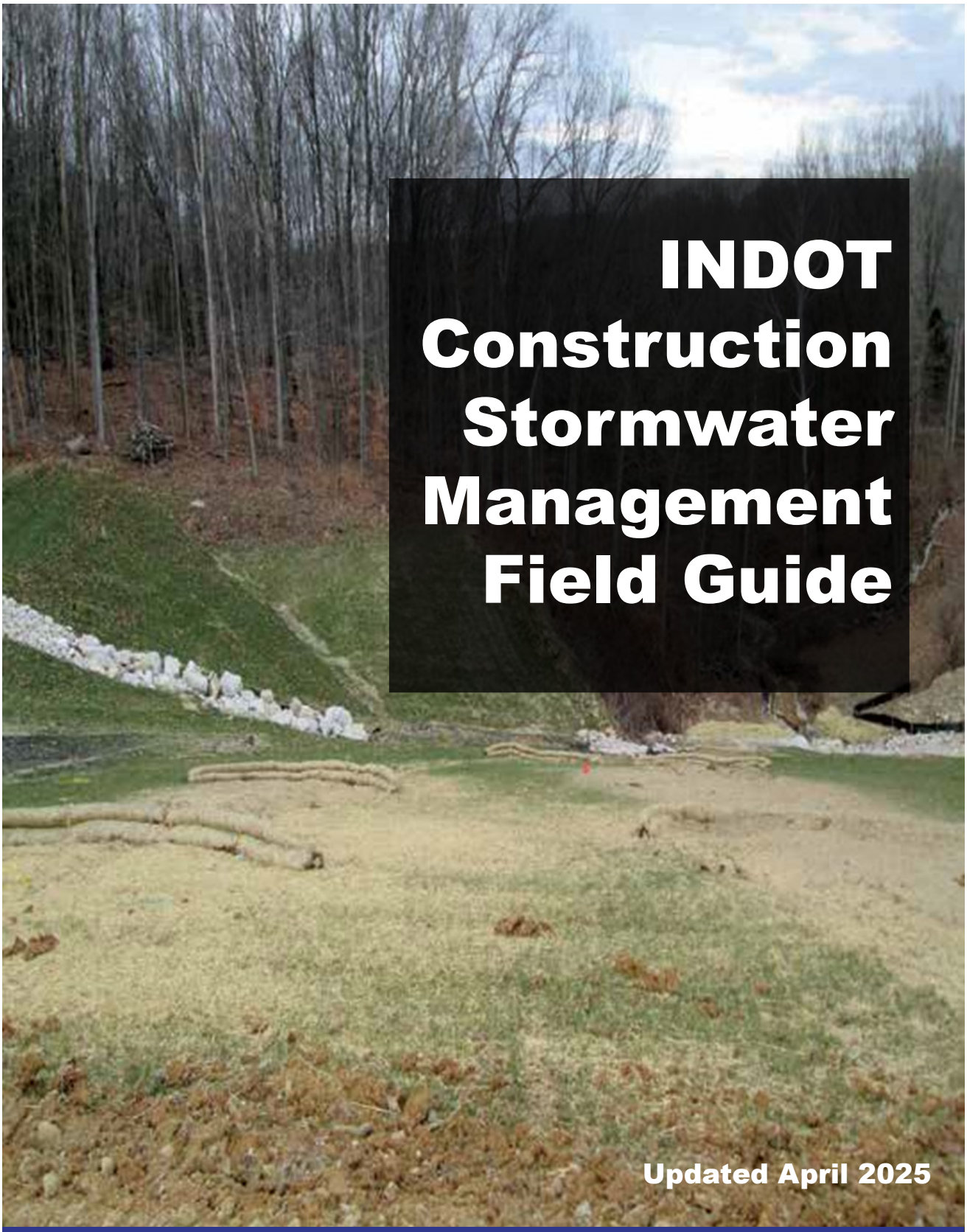


INDOT Construction Stormwater Management Field Guide

Updated April 2025

www.in.gov/indot

TABLE OF CONTENTS

INTRODUCTION

The development of the Indiana Department of Transportation (INDOT) Construction Stormwater Management Field Guide has been a collaborative effort between INDOT's Office of Environmental Services, Construction Management, and District Support. The guide concept was developed as a result of the Joint Transportation Research Program, Project No. C-36-68-DD, File No. 4-7-30, Indiana SPR-3312.

This guide was created to provide guidance on the critical factors of management, setup, inspection, maintenance, and removal of stormwater control features that may be required for INDOT contracts.

The Field Guide is not intended to act as a contract document or design standard but as a visual and conceptual reference for INDOT projects requiring stormwater management. INDOT Standard Specifications and Standard Drawings are referenced throughout this guide and should be used for additional information. The Indiana Department of Environmental Management (IDEM) Stormwater Quality Manual was used as a reference in the creation of this field guide.

This guide is not intended to replace IDEM's manual but rather to provide additional information such as photographs of Best Management Practices (BMPs) used in highway construction settings.

Utilize the QR Code shown below for access to the most up to date links to help further the understanding of stormwater management for INDOT contracts:

How to Use This Field Guide

This guide has been organized to provide a process for implementing BMPs for effective stormwater management. The following is the order of importance when planning for successful stormwater management.

1. COMMUNICATION – Communicate with all members of the team to develop a working communication plan to coordinate work. The Stormwater Quality Manager (SWQM) should be involved in BMP discussions and changes.
2. WORK MANAGEMENT – Develop plans for effective phasing and scheduling with all team members to minimize water pollution.
3. STORMWATER MANAGEMENT – Be aware of how water moves through the construction site and plan for measures to help minimize stormwater exposure to bare soil. Divert stormwater away from bare areas and manage stormwater on site.
4. EROSION CONTROL – Plan to keep soil in place and stable as much as possible. Erosion control measures, such as seeding or mulching, are relatively inexpensive and more effective than sediment control.
5. SEDIMENT CONTROL – Once soil becomes mobile it becomes much more difficult and cost intensive to remove the sediment from the water. Plan for BMP's to minimize the potential for sediment to leave the construction site. Sediment control measures, such as sediment basins, are relatively expensive to use and less effective than erosion control.

These concepts will lead to more efficient and cost-effective management of a construction site for pollution prevention. Each chapter includes stormwater features to help keep soil in place and prevent sediment and pollutants from leaving the job site.

Purpose

Rain and snow melt create stormwater runoff. Stormwater runoff picks up pollutants such as sediment and eventually flows to a stream, wetland, or other water body.

Regulatory agencies do not allow sediment and other pollutants to enter water bodies or storm drains. INDOT, by law, must follow these requirements.

Sediment is one of the most prominent water quality concerns in Indiana. Sediment laden water carries pollutants such as heavy metals to waterways and impacts our drinking water sources. Muddy water kills aquatic organisms, increases the potential for flooding, and ruins wildlife habitat. Construction sites that are mismanaged contribute significantly more sediment pollution per acre than any other land use including agriculture. Loss of soil and its nutrients leads to more difficulty stabilizing and finalizing projects leading to more significant costs due to timelines and possible regulatory action. Effective stormwater management on construction sites can significantly reduce stormwater pollution.

Types of Water Flow:

- Sheet - Overland water moving in a continuous sheet over relatively even ground.
- Concentrated - Sheet flow will eventually collect and transition to shallow concentrated flow.
- Channel - Concentrated flow in a defined path such as a ditch bottom.

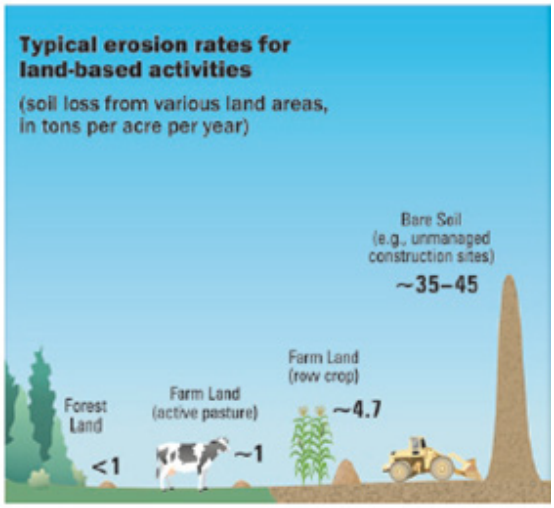


Figure 2. Typical erosion rates from land-based activities. (Dunne, T. and L. Leopold, 1978; NRCS, 2000; NRCS, 2006; ASCE and WEF, 1992)

Mismanagement of construction sites contributes significantly more sediment pollution per acre than agricultural activities. Source: 2007 USEPA Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites.

The photo below shows sediment from a construction site filling in a conveyance channel, which leads to a stream. Sediment entering a waterway is a violation of Army Corps of Engineers, IDEM, and DNR enforced regulations.

PROCESSES AND REQUIREMENTS

Stormwater Quality Control Plan (SWQCP)

As stated within the contract documents the Contractor shall provide a Stormwater Quality Control Plan to the Project Engineer/Project Manager/Project Supervisor (PEMS), no less that 14 days prior to commencing land disturbing activities.

INDOT personnel can contact:

- INDOT District Stormwater Specialist
- Ecology, Waterway, Permitting, and Stormwater Office (EWPSO), for the Office District Map and contact information, see the EWPSO link located on the last page of this guide.

The SWQCP shall be in accordance with ITM 803, IDEM Construction Stormwater General Permit (CSGP), Contract Documents, Standard Specification, and shall include:

- Areas not included in the Department submittal such as:
  - Staging areas
  - Stockpiles
  - Storage areas
  - Fueling locations
  - Batch plants
  - Concrete washout area
  - Haul Roads
  - Construction entrance
- Changes initiated by the contractor
- Name of Stormwater Quality Manager (SWQM) and proof of training.
- Concrete Wastewater Plan
- Construction phasing of stormwater control measures
- Material handling and spill prevention plan
- Monitoring and maintenance plan

Off-site areas (borrow/disposal sites, etc.) may require a separate IDEM CSGP obtained by the Contractor.

Stormwater Quality Manager (SWQM)

The SWQM shall be trained appropriately for the identified contract. Training requirements for SWQMs are as indicated within INDOT Standard Specifications.

Responsibilities of the SWQM, where there is a CSGP, include:

- Attending the pre-construction conference
- Hold the pre-disturbance meeting
- Attending at least one contract scheduling meeting per calendar month.
- Ensuring the contractor's SWQCP has been submitted to PEMS for review 14 days prior to beginning any earth disturbing activity
- Being in responsible charge of stormwater site inspections.
- Being in responsible charge of implementing the SWQCP
- Being in responsible charge of BMP installation, maintenance, and removal
- Accompanying personnel from IDEM or other governmental agencies, as required, during their site visits

Pre-Disturbance Meeting

For contracts requiring a SWQCP a pre-disturbance meeting shall be held on-site prior to land disturbing activities. The following shall be reviewed:

- Phasing and sequencing of stormwater management
- Permit conditions
- Unique and Special Provisions
- Commitments

Standard References

Standard Specifications Reference: 205.03

PROCESSES AND REQUIREMENTS

Stormwater Quality Control Plan (SWQCP)

Successful communication and planning can lead to cost savings and a seamless close of project. Photos show progression from application of permanent seed to final established vegetation. Germination of seed typically occurs within two weeks and the success of the vegetation depends on multiple factors, including, temperature, moisture, and available nutrients. Growth can also depend on topsoil quality which is why it is important to protect topsoil and prevention erosion from the beginning of the project.

Environmental Compliance Requirements

Jurisdictional wetlands and waterways cannot be impacted either temporarily or permanently without obtaining the proper permits. This includes dredging, clearing, filling, redirecting, or otherwise altering. Permits may be required from the United States Army Corps of Engineers (USACE), IDEM, and the Indiana Department of Natural Resources (DNR) Division of Water. These plans must be followed and any changes must be approved by the regulatory entity.

All plans require measures to control erosion and prevent sediment from entering a waterbody or leaving a construction site throughout construction and until disturbed areas are stabilized. When soil is disturbed and left bare, it is highly susceptible to erosion. To prevent erosion, stormwater measures must be implemented on all INDOT projects, including projects that disturb less than an acre of soil.

The tracks in this wetland may not be permitted. Review the project permits to understand what impacts were included. Timber mats or other methods would be required to protect the wetland from temporary impacts.

PROCESSES AND REQUIREMENTS

Other Environmental Considerations

Tips for complying:

- Phase disturbance to allow natural cover to remain in place as long as possible
- Plan for re-establishing vegetation through retaining topsoil, seeding, and stabilizing as soon as possible after obtaining final grade.
- Design and install temporary measures to minimize sediment pollution by considering how they will be removed
- Know your permits –
  - Types of permits -
    a. **USACE 404 permit and IDEM 401 Water Quality Certification (WQC) –** permanent and/or temporary impacts to streams below the ordinary high water mark or wetlands
    b. **DNR Construction in a Floodway (CIF) –** work in a floodway
    c. **IDEM CSGP -** soil disturbance of one acre or more
  - What permits were required for the work being completed and do you have all of the required permits?
  - What stream and wetland resources are in the project area?
- What were the permitted impacts and unpermitted impacts, such as temporary crossings, causeways, and pump-arounds, that may require a permit modification?
  - Examples of permanent impact include additional riprap or changes in structure type (permitted 3-sided RBC replaced with 4-sided).
  - Modifications to permanent or temporary impacts must be reviewed by INDOT EWPSO and submitted to the agencies for acceptance.
- Know the special environmental requirements/restrictions of your project –
  - Fish spawning waivers are required for projects with a CIF permit for in-stream work from April 1 to June 30. Coordinate with DNR Division of Fish and Wildlife, Environmental Unit.
  - Tree clearing is prohibited from April 1 to September 30. Any in-season tree removal or trimming will require approval by USFWS. Coordinate with EWPSO.
  - Protected species USPs –
    a. Bat Avoidance and Mitigation Measures – Contains avoidance and minimization measures.
    b. Migratory Bird – Removal of nest with eggs or young is prohibited. USP is included in contract when use identified during planning process.
    c. Other – USPs included if other federally listed species are present in the project area.

Stormwater Management Inspections

Description

Site inspections are required to keep job sites in compliance with the IDEM CSGP. No construction site is perfect. Deficiencies are expected in these reports. Documented corrective actions based on the deficiencies is an important part of an inspection. These reports can be used to indicate the actions taken to maintain the overall quality of the stormwater management plan on site.

Standard References

Standard References: 205.03

Stormwater, Erosion, and Sediment Control Inspection form

Stormwater Quality Managers shall document and submit inspection reports electronically using the current version of the Department's stormwater inspection management report.

PROCESSES AND REQUIREMENTS

Stormwater Management Inspections

Expectations of the Site Inspections

- All site inspections are to be under the responsible charge of the properly trained SWQM
- Shall be performed at a minimum of once per calendar week, 24 hours prior to a qualifying rain event, or by the end of the next day following every ½" or greater rain event
- No more than three inspections shall be required in a calendar week
- Reports will be reviewed and signed by PEMS within 24 hours of the inspection
- Reports must be readily available and able to provide to a regulatory authority within 48 hours upon request.
- Reports should note required maintenance, additional BMPs needed, and progress made
- Immediate deficiencies as described by Standard Specifications shall be addressed within 24 hours
- BMP deficiencies noted shall be addressed within 48 hours
- Photographs are the best method to document progress and prove efforts toward compliance
- Inspections must continue until the IDEM CSGP permit is closed out with the Notice of Termination (NOT) process

COMMUNICATION

Good communication is essential to effective stormwater management. Below are a few strategies that can be used to help prevent stormwater pollution.

Strategies to Save Time and Money

Communicate Early

- Prior to bid, the contractor should communicate with subcontractors and suppliers about stormwater quality management.
- One of the best tools for saving money and using time effectively on environmental compliance is to thoroughly discuss stormwater management at the Preconstruction, Pre-disturbance, and at least monthly during Progress Meetings.
- The SWQM, contractor, subcontractors, and INDOT should all be communicating stormwater management issues and project phasing beginning at the Preconstruction and Pre-disturbance Meetings.

Education

- Prior to installing any BMP, the SWQM should communicate with the operators and laborers on proper installation. It is more cost effective to install them correctly the first time and avoid having to repair them.

Contract Progress Meetings

- SWQMs are required to attend at least one contract scheduling meeting a month and be on the agenda each time. They shall take an active role and keep stormwater management and pollution prevention as an item on the schedule.

Qualified Professional

- The contractor's SWQM should be qualified to assess the situation and provide a resolution on stormwater management issues based on Standard specification's definition.

Team

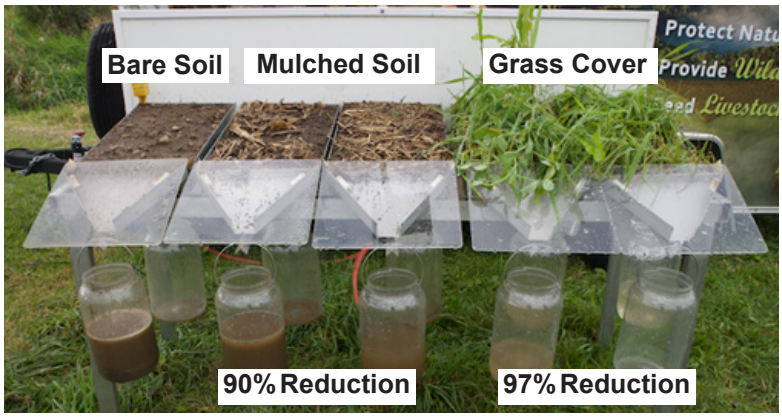
- Communication should flow in all directions. Each team member (contractors, subcontractors, INDOT field staff, District Stormwater Specialists, etc.) should keep each other informed.

WORK MANAGEMENT

Successful Strategies to Save Time and Money

Minimize Disturbance

- Managing construction operations to minimize disturbance or leave existing vegetated areas intact as long as possible is one of the most effective ways to prevent erosion.
- Existing vegetation is approximately 97 percent effective in preventing erosion, costs nothing to install, and needs no maintenance.



Save Topsoil

- When removing topsoil, save it to use on slopes and ditches that will be seeded and sodded. To retain nutrients and soil structure protect the soil stockpile with temporary seed and mulch and ensure perimeter protection is installed when needed.

Assembly Line Grading

- Plan grading operations like an assembly line, grade ditch, followed by roughening, followed by seeding and mulching.

Have a Plan "B"

- If a seeding subcontractor is not available, have an alternate plan to accomplish the work.

Timing is Everything

- Use weather forecasts for proactive stormwater management.
- Schedule work to ensure site is stabilized and/or BMPs are inspected prior to rain events.
- Seed and mulch exposed soil within seven days after earthwork operations to prevent erosion and allow as much time as possible for vegetation growth.
- Time grading operations so that any remaining permanent seeding can be completed and established before winter.

Install Perimeter Protection First

- Prior to any earth disturbing activities, including tree clearing, install: silt fence, filter sock, sediment traps, filter berms, construction entrances, and other BMPs to prevent off-site sedimentation and divert water away from the site.

Phasing

- Have a plan for each phase of construction and amend the SWQCP as needed in response to changing site conditions.

Prioritization of erosion and sediment controls for construction sites

Practice	Cost	Effectiveness
Limiting disturbed areas through **phasing**	$	💧💧💧💧
Protecting disturbed areas through **mulching and revegetation**	$ $	💧💧💧💧
Installing diversion around disturbed areas	$ $ $	💧💧💧
Sediment removal through **detention** of all site drainage	$ $ $ $	💧💧
Other **structural controls** to treat sediment laden flow	$ $ $ $ $	💧

Generally, the least expensive stormwater measures are the most effective. For example, limiting the amount of bare soil by phasing your project and preserving existing vegetation is less expensive and works better than installing large stormwater sediment basins or ponds. Source: 2009 edition KY Erosion Prevention and Sediment Control Field Guide.

STORMWATER MANAGEMENT

Stormwater flowing through disturbed areas causes erosion. Minimizing the amount of water flowing through the disturbed areas will decrease erosion.

Successful Strategies to Save Time and Money

Divert Off-Site Water

- Divert off-site stormwater around disturbed areas through a stabilized channel so it does not have to be filtered. Off-site water that becomes dirty as it moves through a construction site must be managed.
- Sediment control measures will not need to treat as much water and will require less maintenance.

Keep Water Off Slopes

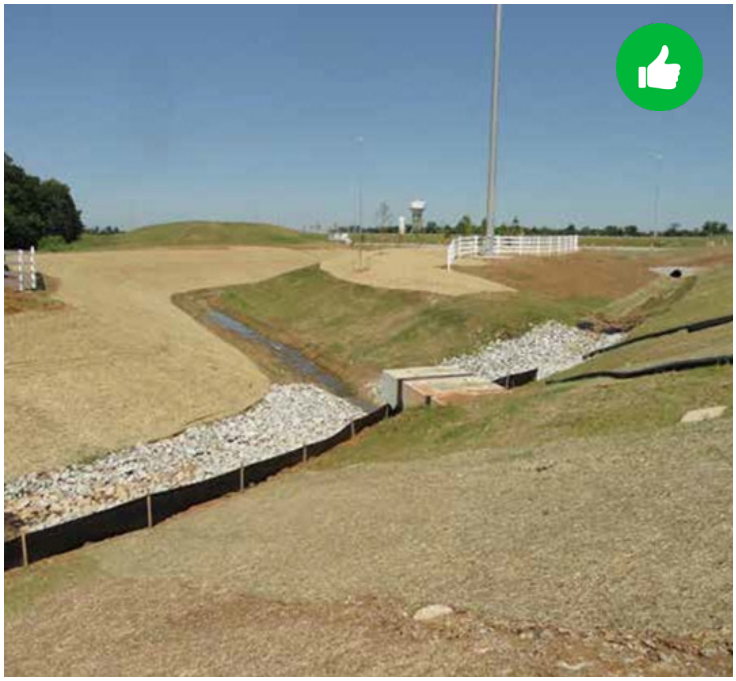
- Divert stormwater to slope drains or rock chutes to protect slopes while grass is getting established.
- Use slope drain to extend underdrains and median drains down to the ditch line while stabilizing slopes.

Treatment Train

- Installing a series of BMPs keeps water velocity low, erosion to a minimum, reduce BMP maintenance needs and enhance effectiveness of stormwater management.

Identify and Protect Environmentally Sensitive Areas

- Wetlands and Streams
- Karst features (Caves, sinkholes, underground streams)
- Endangered species habitat
- Ponds, open water
- Fish, wildlife or plant resources
- Long and steep slopes
- Public roads
- Sediment and erosion beyond project limits



Multiple Stormwater BMPs working together to protect slopes and waterway.

Silt fence and protective resource fence protecting a wetland (environmentally sensitive area).

Slope Drain

Standard References

Standard Specification Reference:
205.05(f) Slope Drains
205.07 Maintenance

Standard Drawing Reference:
205-TECS-02, 03, 04

Description

Slope drains help reduce erosion on slopes. When properly constructed, the drains will collect stormwater at the top of the slope and direct the flow through an inlet into a pipe to a discharge area at the toe of the slope.

Using a slope drain can temporarily transport stormwater, from underdrains, median drains, and sheet flow to the ditch while the slopes are stabilized. This reduces the potential for rills and gullies on freshly graded slopes. The outfall area should be stabilized/protected as per the Standard Drawings to further reduce sediment transfer.

Installation

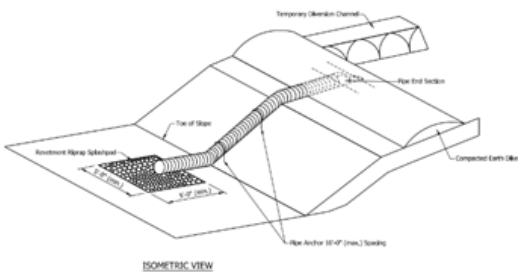
- Construct a temporary diversion channel (see Diversion Interceptor on page 18) to divert runoff towards the inlet.
- Lay the pipe down the slope face, connect an inlet section to the pipe at the top of the slope, and anchor it in place.
- Extend the pipe beyond the toe of the slope to a stable grade with the end of the pipe on a riprap pad to protect the outlet from erosion.
- Construct a ridge over the inlet section of pipe by placing fill over the pipe in six-inch lifts. **Do not** compact with heavy equipment.
- Following installation, stabilize all areas down slope of the diversion.

Inspection

- Inspect weekly and 24 hours before or after a ½ ” or more rain event.
- Inspect the installation for inlet/outlet erosion problems and pipe anchoring and leakage issues. Correct as necessary.
- Inspect for rills and other potential areas where slope drains should be installed.

Maintenance

- Check the inlet for sediment or trash accumulation; clear and repair as needed.
- Check the fill around the pipe for settling, cracking, or holes. Repair promptly.
- Check pipe for evidence of leaks or inadequate anchoring; repair promptly.
- Check the outlet for erosion or sedimentation; clean and repair or modify as necessary.
- Once slopes have been stabilized, remove temporary diversions and slope drains, and stabilize all disturbed areas.



Example Installations

A slope drain would minimize the potential of erosion from the underdrain.

Good example of slope drain diversion channel and inlet.

Slope drains are properly constructed with a stable outlet.

Good example of slope drains, diverting flow from the slope and allowing vegetation to establish.

Cofferdam and Temporary Construction Dikes

Standard References

Standard Specification Reference:
205 Stormwater Management
206 Cofferdams and Temporary Construction Dikes

Standard Drawing Reference:
Drawings shall be supplied by the Contractor for the specific use or are shown on the plans.

Description

Cofferdams isolate a jurisdictional stream and/or provide a dry area to work within and help prevent sediment generated by the work area from entering the waterbody. Cofferdams are temporary enclosures usually constructed within a body of water that are dewatered. Once dewatered, the cofferdam is either filled in to create a working platform or, left empty and used to construct a structural foundation. There are times when cofferdams can be utilized to protect a body of water adjacent to an active work area. Cofferdams must be constructed with materials that are impermeable and non-erodible.

Cofferdams made of earth are never permitted.

Installation

- Ensure the proper permits, including 401/404 permits, are obtained.
- Working drawings for a cofferdam installation shall be submitted by the contractor and will provide the method of construction for details not fully shown in the plans.
- Dewatering is outlined on page 16.
- If concrete is being poured inside a dewatered excavation, any water that mixes with the uncured concrete shall be pumped into an approved concrete wastewater containment and disposed of properly in accordance with 206.09 and 702.20.
- Ensure all banks are stable prior to removal of cofferdams.
- Remove carefully with as little disturbance as possible.

Inspection

- Review all plans and working drawings to understand what is being built.
- Inspect the cofferdam installation to ensure the location and methods are correct.
- Inspect daily for leakage or bowing of the cofferdam sides. Report any deficiencies immediately. Ensure cofferdams are not tilted or shifted.
- If excessive water is entering work area, inspect for leaking areas such as joints.

Maintenance

- Remediate any leaking or bowing of the cofferdam body prior to re- entry. If cofferdams have tilted or shifted, straighten as necessary and brace to prevent future movement.
- Repair any leaks to the cofferdam body in order to provide a buffer to any sediment leaving the area.
- Regrade and reseed work areas adjacent to the waterway as soon as practicable prior to removal.

Example Installations

One-ton sandbags and plastic sheeting together makes an effective cofferdam to isolate the waterway during the bridge replacement.

Bare earth is highly erodible and not a suitable barrier to be used for cofferdams. Water infiltration is evident.

Steel sheet piling used for a working platform within the waterway.

Ineffective sheet piling cofferdam. Sediment off-site in the waterway.

Pump Around

Standard References

Standard Specification Reference:
206.09 Cofferdams and Temporary Construction Dikes

Standard Drawing Reference:
Details shown on plans and in environmental permits.

Description

Pump arounds are used to divert streams or waterways and isolate the jurisdictional water from the work area. This BMP is usually designed specifically for a contract and will be detailed within the permit and plans. This method may be used in lieu of stream diversion.

Earthen dikes are never permitted on INDOT projects.

Installation

- Place watertight cofferdams (see Cofferdam page 12) in the waterway **both** upstream and downstream of the work area.
- Pump water from the upstream side, around the work area, and outlet on a stable outlet (usually riprap) on the banks of the waterway downstream of downstream cofferdam.
- Pump should be sized to ensure upstream water does not overtop the cofferdam and allow water into the work area.
- Pump around stream water is not to be filtered through a filter bag.
- Stream water should not be allowed to flow through work area until the area is completely stable, which includes the final shaping of the disturbed stream banks and stabilization of those banks according to the plans and, if applicable, permit.
- See Dewatering (page 16) for work area.

Inspection

- Inspect daily during pump around operations.
- Inspect outlet for stability and erosion.
- Monitor water level upstream to ensure pump is adequately sized and water does not overtop cofferdam.
- Monitor the weather forecast and anticipate increases in water levels.

Maintenance

- Adjust outlet stabilization if erosion is noticed.
- Adjust pump capacity as needed.
- Fix leaks or otherwise stabilize cofferdams if water is back flowing into work area.

Example Installations

Pump around for clean water from upstream, being discharged to an energy dissipator (riprap).

Stable outlet shall not be placed in the stream channel. This is an unpermitted fill and a violation of 401/404 permits.

Proper pump around set up. Clean water is discharged to clean water from a stable area. Dewatering is pumped into a filter bag on a stable area with secondary containment.

Clean water discharging directly into a stream without an energy dissipater is causing erosion.

Dewatering

Standard References

Standard Specification Reference:
206 Structure Excavation

Standard Drawing Reference:
Details shown on plans and in environmental permits.

Description

Dewatering can be used to remove water from the bridge foundation footing excavations, drainage structure installations, or within the work area of a pump around.

Proper discharge of the dewatering activity should be reviewed and planned for in the design of the system. The dewatering process should include water filtering and stabilized outlets. The filtering operation removes sediment, which is associated with the dewatering operation.

Installation

- Locate the desired discharge area for the dewatering system then ensure a stable pathway to the waterbody.
- Coordinate the filter and stabilization methods with the installer.
- Discuss the pump capacity and piping components to be used with the installer.
- Review the layout of the system prior to placement and have any deficiencies corrected prior to operation.
- Construct a secondary containment BMP such as a rock filter berm, 8” diameter or greater filter sock, or sediment trap near the waterway.
- If using a filter bag, place on a flat stable surface outside of the waterway behind the secondary containment.
- Place filter bag in a location that they can be removed without causing damage or losing sediment.

Inspection

- Inspect daily during dewatering operations.
- Inspect the filter location and condition for necessary repair.
- Review the piping system for leakage, kinks, and conditions for needed repair.
- Inspect the filter bag for tears, sediment, and water capacity.
- Look for erosion between the filter bag and waterway.

Maintenance

- Repair any damaged or ineffective pumps.
- Repair or replace filters that are leaking or fail.
- Filters may need to be replaced when they become laden with sediment.
- Repair or replace leaking or damaged piping.
- Repair eroded areas and stabilize disturbed areas.

Example Installations

Filter bag has been placed outside construction limits and in a jurisdictional wetland. This would be considered a permit violation, cause work to stop and possible fines.

Filter bags should not be placed in waterways. Bags often break or become dislodged, sending sediment downstream.

Properly placed dewatering filter bag, on flat surface and provides stable pathway to waterbody.

Filter bag placed on flat surface away from sensitive environments.

Diversion Interceptors

Standard References

Standard Specification Reference:
205 Stormwater Management
205.05(c) Diversion Interceptors
205.07 Maintenance

Standard Drawing Reference:
205-TECS-01, 205-TECS-02, 205-TEC-03, 205-TECS-04

Description

Slope diversion interceptors are constructed stormwater control measures, consisting of a dike, or dike and channel, construction along the up-slope perimeter of a disturbed slope to control stormwater runoff from undisturbed areas and divert it around disturbed areas.

A temporary interceptor ditch is a stormwater control measure consisting of a temporary ridge, excavated channel, or combination on a predetermined grade across a slope to collect stormwater runoff and divert it to a BMP or stable outlet.

Water bars are a series of small ridges, or ridges and channels, used to intercept and divert stormwater runoff from long, narrow corridors and discharge it into a stabilized area, slope drain, or sediment treatment device.

Installation

- Construct the diversion to the dimensions and grades shown in the construction plans or to dimensions listed below.
  a. Side slopes – ratio of 2:1 or flatter (3:1 or flatter if mowed).
  b. Grade – positive towards outlet, but not exceeding one percent.
  c. Stabilize for flow.
- Construct the diversion ridge in compacted lifts. Leave enough area along the diversion to permit cleanout and re-grading.
- Stabilize interceptor ditches and slope diversions within seven days.
- Stabilize diversion interceptors and outlets within seven days. The diverted stormwater flow must pass through an appropriate sediment control measure prior to leaving the construction site.

Table 1. Water Bar Spacing

Slope		Spacing
< 5%	< 20:1	125 feet
5% to 10%	20:1 to 10:1	100 feet
10% to 20%	10:1 to 5:1	75 feet
20% to 33%	5:1 to 3:1	50 feet
>33%	> 3:1	25 feet

Note:
Diversion interceptors are also used in conjunction with temporary slope drains (Temporary Slope Drain page 10).

Inspection

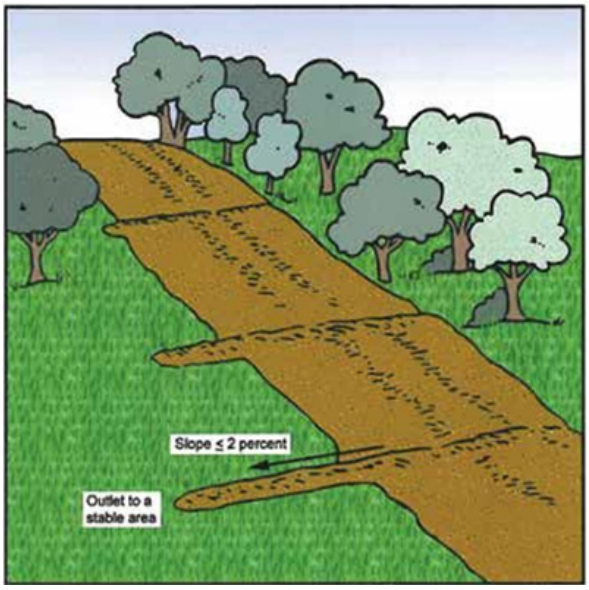
- Inspect weekly and within 24 hours of a ½" or more rain event.
- Inspect daily if impacted by grading operations.
- Inspect ridge height and valley depth.
- Check outlets for debris and erosion.

Maintenance

- Remove sediment from channel to maintain positive grade.
- Adjust ridge height to prevent overtopping.
- Make necessary repairs immediately to outlets.
- Stabilize areas that are eroding.
- Reform diversion interceptors as needed if disturbed by grading operations.

Example Installations

Temporary or permanent stabilization has not been accomplished, allowing sediment to travel off-site. Stabilization and additional BMPs are needed to prevent sediment from reaching the waterway.



Schematic of diversion interceptor concept. IDEM Indiana Stormwater Quality Manual.

Stable diversion interceptor around a box culvert installation (not pictured).

Example of permanent diversion interceptor installation.

Rock Chute

Standard References

Standard Specification Reference:
616.01-08 Riprap, 616.10-11 Geotextiles

Standard Drawing Reference:
Rock Chute details shown in plans

Description

A rock lined chute is a constructed riprap lined channel used to move water down a slope to prevent erosion. Its main purpose is to reduce water velocity and provide a stable outlet. Riprap is used to stabilize a channel but should not be used to collect sediment.

Installation

- Construct the chute with a depression down the middle of the chute to direct flow and erosion along the sides.
- Excavate and compact the chute prior to placement of geotextile.
- Riprap is recommended to be placed at a depth of twice the stone diameter or 12 inches, whichever is greater.
- Overlap geotextile sheets 18” with the upstream sheet over the downstream sheet.
- Blend the lining material into the surrounding grade.

Inspection

- Inspect weekly and within 24 hours of a ½” or more rain event.
- Inspect channel geotextiles and lining materials for gaps, breaks, or washouts for necessary repairs.
- Inspect for any undermining of the channel and repair as needed.
- Look for any rills that may begin to form.
- Inspect for sediment collecting in the riprap.

Maintenance

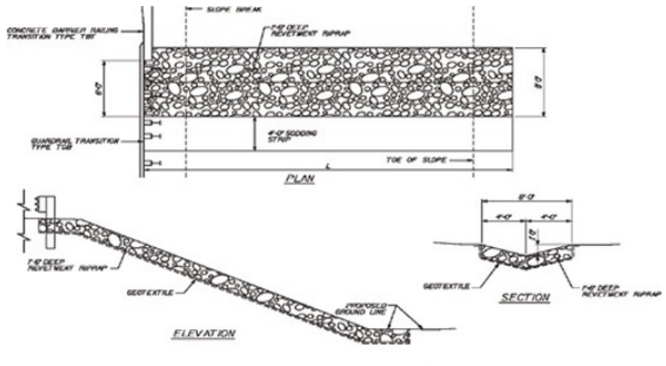
- If scour is found along the sides of the chute, reshape chute as needed for water to flow through the riprap down the center of the chute.
- Promptly repair and reseed/mulch any small rills that form.
- Repair or replace any breaks, gaps, washouts or damage in the geotextile or the channel lining material.
- If sediment is found in the riprap, stabilize slopes and areas upstream of channel, clean out or replace riprap.
- If scour is found downstream of the chute, additional riprap may be needed. Consult with designer and/or Environmental Services to ensure no permits or permit modifications are needed.

Example Installations

Good example of placement of a rock chute to help with runoff from an adjacent farm field.

Rock chute installed without proper swale depression causing erosion rills.

Water is bypassing rock chute.



RIPRAP TURNOUT DETAILS

Riprap turnout details can be found in the plans with the miscellaneous details.

EROSION CONTROL

Erosion control involves maintaining the soil on the ground, within the construction area, and minimizing its movement. **Preventing erosion is more efficient and cost effective than managing sediment after it begins to be transported by stormwater.** Keeping soil in its place with well managed erosion control, minimizes the need for sediment control BMPs, reduces maintenance on those BMPs, and lowers costs of regrading, soil amendments, and fertilizing.

Successful Strategies to Save Time and Money

Minimize Disturbance

- Preserve as much existing vegetation for as long as possible.
- Bare soil that is scheduled to be inactive for more than seven days shall have mulch and seed applied to the area as soon as possible.
- Limit disturbance by phasing construction activities.

Protect the Soil

- Permanent seed as soon as possible
- Erosion control blankets can also be used for temporary stabilization for bare or exposed areas. Blankets are recommended for stabilization on slopes of 3:1 or steeper.

Vegetative Buffers

Standard References

Standard Specification Reference:
205 Stormwater Management
205.05(g) Vegetative Filter Strips
205.07 Maintenance

Standard Drawing Reference:
N/A

Description

Grass, shrubs, trees and other vegetation around work areas should be preserved if possible. A vegetative buffer located above a construction site reduces water velocity on to the site. Vegetative buffers located below construction activity helps trap and filter sediment and other debris before it can move into ditches, channels, and streams. All vegetated areas help to promote infiltration of stormwater, which helps prevent erosion and controls sediment movement. Flat areas with sheet flow are a more effective buffer than steep areas or areas of concentrated flow.

Installation

- Evaluate existing vegetation and determine if it will serve as a filter strip (scrub shrubs are not an acceptable vegetative filter). Look for areas where vegetation is at least four inches high and covers 80 percent or more of the soil surface.
- If existing vegetation is not adequate, and if site conditions and seeding conditions are favorable, overseed the area or fertilize the existing vegetation to enhance growth and density. Allow time for sufficient vegetative growth before discharging sediment-laden stormwater runoff into the filter strip.
- If vegetative buffers are being preserved per IDEM CSGP requirements, then they must not be used as a vegetative filter strip. Riparian buffers will be identified in the construction plans as do not disturb and will have a BMP to protect the area from sedimentation.

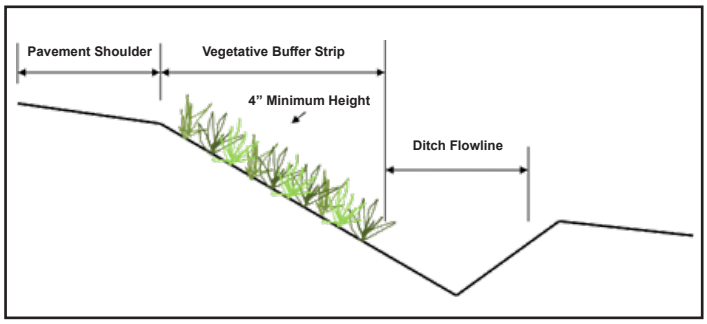
Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Inspect for erosion or rills.
- Inspect for areas of accumulated sediment.

Maintenance

- Promptly repair any small rills that form.
- Add fertilizer and soil amendments as needed to maintain healthy vegetation.
- Mow as needed but not shorter than four inches.
- Where the filter strip has actively trapped sediment during construction, remove the accumulated sediment, and if the filter strip has been disturbed then the area may need to be graded and reseeded once conditions are favorable for vegetative establishment.

Example Installations



Vegetative buffer helps trap and filter sediment before it enters ditch flowline.

Narrow strip of vegetation on the bank is only partially protecting the stream.

Note, sediment within the waterway.

Existing vegetative buffer along and within the ditch.

Good example of vegetative filter strip (and silt fence) protecting the waterway from sediment.

Roughening/Tracking

Standard References

Standard Specification Reference:
203.09 General Requirements
205.07 Maintenance

Standard Drawing Reference:
N/A

Description

Surface roughening, or tracking, is the creation of ridges and valleys parallel to the contour of the slope. The track marks help reduce erosion by slowing stormwater as it travels down the slope. These track marks also capture sediment and seeds which helps establish vegetation.

Installation

- All slopes shall be roughened until permanent erosion control measures are placed. Roughening shall take place each day after work is performed on the slopes, or as directed.
- Slopes shall be roughened to create a series of ridges and depressions **parallel to the contour** making grooves at least 1” deep and not more than 15” apart.
- Discuss the operation of roughening with the Stormwater Management Team to ensure understanding of the operation.

Inspection

- Inspect weekly and within 24 hours after a ½” or more rain event.
- Ensure that the ridges and depressions created by the track marks are horizontal or parallel to the contour of the slope.
- Check for rills and gullies.

Maintenance

- Promptly repair any small rills that form and re-roughen the repaired area.
- As soon as possible, reinforce the slope roughening with an appropriate erosion control measure such as seeding and mulching.

Example Installations

Vertical track marks will contribute to rill erosion.

Operate bulldozer or other tracked vehicle up and down slopes before seeding to create tread-track depressions for catching and holding seed.

Horizontal track marks help stabilize a slope by creating small ridges and valleys to trap seed and mulch.

Vertical track marks make erosion worse and creates a series of rills to quickly move water and sediment to the ditch bottom.

Temporary Seed

Standard References

Standard Specification Reference:
205.04(a) Seed
205.07 Maintenance

Standard Drawing Reference:
N/A

Description

Temporary seed is used to stabilize bare soil, including temporary soil stockpiles, until the areas are ready for permanent stabilization. Temporary seeding can reduce problems associated with sediment or dust and lowers costs of regrading, soil amendments, and fertilizing. Temporary seeding may be required to be used several times throughout the development of the project. Permanent seed (page 45) should be placed as soon as practicable.

Installation

- Temporary seed and mulch shall be placed as soon as possible on disturbed areas that are planned to be inactive for more than seven days, or as directed.
- Prepare slopes by roughening the soil surface prior to temporary seeding (see Roughening page 25). If soil is compacted, loosen soil to a depth of 2-3” prior to temporary seeding.
- Install the seed by drilling, hydroseeding, hand broadcasting, or other approved method that provides a uniform distribution.
- Do not cover the seed with more than one-half inch of soil.
- Mulching should take place within 24 hours after the seeding operation (see Temporary Mulch page 29).
- When directed, fertilizer may be applied at the temporary application rate, in accordance with 205.04, during the active growing season from March through November.
- Temporary seed application rates:
  - Spring Mix: January 1 to June 15 (oats at 150 lbs/acre).
  - Fall Mix: September 1 to December 31 (winter wheat at 150 lbs/acre).

Inspection

- Inspect weekly and within 24 hours after a ½” or more rain event.
- Look for eroded areas, rills and gullies.
- Look for bare patches, spot seed if necessary.
- Adequate temporary stabilization is approximately 80 percent vegetation density.

Maintenance

- Repair eroded areas by reworking the area and reseeding promptly.
- Apply Mulch to reseeded areas within 24 hours.
- Fertilize if needed during the active growing season (March through November).

Example Installations

Weeds indicate slope has been unprotected for an extended amount of time. Temporary seed and mulch should have been applied within seven days of inactivity.

Early stages of temporary vegetation providing slope stability.

Temporary vegetation and slope drains providing slope stability.

Temporary seeding on long steep slope requires maintenance. Notice the beginning of rills.

Temporary Mulch

Standard References

Standard Specification Reference:
205.04(b) Mulch
205.07 Maintenance

Standard Drawing Reference:
N/A

Description

Temporary mulch prevents erosion by protecting the soil from wind and water impact. Mulch helps to stabilize slopes, prevents soil from crusting, conserves soil moisture, moderates soil temperature, and promotes seed germination and growth.

Installation

- Mulch can be straw, wood chips or other products in accordance with 914.05.
- Install within 24 hours of seeding.
- Mulch shall be secured with acceptable netting, punching in with notched disks, cleating with dozer tracks, commercially produced water borne mulch binder, or other approved method.
- Punching or cleating of mulch should be performed in the same direction as roughening (page 25).
- Mulch is not effective in ditch bottoms or other concentrated flow areas.
- Do not mulch in waterways or wetlands unless explicitly permitted or authorized.

Inspection

- Inspect the day of application to ensure uniform coverage and secured.
- Inspect weekly and within 24 hours after a ½ ” or more rain event.
- Check for mulch movement and eroded areas.
- Continue to inspect mulch coverage until vegetation is established.

Maintenance

- Repair eroded areas by reworking the area and reseeding promptly.
- Correct eroded areas, reseed, and reapply mulch as needed.
- If erosion is severe, reoccurring, or in channelized flow, consider using erosion control blanket (page 22) and slope drains (page 10).

Example Installations

Temporary mulch applied too thin. Mulch and seed application rate should be per Specification.

Mulch applied adequately and uniformly with tackifier.

Wood chips from tree clearing used as erosion control between work sequences.

Mulch applied adequately for temporary cover.

Dust Control

Standard References

Standard Specification Reference:
107.08 (b) Dust and Air Pollution

Standard Drawing Reference:
N/A

Description

Dust control, especially during hot and dry conditions, helps reduce wind erosion. Methods can include watering, resin/polymer application (in accordance with local, state, and federal regulations), mulching, street sweeping, and temporary vegetative covers. A proactive approach should be used for effective dust control.

Mechanical methods, such as the use of a leaf blower that may result in the mobilization of dust off a construction site is prohibited.

Installation

- The contractor and INDOT's PEMS should discuss the location of haul roads at the pre-construction meeting to determine the best method to utilize for dust control. If possible, locate haul roads away from residential, commercial or other public areas.
- Apply water at a rate to keep soil wet/moist, but not saturated or muddy.
- If brooming is a chosen method, wet the area with water prior to the brooming operation to aid in dust suppression.
- Sweeping is generally more efficient for cleaning large areas in less time and generates less dust than brooming.

Inspection

- Be aware of the potential for dust as the season progresses and keep discussions on the issue open between the SWQM and INDOT's PEMS.
- Inspect as needed, daily during hot and dry seasons. Be proactive. Stay ahead of the issue.

Maintenance

- Apply additional water or mulch as needed to control dust. Repetition is required to be effective.
- Keep construction equipment speeds appropriate for the conditions.
- Stabilize disturbed areas with vegetation and mulch as much as possible.

Example Installations

Dust contributes to air pollution, can interfere with drainage, and can create traffic hazards. Dust can be compounded with the use of a leaf blower.

Mechanized broom removing debris and dust from paved surface.

Covering exposed soil with mulch is an effective dust control practice. Also, temporary seed or permanent seed as early as possible to reduce dust on a construction site.

Street sweepers utilize water and vacuum systems to remove debris and prevent dust.

Rock Check Dam

Standard References

Standard Specification Reference:
205.05(a) Check Dam
205.07(g) Maintenance

Standard Drawing Reference:
E 205-TECD-06

Description

A rock check dam consists of geotextile fabric and aggregate, placed across drainage channels to slow stormwater runoff. This measure is primarily to prevent channel erosion in roadside ditches but may also provide limited sediment control. Rock check dams should not be used as a substitute for other erosion control BMPs (seed and mulch) and sediment control BMPs (sediment traps).

Installation

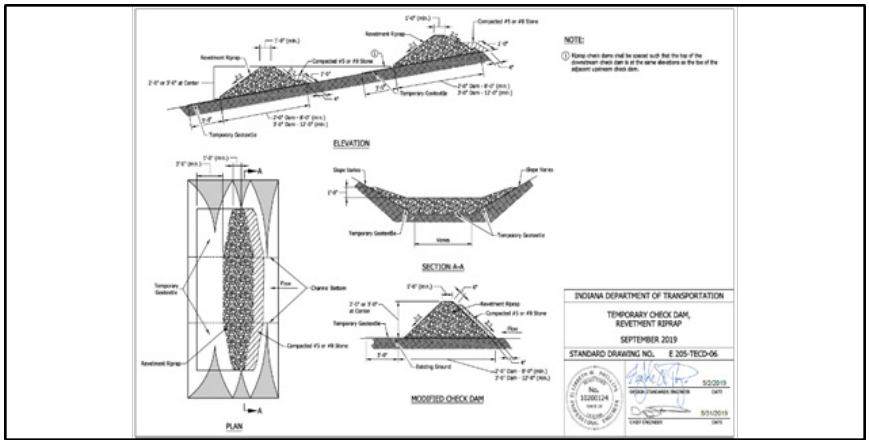
- Discuss with team members and identify the areas for rock check dam installation.
- Place revetment riprap on geotextile fabric that extends downstream of check dam.
- Include #5 or #8 filter stone on upstream side.
- The weir (lowest part of the dam) should be in the middle with the sides tied into the slopes. (Like a smile).
- Space check dams so that the bottom of the upstream dam should align with the weir of the downstream dam.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Check to make sure the center of the dam is low and the sides are tied into the slopes so water flows across center of dam.
- Check for #5 or #8 filter stone on front face of dam.
- Geotextile under dam should extend 3 feet down the slope.
- Inspect for channel erosion. If channel erosion is found, space check dams closer.

Maintenance

- Remove sediment once it reaches one-half the height of the check dam.
- Repair or replace if the check dam is damaged or ineffective.



INDOT Standard Drawing, Temporary Check Dam, Revetment Riprap.

Example Installations

Check dam is much bigger than necessary. Wasted material, wasted money, can cause flooding, and will be much more difficult to remove.

Check dam not shaped correctly causing water to bypass dam and erode slopes.

Check dam shaped correctly with low weir in the middle and tied into the slopes.

Rock check dam not built to specification. Not shaped correctly, no filter stone, no geotextile. The check dam should be rebuilt.

Traversable Check Dam

Standard References

Standard Specification Reference:
205.05(b) Check Dam, Traversable
205.07(g) Maintenance

Standard Drawing Reference:
E 205-TECD-07 and E 205-TECD 08

Description

A traversable check dam consists of geotextile fabric and filter socks, placed across drainage channels to slow stormwater runoff. This measure is primarily to prevent channel erosion but may also provide limited sediment control. Traversable dams should not be utilized as a first choice when selecting a channel erosion control measure. This option should only be used in clear zones with active traffic, and when watersheds and velocities are small.

Installation

- Place only in clear zone areas with active traffic and low stormwater velocity.
- Place filter socks on geotextile fabric that extends downstream of check dam.
- Trench the bottom of the check dam into the ground 4 inches.
- The weir should be in the middle of the dam with the sides tied into the slopes (like a smile).
- Space check dams so that the bottom of the upstream dam should align with the weir of the downstream dam.
- Filter socks should be placed three in a pyramid shape.
- Stake into the soil to securely anchor dams

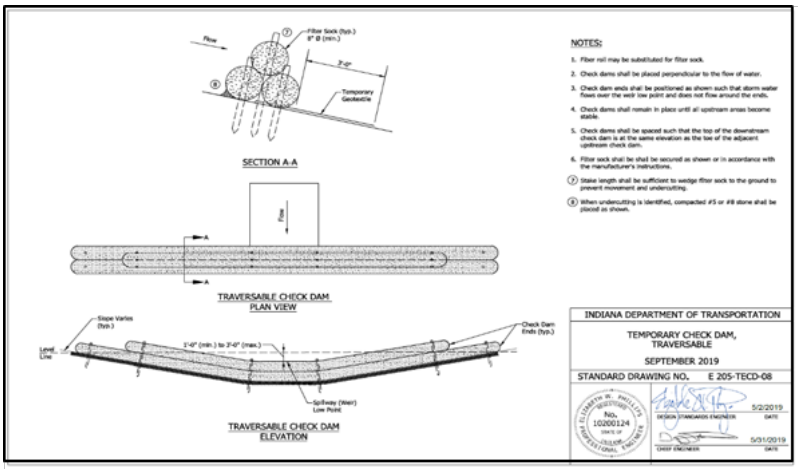
Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Check to make sure center of dam is low and the sides are tied into the slopes so water flows across center of dam.
- Check for #5 or #8 filter stone on front face of dam (when using filter socks).
- Geotextile under dam should extend 6 feet down slope.

Maintenance

- Remove sediment once it reaches ½ the height of the check dam.
- Repair or replace if the check dam is damaged or ineffective.

Example Installations



INDOT Standard Drawing for temporary check dam, traversable.

The water volume and velocity in this area are too much for traversable check dams. There should be more focus on erosion control with seed, mulch and erosion control blanket.

Filter sock check dams undermined due to high velocities.

Filter sock installed in a pyramid and high on sides of bank, to ensure flow does not go around measure.

Erosion Control Blanket

Standard References

Standard Specification Reference:
205.04 (c) Temporary Surface Stabilization

Standard Drawing Reference:
N/A

Description

Erosion control blankets are a manufactured surface protection product. They act as a specialized mulching material and are normally used on long or steep slopes and in concentrated flow channels. The advantages that erosion control blankets provide include preventing erosion by protecting the soil from rainfall impact, overland water flow, concentrated runoff, and wind. The blankets are also anchored. Blankets tend to conserve moisture and increase seed germination and seedling growth. Blankets are recommended for stabilization on slopes of 3:1 or steeper.

Installation

- Select the appropriate type of blanket needed specifically for the designated area and anticipated water velocity.
- The area shall be relatively free of all rocks or clods over 1½" in diameter.
- Lay erosion control blankets on the seeded area so they are parallel to the primary direction of water flow, in continuous contact with the soil, and with each upstream blanket overlapping the downstream blanket.
- Tuck the upper edge of the slope blankets into a check slot, then backfill with soil and firmly tamp it down. This secures the blanket in place. Anchor the blankets in place by driving staples, pins, or stakes through the blanket and into the underlying soil.

Inspection

- Inspect weekly and within 24 hours of a ½" or more rain.
- Check for erosion, displacement, or gaps/rills under the blanket.
- Blanket needs to be anchored and overlapped properly according to specification to ensure proper function.

Maintenance

- If any area shows erosion, pull back that portion of the blanket covering the eroded area, add soil and tamp, reseed the area, replace and staple the blanket.

Utilizing wildlife friendly materials, such as plastic free jute nets and straw is required by waterway permits. Review applicable permits to ensure compliance.

Example Installations

Mulch and seed will be washed away in ditches without blankets.

Erosion control blanket being used for permanent vegetation establishment and slope protection.

Erosion control blankets will not work if proper soil grading is not completed first. In this photo, the blankets were not installed parallel to direction of water flow.

Blankets can be used as temporary or permanent erosion control around Environmentally Sensitive Areas such as creek banks. If below the OHWM, permitting may be necessary. For assistance contact the District Stormwater Specialist.

Permanent Inlet Protection

Standard References

Standard Specification Reference:
616.05 Riprap
616.11 Geotextile under riprap

Standard Drawing Reference:
N/A – Contract Specific Design

Description

Permanent inlet protection is protection for the upstream side of culverts and pipes. Channel flow upon approaching a structure, pipe or culvert will constrict and increase velocity having to enter a smaller cross- sectional area. This increased velocity can cause erosion around the structure inlet. Typically, riprap is used on the upstream part of the structure to armor the areas affected by the increased velocity of the water flow.

Installation

- Geotextile must be laid out according to the plans and details. Geotextiles should cover the bottom of the channel and at least halfway up the side slopes of the channel.
- Geotextile must be placed under all the intended areas for riprap. The geotextiles shall be placed on a relatively smooth grade free of obstructions, depressions, and debris.
- Place riprap on geotextile at the depth shown on the plan and matching the plan location and grade.

Inspection

- Inspect weekly and within 24 hours of a ½" or more rain event.
- Ensure that the geotextile has been handled and placed according to specification.
- All riprap shall be placed on top of installed geotextile.
- Inspect for scouring around the inlet and beyond the limits of the riprap.

Maintenance

- Promptly repair any erosion that forms.
- Replace geotextile if it has been damaged.
- Clean out or replace any riprap showing excessive sediment build-up.

Example Installations

The lack of permanent protection has caused scouring around pipe inlet.

Pipe does not need riprap for permanent inlet protection because permanent vegetation was established for stabilization and velocity is low.

Permanent inlet protection without geotextile fabric and haphazard placement.

Permanent inlet protection includes wing walls and riprap protection.

Permanent Outlet Protection

Standard References

Standard Specification Reference:
616.05 Riprap
616.11 Geotextile under riprap

Standard Drawing Reference:
N/A – Contract Specific Design

Description

The outlet protection is described as the permanent protection of the downstream end of culverts and pipes. Channel flow velocity leaving a structure, pipe or culvert may increase. This increased velocity can cause erosion downstream of the structure. Typically, riprap is used on the downstream part of the structure to armor the areas affected by the increased velocity of the water flow.

Installation

- Geotextile must be laid out according to the plans and details. Geotextiles should cover the bottom of the channel and continue at least halfway up the side slopes of the channel.
- Geotextile must be placed at all the intended areas for riprap. The geotextiles shall be placed on a relatively smooth grade free of obstructions, depressions, and debris.
- Place riprap on geotextile at the depth shown on the plans and matching the plan location and grade.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Ensure that the geotextile has been handled and placed according to the specifications.
- All riprap must be placed on top of installed geotextile.

Maintenance

- Promptly repair any erosion that forms.
- Replace geotextile if it has been damaged.
- Clean out or replace any riprap with excessive sediment build-up.

Example Installations

Too much riprap has been placed within the channel. Riprap should be sumped to allow the waterway and box culvert to naturally fill with sediment over time and form a new channel above the riprap. Refer to and follow the IDEM 401 and USACE 404 permit conditions.

Outlet protection not shaped correctly. Water should flow down the middle of the riprap.

Ditch is properly sumped to create a natural flow line to eliminate erosion.

Outlet protection slows the velocity of water exiting the pipe to help prevent erosion.

Riprap Ditch

Standard References

Standard Specification Reference:
616.01-08 Riprap,
616.10-11 Geotextiles

Standard Drawing Reference:
N/A – Contract Specific Design

Description

Riprap is used to slow the velocity and dissipate the energy of water in concentrated or channel flow to prevent erosion. Stone should be extended far enough up the slope to prevent scouring at the edge of the riprap. A riprap ditch is often placed where water volume or velocity is too high to establish adequate permanent vegetation. Riprap is used to stabilize and armor a channel but should not be used to collect sediment. Geotextile should always be placed under the riprap. Riprap should never be placed in a wetland or jurisdictional waterway without explicit permit conditions.

Installation

- Ditch must be cut to final cross section/grade.
- Place geotextile on a relatively even surface. Overlap geotextile sheets 18 inches with the upstream sheet over the downstream sheet.
- Riprap must be placed at the specified thickness shown on the plans.
- Top of riprap must match the cross-section grade. The finished surface shall vary no more than 9 inches from a true plane.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Verify riprap was placed in the correct location and quantity shown in the plans and standard specifications.
- Inspect for scour along the sides of and downstream of riprap channel.
- Inspect for sediment collecting in the riprap channel.

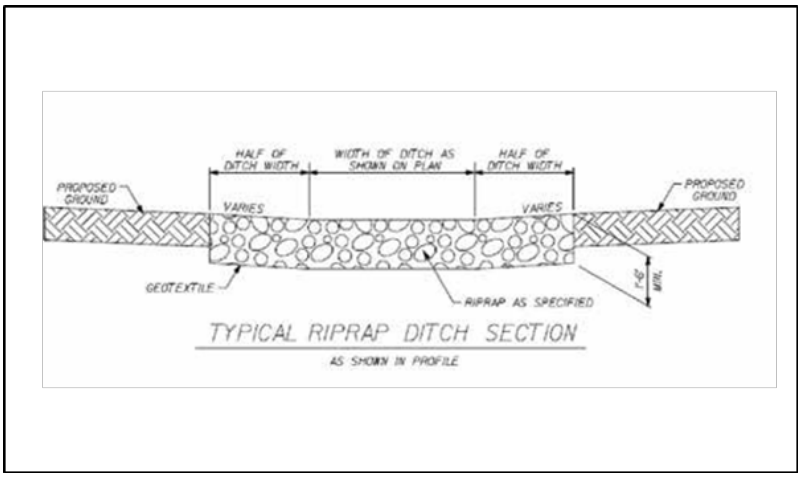
Maintenance

- If sediment is found in the riprap, stabilize slopes and areas upstream of channel. Clean out or replace riprap.
- If scouring is found along the sides of the channel, reshape channel as needed for water to flow through the riprap.
- If scouring is found downstream of the channel, additional riprap or geotextile repair may be needed.
- Consult with the designer and/or Environmental Services to ensure no permits or permit modifications are needed. Repair any damaged geotextiles.

Example Installations

Permanent riprap should be installed in steep ditches to prevent gully erosion.

Permanent riprap ditch with correct shape and placement.



Typical riprap ditch section can be found in the plans.

Riprap is not extended far enough up the slope and not shaped correctly, causing scour.

Permanent Seed

Standard References

Standard Specification Reference:
621 Seeding and Sodding
RSP 629-R-630 Plant Growth Layer
914 Roadside Development Materials

Standard Drawing Reference:
N/A

Description

Healthy permanent vegetation stabilizes slopes and minimizes maintenance years after the project is complete. Permanent vegetation helps filter pollutants such as oils and nutrients. Timing of seeding is critical. September is the best time to plant seed due to the temperature and moisture. Seeding is allowed throughout the year per specification 621.12 but may require a warranty bond and/or watering.

Installation

- Topsoil should be capable of supporting normal vegetation, free of noxious weeds and shall be in accordance with the final cross section and grade.
- Topsoil shall be free of rocks over 1 inch in diameter.
- Topsoil shall have a pH value within acceptable range. A soil test is recommended to determine if amendments are needed.
- Loosen topsoil a minimum of 3 inches deep.
- Fertilizer shall be uniformly applied at the appropriate rate.
- Seed may be drilled or mixed with water and sprayed over area. Seed shall not be covered more than one-half inch.
- Permanent mulch shall be applied uniformly at 2 tons per acre within 24 hours after seeding.
- Alternatively, erosion control blanket can be used to protect seed and slope. Erosion Control Blankets are required on slopes 2:1 or steeper. They are strongly recommended on slopes 3:1 or greater for higher vegetation establishment success.
- Punch mulch into soil with a mulch tiller.
- Unless seed was applied by a hydro seeder, water thoroughly.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Areas should be monitored to ensure that mulch cover stays in place.
- With appropriate temperature and moisture, seed should germinate in approximately 2-3 weeks.
- Any areas void of seed germination shall be subject to soil test for proper correction measures before reseeding. Change order for soil test might be warranted.

Maintenance

- Promptly repair any small rills that form and reapply seed and mulch as needed.
- If consistent rills or gullies are forming, consider installing slope drains or fiber rolls at the top of the slope until vegetation is established.
- If vegetation appears yellow or wilted, fertilizer and/or watering may be needed.

Example Installations

Picture represents a higher than 70 percent uniform density permanent vegetation.

Mulch is not an appropriate protection for seed in concentrated flow areas.

Erosion control blanket and filter sock together are assisting with the permanent seed establishment on this slope.

Poor soil conditions can hinder vegetative growth.

Permanent Sod

Standard References

Standard Specification Reference:
621 Seeding and Sodding
RSP 629-R-630 Plant Growth Layer
914 Roadside Development Materials

Standard Drawing Reference:
Sod typical drawing within plan details

Description

Installing permanent sod is one method to provide permanent vegetation (page 45). Sod edges should be tightly butted together to help keep moisture in the soil and prevent air from drying out the grass roots.

Installation

- Topsoil should be capable of supporting normal vegetation and free of noxious weeds and have a pH value within acceptable range.
- Loosen topsoil to a minimum of 3 inches. Soil shall be smooth, uniform and free of clods, lumps, boulders and waste material.
- Fertilizer shall be applied at the appropriate rate and raked into 1-2” deep loose topsoil prior to laying sod.
- Notch the sod into the soil so that after installation, the surface is in accordance with the final cross section and grade.
- Lay sod in the direction of water flow. Tightly butt together to avoid open joints.
- Water immediately after laying the sod, enough to saturate the sod and the top few inches of soil.
- After watering, tamp or roll to ensure contact with the soil. Surface shall be smooth and free from lumps and depressions.
- Secure sod in place with wood pegs or wire pins driven flush with top of the sod when required.

Inspection

- Inspect weekly and within 24 hours after a ½” or more rain event.
- Repair or replace sod that is no longer in contact with the soil or has moved.
- Monitor after the required minimum watering time frame and water as necessary during dry and/or hot weather conditions.

Maintenance

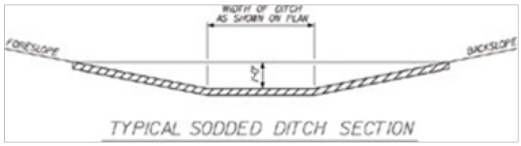
- Water sod every day of the first week, once every second day of the second week, once every third day of the third week and once a week thereafter for a minimum of four weeks.
- During ample rainfall, watering may be modified to simulate the above schedule.

Example Installations

Area upstream of sodded ditch is not stable and causing sedimentation on permanent sod.

Permanent sod installed in concentrated flow area in median.

Sod failed because it was installed on a thick bed of straw mulch. An adequate growing surface is needed for the sod to take root.



When placing sod in a ditch, extend the sod up the slope to prevent scour on the edge of the sod. Notch sod into the soil so that there is a smooth surface transition in accordance with the final cross section and grade.

Sod was not adequately watered or otherwise maintained.

SEDIMENT CONTROL

If previous stormwater management efforts have been exhausted, sediment control BMPs will be needed to minimize sediment and other pollution from leaving the site. Sediment control measures are designed to slow water down long enough for sediment particles to settle out of flowing water. Smaller particles (such as clay) need more time to settle out than larger particles (such as sand). Because of this, sediment control features are not very effective in areas with clay soils. This is why the focus should be on other management tools (Communication, Work Management, Stormwater Management and Erosion Control). Once the soil is on the move, it's hard and expensive to manage. Generally, sediment control measures are the most expensive, require the most maintenance, and are the least effective stormwater management tools.

Successful Strategies to Save Time and Money

Last Line of Defense

- Use all other Best Management Practices so that sediment control measures do not need as much maintenance.

Plan for Maintenance

- When sediment control measures are placed, install them in a location where they can easily be maintained. If the last measure cannot easily be maintained, consider additional measures that minimize maintenance needs.

Consider the Watershed

- Sediment control measures should be designed to handle the sediment load and stormwater velocity of the entire watershed.
- If the watershed size is not known, existing features such as ditch size, pipe size, etc. will provide an indication of an appropriate sediment trap or basin size.

Construction Entrance

Standard References

Standard Specification Reference:
205.03 General Requirements
205.07 Maintenance

Standard Drawing Reference:
E 205-TECD-12

Description

The construction entrance is a stone pad made of geotextile fabric placed under #2 stone. The construction entrance provides access to a construction site and minimizes tracking of mud and sediment onto public roadways. Sediment on public roadways is a safety hazard due to slippery conditions, loose rocks, and decreased visibility from dust.

Installation

- Place geotextile fabric under #2 stone.
- Construction Entrance must be 150 feet in length. However, if site conditions justify, the length may be reduced but cannot be less than 50 feet.
- Do not block ditches. Install an appropriately sized culvert if traversing a ditch. Waterway permits may be necessary.
- Verify that the entrances are where they are most effective. Is the location safe? Are the trucks entering and exiting in that location?
- Avoid placing on steep slopes or curves onto public roads.
- Ensure the entrance will not interfere with existing drainage patterns.
- In certain situations, construction entrances other than stone may be preferred and reduce cost. Alternatives include: timber mats, reusable rubber mats or rumble plates, and wheel wash systems or other manufactured systems with PEMS approval. Prior authorization may be required for alternative entrances.

Inspection

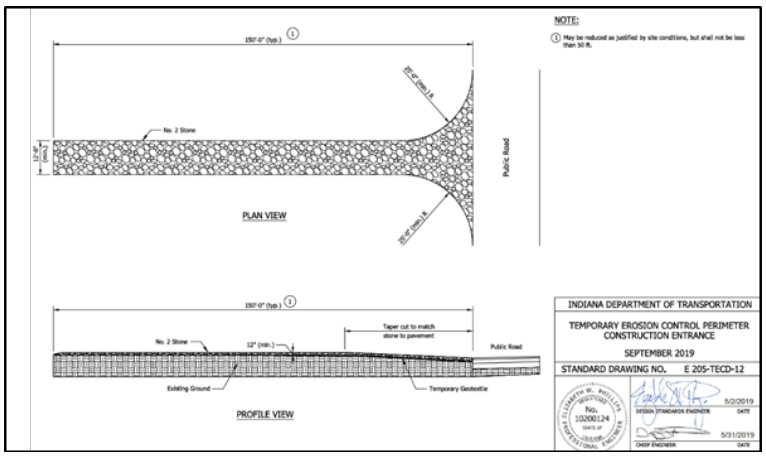
- Inspect the entrance each day it is being used.
- Monitor tracking onto public roads.
- Observe the sediment being collected in the stone. Redress or remove stone and sediment and replace with clean stone as necessary.

Maintenance

- Redress the #2 stone as necessary to provide clean stone with voids capable of trapping additional sediment.
- Remove stone and sediment and replace with clean #2 stone on construction entrances.
- Sweep or otherwise remove sediment from public roads immediately.
- Reshape, resize or relocate ineffective construction entrances.

Example Installations

Construction entrance not the minimum 50’ long. Tracking onto the roadway will become a safety hazard.



INDOT Standard drawing, Construction Entrance.

Insufficient #2 stone on construction entrance. Note tracking onto public roadway. Mud tracked onto paved roads becomes a safety issue.

Construction entrance installed correctly, steep slope could not be avoided.

Silt Fence

Standard References

Standard Specification Reference:
205.06 (a) Silt Fence
205.07 (a) Maintenance

Standard Drawing Reference:
E 205-TECD-11

Description

Silt fences are used primarily as perimeter protection in sheet flow areas. Silt fence reduces the velocity of sheet flow to pond the water and allows the sediment to settle out. Silt fence should not be installed across a stream, channel, ditch, swale, or anywhere that concentrated flow is anticipated. Silt fence can be used to divert stormwater around a project.

Wire-backed or reinforced silt fence can be used where additional strength and support are needed, such as steep slopes, areas near a waterway, prolonged project or sensitive ecological areas.

Installation

- The contractor's SWQM and the INDOT PEMS should discuss silt fence locations prior to installation.
- Install prior to earthwork or clearing operations.
- Do not place silt fence in concentrated flow areas.
- Install silt fence parallel to slopes.
- Trench in the bottom of silt fence and install joints per the INDOT standard drawing.
- Place silt fence along a contour and "J" hook the ends to tie into the slope.
- Allow access for maintenance if possible. If maintenance access is impossible or difficult, plan additional erosion control measures to reduce the need for silt fence maintenance.
- Do not place silt fence in concentrated flow areas or floodways.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Check for torn, decomposed, or ineffective fence.
- Ensure fence is trenched in and placed along a contour.
- Check for sediment accumulations and areas where fence has fallen.
- Check for "J" hooks at the end of silt fence runs.

Maintenance

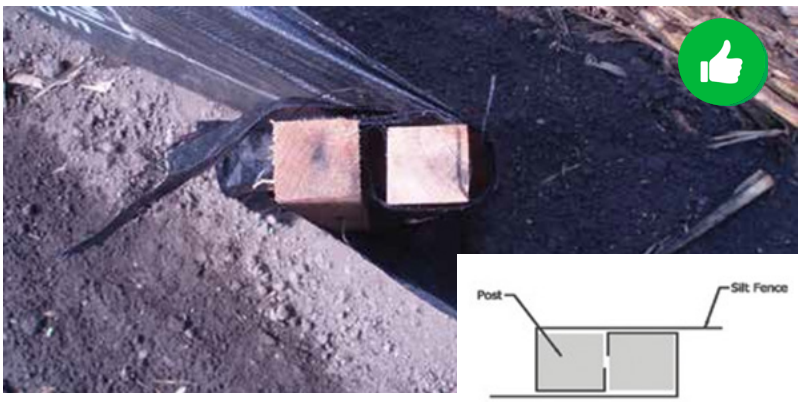
- Repair or replace silt fence if torn, starting to decompose, damaged by construction equipment, or is ineffective. Correct any "J" hook problems at the end of runs.
- Remove sediment once it reaches one-half the height of the fence.

Example Installations

Silt fence is overwhelmed with sediment and requires maintenance.

“J” hook the end of the silt fence uphill to prevent water from bypassing fence.

Silt fence is not an appropriate BMP for concentrated flows, nor can it be used across jurisdictional waterways.



Joint between two segments of silt fence properly installed.

Sediment Trap

Standard References

Standard Specification Reference:
205.05 (d) Sediment Trap
205.07 (e) Maintenance

Standard Drawing Reference:
E 205-TECD-09

Description

A sediment trap is placed to contain and minimize sediment by ponding stormwater runoff and allowing time for settling of suspended solids. Sediment traps should be placed in ditches at the downstream end of the construction area or immediately before a ditch flows into a jurisdictional waterway. Sediment traps are designed for a maximum drainage area of five acres. If the watershed is more than five acres, a sediment basin (page 56) should be constructed instead. Sediment traps should be the last measure in a treatment train.

Installation

- Sediment traps are to be installed before soil disturbance.
- Install in concentrated flow areas where water leaves the construction site.
- Traps should be sized for the watershed including on-site and off-site, disturbed, and stable areas.
- Use geotextile fabric, revetment riprap and #5 or #8 stone.
- Make sure outlet is stabilized with stone, vegetation, geotextile or other material.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Water should drain within 72 hours of a rain event to regain the trap's storage volume.
- If the trap does not drain within 72 hours, check for clogged filter stone and sediment build up.
- Ensure trap is effective for a 2-year, 24-hour storm event (approximately 3 inches). If not, trap is undersized or a series of measures are needed.

Maintenance

- Remove sediment once the sediment trap is one-half full.
- Replace filter stone when water does not drain within 72 hours.

Example Installations

Sediment trap with too much filter stone.

Trap placed within ditch and allowing sediment to reach the inlet. The flow was not controlled, which may indicate additional measures are needed, and the sediment trap needs maintenance.

Sediment trap placed at the end of the ditch right before a waterway.

Sediment trap placed in an appropriate location close to stream with filter stone.

Sediment Basin

Standard References

Standard Specification Reference:
205.05 (e) Sediment Basin
205.07 (b) Maintenance

Standard Drawing Reference:
N/A. Contract specific design

Description

Sediment basins are made up of an embankment/excavation that forms a basin with an outlet of riprap and filter stone around a perforated standpipe, spillway, and/or dewatering structure. Sediment basins minimize sediment release by ponding water and allowing time for particles to settle. Sediment basins should designed to treat runoff from approximately 5 to 30 acres and should be placed as close to the sediment source as possible.

Sediment basins, where feasible will be designed to withdraw water from the surface of the water column unless equivalent sediment reduction can be achieved by use of alternative measures. Alternative measures include but are not limited to increasing the basin length to width ration to 4:1 or greater, implementation of porous baffles, use of flocculants/polymers, and/or phasing of project land disturbance that also incorporates a rapid stabilization program.

Installation

- Sediment basins are designed specifically for each project and should be installed according to the accepted plans.
- Install sediment basins in concentrated flow areas where water leaves the construction site.
- Ensure the basin has stable slopes and stable outlet overflow.
- Standpipes should be placed to the correct height (2' below the top of basin), and #5 or #8 filter stone surrounding the riprap core.
- Make sure the outfall is stabilized with stone, vegetation, geotextile, or other suitable material.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Check to ensure that the basin drains within 72 hours of a rain event.
- Check for clogged filter stone and sediment build up.

Maintenance

- Remove sediment once design volume (check plans) is reached.
- Replace filter stone when water does not drain within 72 hours.

Example Installations

Sediment basin slopes are not stable and no filter stone is used on perforated standpipe.

Sediment basin stabilized with vegetated banks, riser pipe, and stable overflow.

Sediment basins must have stable banks and a stable outlet. This photo shows an active outfall structure, buried in sediment, and ineffective use of straw bales as inlet protection.

Sediment basin with stable slopes, stable outlets, filter stone and standpipe.

Floating Outlet – “Skimmer”

Standard References

Standard Specification Reference:
205 Stormwater Management

Standard Drawing Reference:
N/A. Shown in plans.

Description

Floating skimmers draw water from the water surface, allowing the cleanest water to release from the basin. When the water level in the basin is down, the skimmer rests on a rock dam tall enough for the skimmer to not rest too close to the bottom of the basin. This prevents muddy water from discharging and the outlet from clogging with sediment. Floating skimmers should be designed to remove water from above the rock dam within 48 hours.

Installation

- All floating outlet device joints or connections shall be securely fastened to ensure they are watertight.
- The skimmer shall be connected to the outlet by a flexible pipe to the outlet structure.
- Secure the floating outlet to prevent excessive side to side movement.
- Install a rock dam for the floating skimmer to rest on when the water level is down. Rock dam should be high enough to avoid sediment deposits at the bottom of the basin
- All floating skimmers should include a floatable maintenance rope and trash guard. The rope is meant to manually position the skimmer or move it out of the way of heavy equipment for excavation.
- To account for sediment accumulation around the device, include a shallow pit, with minimum dimensions of 4 feet by 4 feet with a minimum depth of 2 feet and line with riprap.
- Ensure the outlet of the basin is stabilized with stone, vegetation, geotextile, or other approved material.

Inspection

- Inspect weekly and within 24 hours of a ½” or more rain event.
- A portion of the float on the floating skimmer must always be visible above the water surface.
- Inlets to the floating skimmer must not be submerged more than six inches below the water surface.
- Inspect the discharge location to ensure the structure is not clogged or discharging sediment.

Maintenance

- Ensure the basin is draining within 48 hours. Remove debris, trash, or clogged materials.
- Replace any buoys which are no longer floating.
- Repair or replace floating skimmer found to be non-functional.
- Do not use floating skimmers during cold weather periods where freezing conditions could potentially occur.
- Once the contributing drainage area has been stabilized, the floating skimmer can be removed.
- Remove sediment when design volume is reached.

Example Installations

Skimmer placed in temporary sediment basin during construction, with a pad for when water level recedes.

The skimmer shown above was installed incorrectly (upside down).

Sediment basin is stabilized, and skimmer is floating.

The skimmers shown to the left were not installed correctly, which is not allowing the water to enter the device as it should. The skimmer inlet and frame should lay flat with the surface of the water.

Filter Berm

Standard References

Standard Specification Reference:
205.06 (b) Filter Berm
205.07 (c) Maintenance

Standard Drawing Reference:
N/A

Description

Filter berms are used to trap sediment from long, linear disturbed areas. Filter berms capture sediment by filtering stormwater runoff and by ponding water at their base to allow settling. A filter berm can be constructed with rock or filter socks. Only rock filter berms can be used where more concentrated flows are anticipated.

Installation

- Discuss the locations, materials and timing of the construction of filter berms with the PEMS and the Contractor's SWQM.
- Install filter berms along the perimeter of the construction area close to locations where runoff would enter an adjacent waterway.
- Only rock filter berms can be installed for concentrated flow areas.
- Rock filter berms should include geotextile fabric with riprap placed on top.
- #5 or #8 filter stone should be added to the upslope side of the riprap berm.

Inspection

- Inspect weekly and within 24 hours after a ½" or more rain event.
- Monitor for sediment accumulation.
- Look for areas that have been damaged by stormwater or equipment.

Maintenance

- Remove sediment once it reaches one-quarter the height of the berm.
- Repair damaged areas as needed or directed.

Example Installations

Filter berm after a large rain event that needs maintenance.

Filter berm protecting creek with geotextile, revetment riprap and filter stone. Note existing vegetation left in place between filter berm and waterway.

Filter berm protecting creek from long fill slope. Note existing vegetation left in place along creek bank.

A rock filter berm would have been the correct BMP for this situation. Silt fence is not sufficient and not functioning properly, sediment has moved into the stream from the unprotected slope and bank.

Filter Sock

Standard References

Standard Specification Reference:
205.06(b) Filter Berm
205.07 Maintenance

Standard Drawing Reference:
E 205-TECD-07, Temporary Check Dam, Traversable, Low Profile
E 205-TECD-08, Temporary Check Dam, Traversable
E 205-TECD-10, Perimeter Protection, Filter Sock

Description

Filter Socks can be used as a filter berm, perimeter protection, or traversable check dam. Filter socks are mesh tubes at least 8” in diameter and filled with organic material, such as 2” wood chips, that are staked into the ground. They are designed to slow runoff water velocity, filter sediment, and temporarily pond small amounts of water. Clear zones should use filter socks as traversable check dams and low stormwater velocities. Filter socks, or coir rolls, are a good choice for tree clearing areas where roots prevent trenching in of silt fence. Filter sock must be free of invasive seed.

Installation

1. Traversable check dam
    - Install three horizontal rows to form a pyramid and secure with stakes.
    - Install geotextile fabric below the socks and extend the fabric downstream to prevent scour.
    - When used within a ditch line, shape with a lower center and sides tied into the slopes (like a smile).
    - Adding a filter stone wedge to face will increase efficiency in filter sock traversable check dams.

2. Filter berm
    - Install in sheet flow areas with small watersheds and low velocities.
    - Secure into soil with wooden stakes.
    - Can be used at the top of slopes to reduce runoff velocity and help vegetation establishment.

Inspection

- Inspect weekly and within 24 hours after a ½” or more rain event.
- Monitor sediment accumulation.
- Look for areas that have been damaged.

Maintenance

- Secure or replace damaged filter socks.
- Replace with a stronger measure, such as rock, if damage is severe or reoccurring.
- Remove accumulated sediment once it reaches one-quarter of the height of the filter berm.

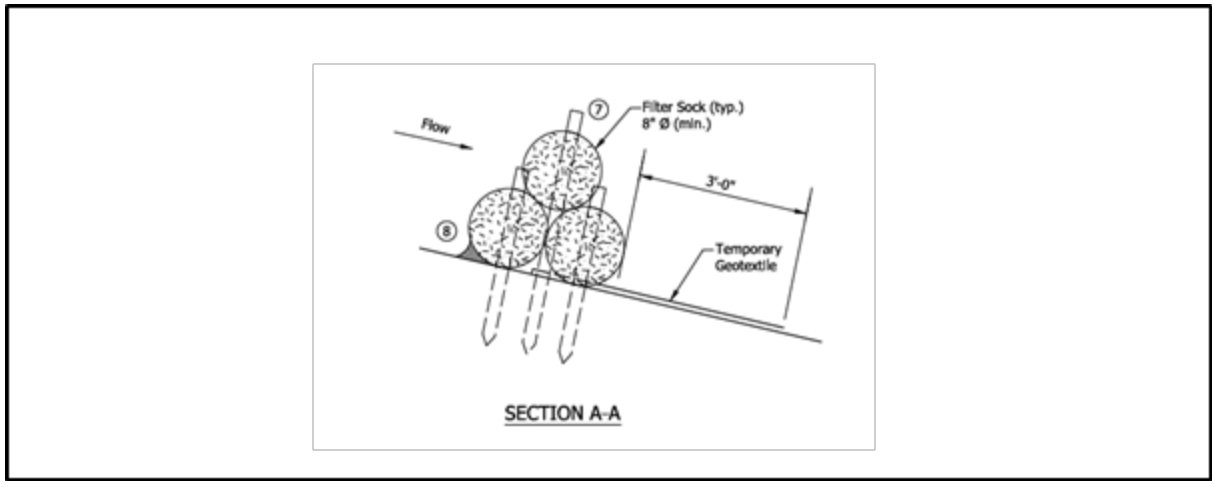
Example Installations

Filter sock used as traversable check dam in the clear zone (good) but installed where water velocity is very high (bad). No geotextile was used and only one filter sock was used (verses three in a pyramid).

Filter socks can be used on the edge of pavement to slow or divert water before vegetation is established.

Filter socks can be placed horizontally across a slope to shorten a slope's length and prevent rill and gully erosion.

Filter socks are not properly overlapped/ abutted. Without the proper overlap of the two socks, stormwater can pass through the joint without being slowed down or filtered.



Standard Drawing showing filter socks used as traversable check dam with stone wedge at the face if undercutting is identified.

Inlet Protection

Standard References

Standard Specification Reference:
205.05 (i) Inlet Protection
205.07 (d) Maintenance

Standard Drawing Reference:
E 205-TECD-02 through
E 205-TECD-05

Description

Inlets have the potential to transport sediment to streams, rivers, wetlands and lakes if they are not properly protected. Inlet protection can take many forms, review the Standard Drawings listed above to understand the different methods. The choices within the Standard Drawings will allow for a "best fit" solution for specific construction situations. Inlet protection may need to be coordinated with a local MS4.

Installation

- Discuss the inlet protection methods with all personnel involved in the installation. Choose the best method for project conditions, urban street conditions are different from rural road conditions.
- Install the specified inlet protection so that stormwater does not bypass the inlet.
- Use #8 filter stone and #2 coarse aggregate for gravel ring.
- Follow the standard drawing and/or manufacturers installation information (when using a commercially available product) when installing inlet bag type protection for inlets.
- Do not place this type of protection within any jurisdictional waterways unless explicitly Permitted.

Inspection

- Inspect weekly and within 24 hours of a ½" or more rain event.
- Look for damage, clogs or ineffective protection.
- Make sure stormwater is not bypassing or undercutting any type of inlet protection.

Maintenance

- Remove sediment after each storm event.
- If measure is repeatedly damaged or clogged, consider additional erosion and sediment control measures upstream as part of a treatment train.
- Cleaning by flushing with water is not allowed
- Remember, only rain goes down the drain.

Example Installations

Geotextile placed under inlet is not an acceptable inlet protection measure. Geotextile will clog causing standing water, making measure impossible to maintain without getting muddy water into storm system. Ponding water could cause traffic hazards or muddy construction conditions.

Inlet bag protection can be used on curb inlets with active traffic. Maintain bags after each storm event. Bags can get heavy and hard to maintain when very full.

Filter sock inlet protection staked correctly.

Filter sock inlet protection, not working.

Culvert Inlet Protection

Standard References

Standard Specification Reference:
205.05 (i) Inlet Protection
205.07 (d) Maintenance

Standard Drawing Reference:
N/A. Shown in plans.

Description

Culverts connect drainage areas under roadways and can carry sediment from stormwater can be transported through unprotected or under-protected culverts into waterways. Culvert inlet protection should be constructed using methods similar to permanent culvert protection methods. The use of rock rings is also considered to be an acceptable culvert inlet protection measure.

Installation

- Review and discuss the installation process, methods, and locations of culvert inlet protection measures with all personnel involved in installation.
- Install culvert inlet protection as indicated within the plans.
- Use #5 or #8 filter stone around the perimeter of the revetment riprap basin material.
- Do not place culvert inlet protection in jurisdictional waterways unless explicitly permitted.

Inspection

- Inspect weekly and within 24 hours of a ½" or more rain event.
- Look for clogged or ineffective materials.
- Make sure stormwater is not bypassing or undercutting the culvert inlet protection.

Maintenance

- Remove sediment after each storm event. Replace filter material if it becomes clogged with sediment.
- If the protection measure is repeatedly clogged or overburdened, consider additional erosion and sediment control measures placed further upstream in a series.

Example Installations

Silt fence should not be located in concentrated flow areas and is not appropriate as culvert inlet protection.

Inlet protected from sediment with filter stone surrounding riprap.

Filter sock and riprap functioning well for culvert inlet protection. Sediment build up, such as shown in this photo is a sign that maintenance is needed. Ensure stabilization measures upstream are adequate and remove sediment.

Culvert inlet protection not shaped correctly contributing to scour around inlet.

Temporary Inlet Protection Gravel Ring - Rock Horseshoe

Standard References

Standard Specification Reference:
205 Stormwater Management

Standard Drawing Reference:
N/A. Shown in plans.

Description

Rock horseshoe is an outlet protection device in a sediment basin to minimize sediment leaving from a sediment basin or outlet connected to a direct conveyance channel. The rock horseshoe, or arc, is constructed out of geotextile fabric, INDOT Revetment Riprap, and #5 or #8 filter stone. Drainage area should not exceed 5 acres.

Rock horseshoes are not allowed to be placed in a jurisdictional waterway, such as a stream or channel, without first obtaining the required permitting.

Installation

- Place geotextile fabric under all riprap and filter stone.
- Install the INDOT Revetment Riprap in an arc around the sediment basin inlet or outlet apron to culvert.
- On the upstream side of the revetment riprap, install INDOT #5 or #8 filter stone.

Inspection

- Initial inspections should ensure the rock horseshoe is intercepting discharges from the basin, and flow is passing through the measure.
- Inspect weekly and within 24 hours of a rain event.
- Ensure maintenance is conducted per standard specifications.
- Look for washouts, undercutting and bypasses.
- Check rock horseshoe for scouring, where overflows of the rock horseshoe may occur.

Maintenance

- Remove sediment once it reaches one-half the height of the rock horseshoe. Redressing the filter stone as needed.
- Ensure the rock horseshoe maintains the initial configuration and ponding, filtration, and flow function.
- Repair or replace rock horseshoe found to be non-functional.
- If frequent maintenance is needed, assess the drainage area and install additional BMPs.
- When all areas above the rock horseshoe have been stabilized, the temporary rock horseshoe must be removed.
- After removing the temporary rock horseshoe, collect and dispose of the accumulated sediment, and fill and compact holes, trenches, depressions, or any other ground disturbance to meet final grade.
- Stabilize the area with seed and mulch, or per the final stabilization plans.

Example Installations

Rock Horseshoe placed without stabilization above the pipe and tracking of the soil was completed in the wrong direction, adding to the erosive potential of the basin side walls.

Riprap is forming a donut/ring around the structure, and #8 filter stone is placed on the upstream of the riprap donut/ring.

There is inadequate filter stone present and sediment has accumulated.

Maintenance needs to be conducted to remove the accumulated sediment, and #8 filter stone will need to be placed at the upstream face of the riprap.

Riprap is creating a protective ring around the structure, with filter stone positioned upstream to assist with filtering sediment.

Baffle Systems

Standard References

Standard Specification Reference:
205 Stormwater Management

Standard Drawing Reference:
Drawings shall be supplied by the Contractor for the specific use or are shown on the plans.

Description

Baffle systems can be used inside a temporary sediment basin to slow down the water flowing through the basin and spreading the flow across the entire width of the basin. Baffles allow sediment to settle and sediment retention efficiency is improved by increasing residency time.

Installation

- Spacing between baffles shall be determined by the designer.
- Ensure the basin is debris free, level, and dry enough to install.
- Ensure porous baffle systems are installed perpendicular to flow.
- Install porous baffle systems across the entire width of the sediment basin.
- Ensure the length of the basin and distance between the baffles are identified within the baffle system design per the contract and Engineer accepted Stormwater Quality Control Plan.
- Typically, the baffles are installed equal distance apart to ensure proper flow mixing.
- Attach the porous baffle system material to the upstream side of the steel posts by using heavy-duty plastic ties, or wire ties that are evenly spaced and placed in a manner to prevent sagging or tearing of the fabric.
- Refer to the design to ensure ties and anchors (stakes, pins, or staples) are spaced according to the specifications. Anchors are used to secure the porous baffle system material to the bottom of the sediment basin and up the sediment basin/dam embankments.
- Utilize one piece of fabric and cut to fit the length of the basin. Do not utilize joints or adhere pieces of the material together.

Inspection

- Inspect weekly and following each rain event.

Maintenance

- Remove sediment when it reaches 50% of the height of the first baffle row.
- Ensure runoff has not eroded a channel beneath the porous baffle.
- Ensure the porous baffle material stays securely installed along the basin sides and in the bottom and has not sagged or collapsed.
- Replace the material if torn or if evidence of deterioration is noted.
- Replace baffles immediately if the baffle collapses, tears, decomposes or becomes ineffective.
- Maintain access to the porous baffles for sediment removal.
- Baffles should be at least as tall as the overflow of the basin.

Example Installations

Baffles are spaced to allow settling, and the outlet is protected with filter stone.

Sediment basin is stabilized, and the baffles are spaced to allow settling of sediment.

Baffles are installed, increasing the flow path length to provide greater sediment removal.

Sediment basin walls are not stabilized, allowing sediment to enter from the side slopes of the basin.

OTHER POLLUTION PREVENTION

There are many pollutants that can come from construction sites. Pollutants can come from leaking equipment, spills, and improperly stored construction materials. Pollution prevention methods should be used not only to protect the environment and retain materials/chemicals but also as a cost saving measure. A widely cited statistic is that for every **$1 spent on erosion and sediment control (ESC) measures,** it is estimated that **$6 are saved** in downstream costs related to flood damage, water quality treatment, and other environmental impacts.

Successful Strategies to Save Time and Money

Protect Natural Resources

- Plan to locate stockpiles, temporary toilets, concrete wastewater containment, fueling operations, etc. as far away from sensitive areas as possible.
- Remove cofferdams, temporary crossings, and other features within streams as carefully as possible. Do not over excavate or unnecessarily disturb soil within water.

Treat Chemicals with Care

- Ensure the concrete washout is adequately sized and completely contained. Concrete washout raises pH levels and can result in high alkaline runoff. High pH causes fish kills in streams, soil contamination, and severe human health risks.
- Store chemicals such as fertilizers, petroleum products and sealants inside if possible. Always protect chemicals in sealed containers so there is no exposure to stormwater.
- Use secondary containment for all fuel storage.

Leak and Spill Prevention

- Ensure all equipment is maintained in good working order. Contain, clean up, and fix fuel, oil, or other fluid leaks as soon as they are discovered.
- Remove any contaminated material as soon as possible.

Temporary Causeway and Crossing

Standard References

Standard Specification Reference:
107.02 Permits, Licenses and Taxes,
205 Stormwater Management
205.07 Maintenance

Standard Drawing Reference:
N/A. Designed for specific site conditions.

Description

Temporary crossings require a permit and should not be installed without a provided plan. The plan must be followed exactly. Any amendments or additions must be communicated and accepted by INDOT EWPSO staff. A temporary crossing is intended to be installed in a stream or waterway for short-term use by construction vehicles or heavy equipment. Temporary stream crossings are individually designed and are specific to the stream and conditions encountered at the site. If the crossing has not been included as part of the plans, the contractor is responsible for developing the crossing design and working with INDOT EWPSO staff to obtain permit amendments. Temporary impacts include stream crossings, cofferdams, demolition of structures, and any other temporary measure in streams or wetlands. If these activities are not already specified in the permit application or if the design is different an amendment will be required. The primary permits that could be required are the USACE 404, IDEM 401, and IDNR Construction in a Floodway.

Installation

- Have discussions with INDOT EWPSO, District Stormwater Specialists, and all Contractor and Construction team members involved in the installation to determine and clarify the construction methods and procedures.
- Ensure proper permitting of the crossing prior to construction.
- Crossings should be placed to disturb as little of the existing stream bed and banks as possible.
- Temporary crossings should be constructed with riprap large enough to not allow the stone to wash downstream.
- Re-grade, re-seed or otherwise stabilize areas of removed vegetation.

Inspection

- Inspect weekly and within 24 hours of a ½" or more rain event.
- Check for accumulation of debris and obstructions such as limbs, trash, rocks, etc. at culvert openings; remove promptly as needed.
- Inspect for erosion of stream banks and approach road, repair promptly as needed.
- Inspect for sediment accumulation in the stone and replace as needed.

Maintenance

- Remove debris or other obstructions and repair eroded areas promptly.
- Periodically remove built up sediment carefully to ensure 10-year, 24-hour overflow is maintained. Replace the sediment laden stone as needed.
- When no longer needed, remove the crossing with as little disturbance as possible.

Example Installations

Pipes under temporary crossing are undersized, as shown by the pooling of water. Undersized pipes may cause upstream and downstream impacts.

Temporary crossing with adequate pipe capacity. These temporary impacts must be permitted, usually by the contractor, prior to installation and should be removed as soon as practical.

#2 stone on temporary crossing needs to be redressed to reduce sediment entering creek during rain events.

The use of this temporary bridge helps protect the stream from repeated equipment crossing.

Material Storage/Staging

Standard References

Standard Specification Reference:
108.04 Prosecution of the Work
205 Stormwater Management
205.07 Maintenance

Standard Drawing Reference:
N/A

Description

Material storage and staging operations contain many pollutants that are harmful to humans and aquatic life. These pollutants need to remain isolated from stormwater to prevent pollutants from entering water bodies, leaving the site, or leaching into the soil. Place fuel and other hazardous materials as far away from sensitive areas as possible such as creeks, wetlands, and inlets.

Installation

- Ensure containment drain plugs are securely installed and are leak free.
- Discuss spill prevention plan with stormwater team members and all personnel using the material storage and staging areas.
- Be ready to handle spills by having a written plan within the SWQCP, spill kits, and containment materials on-site, especially near fueling or equipment service areas.
- Keep spill kits readily accessible and near where a spill may occur.
- The spill kit and other materials should be inventoried at the start of the construction season and materials replaced after use.
- Locate material storage, staging, fueling operations, equipment maintenance, and temporary toilet facilities away from environmentally sensitive areas.
- Hazardous materials (i.e. flammable paints, solvents), hazardous waste, and petroleum products should be stored in a trailer or other structure to protect them from the elements and contain spills and runoff.

Inspection

- Inspect daily.
- Check for soil stains indicating fuel, oil or other leaks.
- Ensure materials are stored in proper containers, have secondary containment when required, and stored indoors or under cover.

Maintenance

- Call the IDEM Spill Hotline at (888) 233-7745 for all reportable environmental emergency spills.
- Remove contaminated soil caused from leaks immediately.
- Keep construction site free of debris and remove trash.

Example Installations

Locate fueling operations, temporary toilets and staging away from waterways and other environmentally sensitive areas. Fuel tanks and containers cannot be stored under bridges.

Good housekeeping includes trash collection.

Construction debris is dropped into the waterway and piled within the floodway.

Prevent fuel or other toxic spills. Locate spill cleanup kits in accessible areas and clean up immediately.

Concrete Wastewater Containment

Standard References

Standard Specification Reference:
205 Stormwater Management
205.03 General Requirements
205.07(f) Maintenance
ITM 803

Standard Drawing Reference:
N/A

Description

Concrete wastewater is generated from concrete truck washouts, pier construction and rehabilitations, hydrodemolition operations, etc. Concrete washout areas are designated locations designed to completely contain concrete slurry. They can be either a prefabricated unit or built measure. Uncured concrete and associated liquids are highly alkaline and extremely harmful to humans and wildlife. If not contained it may leach into the soil, contaminate ground water, or water bodies. Elevated pH levels in the soil may also prevent vegetation growth. Straw bale containment is prohibited on INDOT contracts.

Installation

- Follow the approved concrete wastewater plan included in the SWQCP.
- The washout should be located for easy truck access.
- The washout should be sized to ensure adequate capacity for the day's operations with 12" freeboard.
- Use one continuous sheet of plastic with a thickness of at least 10 mil to line the washout. Do not overlap two or more sheets. Any overlap or tear in the plastic will allow the chemicals to be released.
- Secure plastic with stakes, stone or other acceptable materials.
- Place a sign next to washout and ensure all drivers are aware of its location.
- Never washout into storm drains, waterbodies, wetlands, adjacent property, vegetation, soil, or road surfaces.
- Contractor shall provide secondary emergency wastewater containment on site.

Inspection

- Ensure all concrete slurry generated in a work period can be contained within the washout provided. Construct additional washouts as needed.
- Inspect daily during concrete pour operations.
- Ensure the washout is completely contained with one sheet of plastic that is free of tears.
- Dispose of cured concrete per specifications.
- Any spillage of concrete slurry water on the ground must be fully excavated and disposed of in accordance with 203 Excavation and Embankment.

Maintenance

- Repair or replace if leaks, spills, or tears are found.
- Provide additional concrete washouts as needed to ensure adequate capacity.
- Maintain a minimum of 12" of free board. Dispose of washout wastewater if it exceeds the free board in accordance with 202 Removal of Structures and Obstructions.

Example Installations

Straw bale containment is not allowed on INDOT contracts. INDOT does not recognize straw bale constructed washout to be an effective or reliable method for containing concrete wastewater.

This is a good example of an effective plastic lined dumpster washout. However, this washout has reached its capacity.

Plastic liner was too thin. Dumpster was leaking while driver was washing out. Soil around dumpster is contaminated. It must be excavated, and disposed of as per Standard Specifications 203.

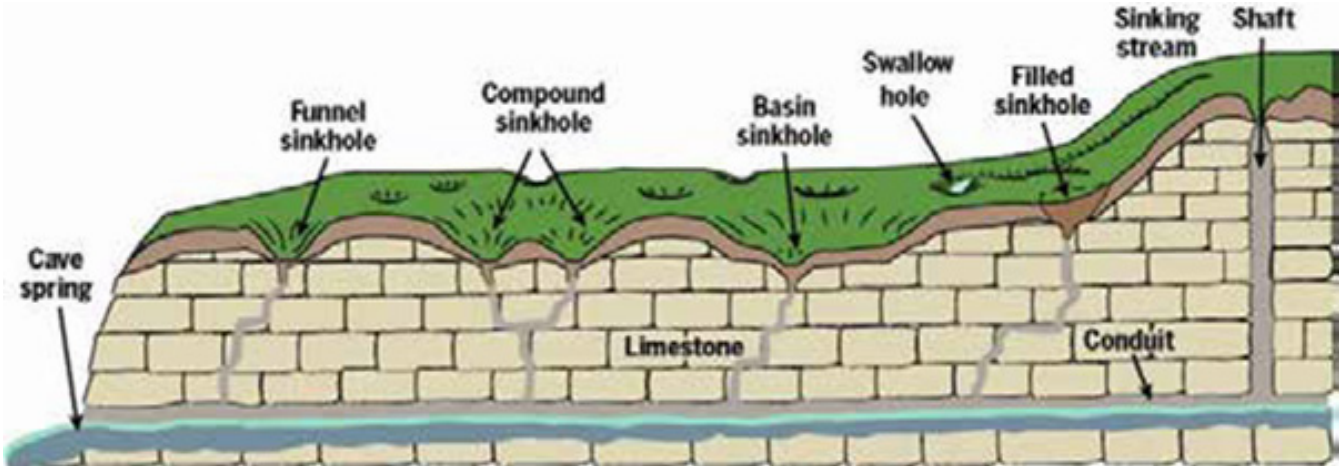
Concrete washout water held within a container which is a sealed approved manufactured product with signage.

SUCCESSFUL STRATEGIES

Environmentally Sensitive Areas

Karst Features:

Karst is an environmentally sensitive area of limestone or dolomite geology formed by dissolving rock and characterized by sinkholes, sinking streams, other closed depressions, subterranean drainage, and caves.



Solution features characteristic of karst terrains Hasenmueller and Powell, 2005 as found on the Indiana Geological and Water Survey website.

The Indiana Karst Region is south of the Wisconsin Glacial limit in Crawfordsville, Seymour, and Vincennes districts. It may be identified during project planning that the project area contains, or may contain, karst features. Karst features may also be discovered during construction. See “Protection of Karst Features During Project Development and Construction” for additional information. If a karst feature is discovered on an INDOT project, call INDOT EWPSO for direction on how to proceed. This karst document contains procedures for capping sink holes.

https://www.in.gov/indot/2522.htm (INDOT Ecology Manual: Protection of Karst Features).

Previously unknown sink hole discovered during construction.

A sink hole being protected during active construction.

Storm Drain Inlets:

“Only rain goes down the drain.”

Inappropriate and ineffective inlet protection.

Storm drain inlet protection is important for both environmental compliance and public safety. Stormwater entering storm drains must contain only rainwater, as required by federal and state regulations. There are many products available for inlet protection but the correct one must be used for roadway conditions and to ensure public safety. Failing to maintain storm drain inlets can result in added costs from cleaning storm sewer systems, removing sediment from receiving waters, and impact municipalities. Street flooding may also cause safety issues.

Long and Steep Slopes:

Long and steep slopes are areas of a project that require special and constant attention. Water flows faster when going down a long steep slope. It is often difficult and expensive to reestablish proper slope elevations after erosion has altered or damaged the slope.

Waterways can also become polluted with sediment from unprotected slopes. This is why it is best to leave vegetation in place as long as possible then seed and mulch or stabilize as soon as possible.

Strategies for protecting slopes:

- INDOT Standard Specifications require slopes to be roughened, or tracked daily (page 25) to provide horizontal ridges created by equipment tracks to trap water, seed, and mulch. Roughening can cut erosion significantly.
- Stabilize slopes that are not being actively worked as soon as possible but no longer than seven days. Stabilization can be seed and/or mulch, erosion control blankets, or temporary terracing of the slopes with filter berms made of rock, or filter sock.
- Geotextile fabric or tarps can temporarily be used to protect small areas before a rain event to prevent slope erosion.
- Temporarily diverting stormwater away from un-stabilized slopes with slope drains, diversion interceptors and other methods will help a great deal in keeping soil in its place.
- To prevent slope erosion use slope drains to temporarily divert water from underdrain and median drain outfalls into a stabilized channel.
- Permanent measures, such as properly shaped rock chutes and vegetation will assist in keeping slopes stable.

Good Housekeeping:

Remember that the construction site is often in the public eye. Thousands of motorists may pass your project daily. A construction site that has trash blowing around, messy staging areas, leaking equipment, large areas of erosion, sediment in a waterway, eroding unprotected stockpiles, unmaintained construction entrances, excessive dust, and tracking are unacceptable situations that attract attention from the public. A visit from a regulatory agency may be prompted by a complaint from the public.

Trash is not stored properly.

Concrete washout is part of a good housekeeping plan.
Concrete washout not properly maintained.

Removing Silt and Vegetation from a Water Feature

Appropriate erosion and sediment control measures should be implemented to prevent silt and vegetation from entering regulated streams and wetlands. If the measures fail and material must be removed follow these steps:

- Repair, redesign, and replace failed features to stop additional material from entering the water feature.
- Evaluate the location, extent of impact, and accessibility to material.
- Coordinate with the EWPSO Ecologist to determine agency notification or permit requirements for the activity.
- Removal method should be designed to minimize permanent impacts.
- Place removed material in a location that will not result in additional impacts with the next rain event.
- Approved methods for containing sediment should be used.
- Material or equipment shall not be placed below the ordinary high-water mark (OHWM) of the stream or wetland.

Removing Silt and Vegetation from a Water Feature

- Vegetation removal should be limited to the removal of snags, loose debris, and vegetation which obviously obstructs stream flow.
- The side casting of dredged material into wetlands or streams is not allowed.
- Equipment, work areas, or access roads should not be staged within the wetland or waterway without a permit.

Equipment may not enter a stream without permitted BMPs in place to minimize steam disturbance.

Use appropriate and effective BMPs in and around streams and wetlands:

- Silt fence is not an appropriate BMP for use along stream banks, or in areas prone to flooding. Fiber rolls or filter socks are better choices for perimeter control of sheet flow protection around a stream, wetland, or in a flood-prone area. If a disturbance is significant, a rock filter berm may also be needed to protect a stream or wetland.
- A commonly used type of erosion control blanket contains a plastic grid that does not degrade. This product is extremely dangerous to small animals living in and around the streams. The current erosion control provisions for wildlife friendly materials should be followed.
- Turbidity Curtains: This BMP can only be used safely and effectively in specific conditions. The intent of this BMP is to protect stream and lake banks from sediment loss into the waterway. This BMP is difficult to install and remove and there is an increased risk of downstream issues if the product is not installed correctly. In most cases a cofferdam system should be considered instead of a turbidity curtain.
- If a pump around/dewatering system is needed for work in a stream, the designer must provide details in the plans on the set up of the system and location of key elements. Plans must be approved by applicable regulatory authorities.
- When blown mulch is being applied around waterways or wetlands, do not allow the mulch to enter the jurisdictional waterway channel or wetland.

Environmentally Sensitive Areas.

Silt fence does not hold its integrity in areas prone to flooding. Silt fence is not allowed to be used near waterways or below the Q100. Filter sock is a more appropriate BMP around stream banks.

Blown mulch covering and clogging a jurisdictional waterway.

Filter sock and erosion control blanket together providing adequate protection for this stream bank.

Notice of Termination (NOT)

Standard References

Standard Specification Reference:
Construction Memorandum 23-07
IDEM CSGP

Description

Projects that disturb one or more acres of ground require an IDEM Construction Stormwater General Permit (CSGP). After the work has been completed and the site becomes stable, a NOT request must be accepted by IDEM to close the permit coverage. INDOT Environmental Services will review and submit the NOT request to IDEM. Submittal is dependent on INDOT-EWPSO acceptance of the field staff's evaluation of the site including submitted photographs and documentation in accordance with the Notice of Termination Construction Memo.

Note: Third-Party Permitted Contracts include CSGPs that are submitted by the LPAs or the employee in responsible charge (ERC) who initially applied for the CSGP will submit the NOT.

Site Inspection and Evaluation

To reduce the potential for erosion problems after the contract is closed, the vegetation must be healthy and green. Weekly and within 24 hours of rain event inspections are required until the NOT has been successfully obtained. For specific areas of the project which are permanently stabilized with vegetative cover at 70% density and no active erosion, inspections for that area can be reduced to once per month, if approved by the engineer in writing.

Completing permanent stabilization such as seeding and placing erosion control blankets as early as possible will give the vegetation time to germinate and establish prior to the end of the contract. Simply having the site seeded and covered in mulch is not enough to satisfy the stabilization requirement for the NOT. The NOT will not be issued until all requirements listed below have been met.

The PEMS and the Contractor will evaluate the project and agree:

1. No active erosion is evident on the project, all bare areas have been dressed, and vegetation re-established.
2. All temporary stormwater control features have been removed.
3. The entire site has been stabilized (70% uniform density of permanent vegetation).
4. No further earth disturbing activities are planned for the project.
5. All post construction BMPs have been installed, are functioning, and as-built information has been sent to the Permittee.

Vegetation Establishment for NOT

- Save and protect existing topsoil through all phases of the project.
- Protect slopes by tracking, mulching and seeding, and/or using erosion control blanket during vegetation establishment to minimize erosion.
- Track or roughen slopes daily in active work areas or before seeding and mulching.
- Mow or spray weeds, invasive plants, or other undesirable vegetation to aid in the establishment of permanent vegetation (see links on back page).
- Use the correct seed mix for field conditions.
- Test the soil to determine what amendments are necessary for best seed germination.
- Be aware of the sand, silt, and clay components of the topsoil. Good composition makes for good results.
- Weed/invasive plant identification assistance (see links on back page).
- Sow seed into the topsoil with adequate organic matter or fertilizers, and time the permanent seeding operations for late April or early September.

Notice of Termination (NOT) Examples

All temporary erosion and sediment control measures must be removed prior to issuing the NOT. Although the site is stable and more than 70 percent uniform density of vegetation, silt fence was left along the creek.

Good example of 70 percent uniform density vegetation.

This example does not meet 70 percent uniform density vegetation.

The site meets 70 percent uniform density. Completing final grade and placing seed as early as possible helps support thick vegetation growth.

Vegetation Analysis Photographs

The following series of photos should be used to help determine the percentage of permanent vegetative establishment for NOT application.

The series of pictures had been taken and analyzed using the INDOT Vegetation Analyzer.

Percentage of Green: 46.88%

Percentage of Green: 48.89%

Percentage of Green: 53.66%

Percentage of Green: 59.13%

Percentage of Green: 66.87%

Percentage of Green: 68.60%

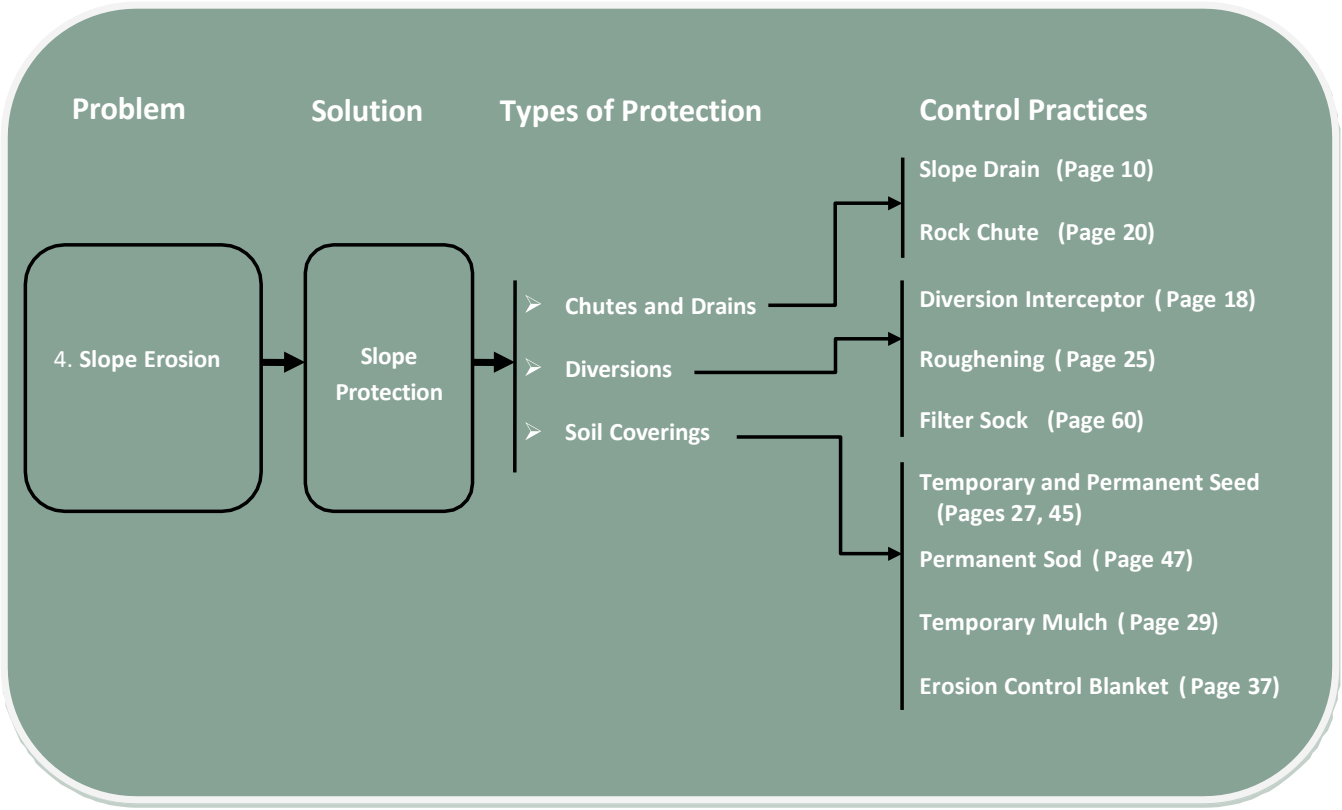
Percentage of Green: 76.22%

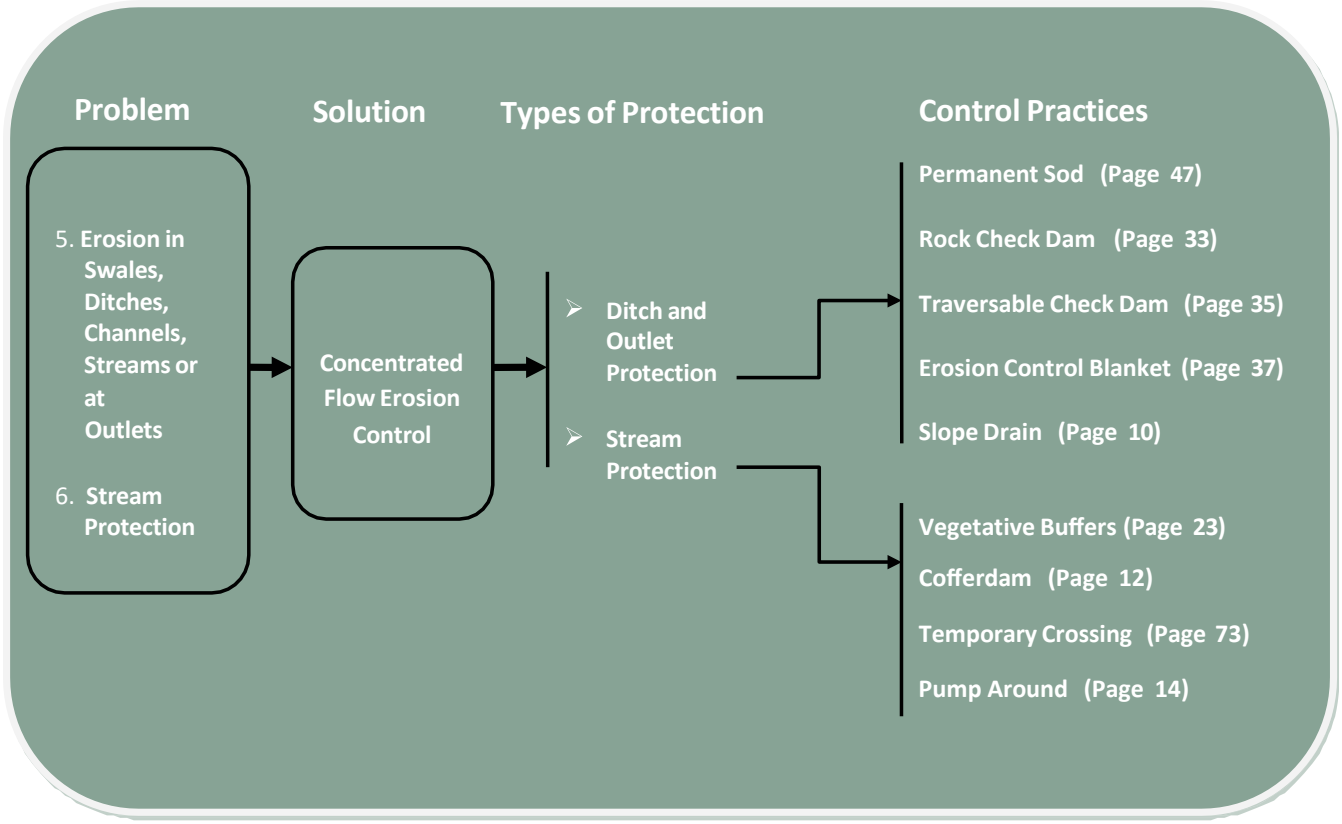
Percentage of Green: 77.17%

Percentage of Green: 85.79%

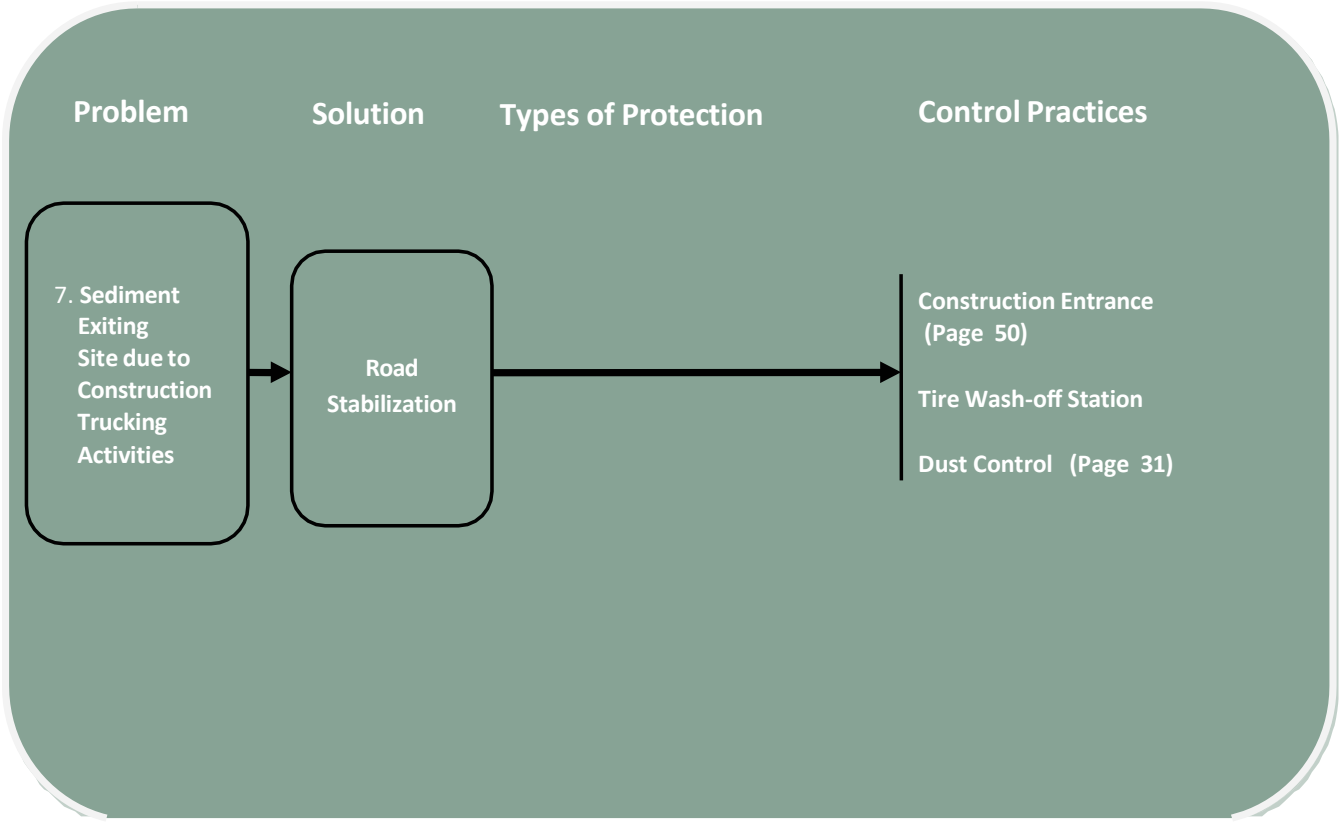
Percentage of Green: 76.22%

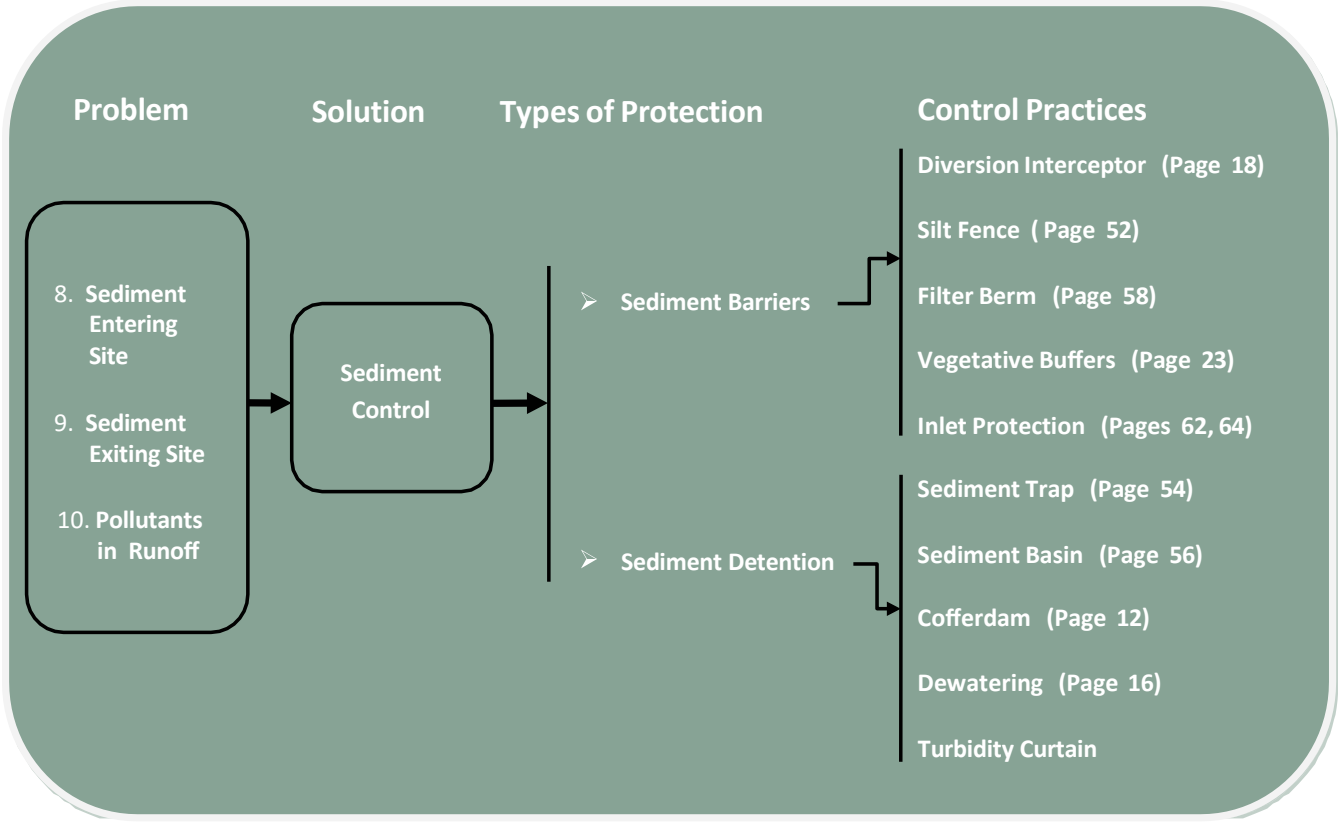
Decision Matrix for Stormwater Management





Decision Matrix for Stormwater Management





Definitions

BMP – Best Management Practice. A general term used to refer to a stormwater feature utilized effectively for stormwater management.

Clean Water Act – Established in 1972 in order to regulate discharges of pollutants into waters of the United States and provide quality standards for the surface waters.

CSPPI – Construction Stormwater Posting Project Information form. In lieu of posting the NOI and NOS, a copy of the CSPPI form shall be posted and meets the CSGP posting requirements.

DSS – District Stormwater Specialist working for INDOT.

EWPSO – Ecology, Waterway Permitting, and Stormwater Office

Gravity Dewatering – Removal of water from an area using a change in grade rather than a pump.

Gully – Larger erosion channel formed as rills combine.

IDEM – Indiana Department of Environmental Management.

IDEM Construction Stormwater General Permit (CSGP) – Indiana state law requiring stormwater management for construction activities.

IDEM 401 Water Quality Certification – IDEM issued water quality permit for any person or company planning to discharge fill materials to Indiana wetlands or other water bodies by filling, excavating, open-trench cutting, or mechanical clearing.

INDOT – Indiana Department of Transportation.

Jurisdictional Waterway – Also known as a “Waters of the U.S.” Generally, these are wetlands, lakes, streams, rivers, etc. that are not to be dredged, filled or otherwise altered without a permit.

Karst – Landscape features such as sinkholes, caves and underground streams formed from continually running water which dissolves limestone-like rock.

MS4 – Municipal Separate Storm Sewer Systems.

NOI – Notice of Intent (IDEM CSGP). A document submitted to IDEM that includes specific project information and confirms the intent to comply with IDEM CSGP laws. This document should be posted at the job site.

NOS – Notice of Sufficiency (IDEM CSGP). A letter from IDEM confirming the receipt of all NOI submittal requirements. This letter contains the permit number and expiration date and should be posted at the job site.

NOT – Notice of Termination (IDEM CSGP). A document submitted to IDEM confirming the completion of the project, including achieving 70% permanent vegetative density, and termination of the permit.

Ordinary High Water Mark (OHWM) – A line on the shore indicating the fluctuations of the water level and identified by physical characteristics such as lack of vegetation, shelving, or the presence of debris.

pH – A scale from 0 to14 indicating the acidity or alkalinity of a solution. Low numbers indicate acidic substances, high numbers indicate alkaline substances. An indication of 7 is considered neutral.

Rill – Small erosion channel only a few inches in depth.

SWP3 – Stormwater Pollution Prevention Plan. The Department’s plan for stormwater management for the contract.

Definitions

SWQCP – Stormwater Quality Control Plan. The Contractor's submitted plan for stormwater management for the contracts with CSGP. The SWQCP works in conjunction with the SWP3 site conditions, and all contract documents to develop a fully functional stormwater management plan for a contract.

SWQM – Stormwater Quality Manager. The trained individual identified by the Contractor to oversee the installation, inspection, and maintenance of all stormwater management features for a contract.

Trained Individual – A trained individual who is trained and experienced in the principles of stormwater management, including erosion and sediment control as is demonstrated by completion of coursework, state registration, professional certification, or annual training that enable the individual to make judgments regarding stormwater management, treatment, and monitoring.

USACE – United States Army Corps of Engineers.

USACE Section 404 – Permit required for any discharge of dredged or fill material into Waters of the United States. Part of the Clean Water Act.

Velocity – The distance an object moves over a period of time.

Waters of the United States – Defined in the code of federal regulations
40 CFR 230.3

Watershed – A region or area drained by a common body of water such as a stream or river.

Weir – The lowest point on a structure where water is designed to flow across.

Wetlands – An area that has been saturated with water which contains soil and plant material specific to that environment.

References and INDOT Links

IDEM Emergency Response # 1-888-233-7745
http://www.in.gov/idem/files/er_quickref.pdf

Indiana Stormwater Quality Manual
http://www.in.gov/idem/stormwater/2363.htm

IDEM Construction/Land Disturbance Permitting
http://www.in.gov/idem/stormwater/2331.htm

Weed and Invasive Plant Identification
https://www.entm.purdue.edu/IISC/invasiveplants.php and https://indiananativeplants.org

INDOT Links

Project Specific Documents
http://www.in.gov/dot/div/contracts/letting/index.html

INDOT Recurring Special Provisions
http://www.in.gov/dot/div/contracts/standards/rsp/index.html

INDOT Request for Approval of Borrow or Disposal Site (IC 203 R4 10/16)
http://www.in.gov/dot/div/contracts/standards/forms/IC-203%20170101.pdf

INDOT Standard Drawings
http://www.in.gov/dot/div/contracts/standards/drawings/index.html

INDOT Standard Specifications
http://www.in.gov/dot/div/contracts/standards/book/index.html

General Instructions to Field Employees (GIFE)
http://www.in.gov/dot/div/contracts/standards/GIFE/GIFEindex.html

INDOT Ecology, Waterway Permitting, and Stormwater Office (EWPSO)
https://www.in.gov/indot/engineering/environmental-services/ecology,-waterway-permitting,-and-stormwater-office-ewpso/

INDOT Ecology, Waterway Permitting, and Stormwater Office (EWPSO) Staffing Map
https://www.in.gov/indot/engineering/files/EWPSOStaffingMap-1-10-2025.pdf

INDOT Environmental Services Stormwater Link
http://www.in.gov/indot/2892.htm

INDOT Construction Memorandums
http://www.in.gov/dot/div/contracts/conmemo/con_memo.htm

INDOT Design Memorandums
http://www.in.gov/dot/div/contracts/standards/memos/memos.html

INDOT Indiana Design Manual
https://www.in.gov/indot/design-manual/

INDOT ITM 803
https://www.in.gov/indot/doing-business-with-indot/files/803_testing_old.pdf

INDOT STORMWATER