SCS ENGINEERS

STORM WATER POLLUTION PREVENTION PLAN

BROWNING PROPERTY BORROW AREA
LEE'S SUMMIT RESOURCE RECOVERY PARK

Prepared for:

Summit Waste Systems, LLC

and

LEE'S SUMMIT
MISSOURI

Prepared by:

SCS ENGINEERS
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May 2017
File No. 27216270.13

Offices Nationwide
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CERTIFICATION

By means of this certification, the Professional Engineer affirms that this Storm Water Pollution Prevention Plan (SWPPP) has been prepared in accordance with good engineering practice, including consideration of industry standards and applicable regulations. Procedures for required inspection and documentation have been established and the SWPPP is adequate for the facility described herein. Such certification must in no way relieve the owner or operator of the facility of his duty to fully implement the SWPPP.

Prepared by: Anastasia Welch

Anastasia Welch, P.E.
Vice President/Project Director
SCS ENGINEERS

AMENDMENT SCHEDULE

This Storm Water Pollution Prevention Plan (SWPPP) requires periodic updates to address changes in site conditions, facility operations, and/or government regulations. The original plan should be included at the top of the amendment schedule provided below. Meetings where the SWPPP is discussed shall be documented and kept in the SWPPP records.

Amendments to the SWPPP must also be documented on the SWPPP amendment schedule. The authorized representative who approves the revised SWPPP should be an individual at or near the top of the facility's management organization, such as the solid waste superintendent. The signature of this representative in the appropriate space below attests that the SWPPP amendment information is true and accurate. Amendments to the SWPPP can be inserted into the correct part of the original SWPPP, and properly identified as a revision, or the entire document may be revised for clarity.

Major changes in the site's design, construction, operation, or maintenance will necessitate changes in the site's SWPPP.

Amendment Schedule

Amendment	Date	Approved By
Revision 1	May 2017	Chris Bussen

1 INTRODUCTION

SCS Engineers has prepared this Storm Water Pollution Prevention Plan (SWPPP) for the offsite Browning Property Borrow Area activities associated with the City of Lee's Summit Resource Recovery Park (RRP) owned by the City of Lee's Summit, Missouri (City). The RRP is operated by Summit Waste Systems, LLC (Summit Waste) who is also the contractor for the planned excavation activities at the Browning Property. This SWPPP has been prepared pursuant to applicable regulations and the *Storm Water Pollution Prevention Plan Guidance Document i*ssued by the Missouri Department of Natural Resources (MDNR). The SWPPP has been prepared under the supervision of a Missouri-licensed professional engineer. A complete copy of this SWPPP shall be maintained electronic or in hard copy at the RRP office. The SWPPP must be accessible to anyone onsite at all times when land disturbance operations are in progress, or when other operational activities occur that may affect the maintenance or integrity of the BMP structures. The SWPPP must be made available upon request for onsite review. The site received land disturbance permit number MORA10308 to use the area for stockpiling and for borrow soil activities.

1.1 SWPPP PURPOSE

The purpose of this SWPPP is to identify potential sources of pollution that may affect the quality of storm water discharges associated with excavation activities at the proposed site. This SWPPP is intended to describe and outline the implementation, management, and maintenance of best management practices (BMPs) in order to reduce the potential for sediments and other pollutants in storm water discharges associated with the site excavation activities.

1.2 SWPPP OBJECTIVES

Site development of the area will require minor earthwork activities to facilitate material excavation. BMPs will be implemented to reduce erosion and the conveyance of sediment from the site excavation areas during rain events. Applicable BMPs and a timeline for their implementation are described in this SWPPP.

2 SITE DESCRIPTION

The Browning Property (site) includes an approximately 80-acre area located in Lee's Summit, Missouri approximately two miles south of US Highway 50 on SE Hamblen Road in Section 16, Township 47 North, Range 31 West. The Browning Property was previously a small farm and home to the Browning family until it was purchased by the City for use as a soil borrow site in 2009. The entire 80-acre site is referred to as the Browning Property and located immediately north of the City of Lee's Summit Maintenance Facility and RRP. The property address is 1745 SE Hamblen Road in Lee's Summit, Missouri; however the site will be accessed through an entrance along the south portion of the property from the adjacent Resource Recovery Park (RRP). The general location of the site is depicted on the enclosed **Figure 1, Site Location Map**.

Approximately 51.7 acres of the 80-acre parcel will be disturbed during the initial soil removal activities; this area is referred to as the Browning Property Borrow Area (site), or may also be referred to as Browning 1 in other RRP documents and drawings. The proposed area of excavation is outlined on the enclosed **Figure 2, Existing Conditions**. Excavation activities are anticipated to begin in the Spring of 2017 and will be ongoing until the landfill completes final closure activities. A U.S. Army Corps of Engineers 404/401 Permit is not required at this time because the streams located to the east of the site (Browning 1) will not be crossed or impacted with this initial phase of soil borrow activities. A 100-foot vegetated buffer zone, shown on **Figures 2 and 3**, will be left in place to protect the stream to the east of the project area.

2.1 SITE DRAINAGE

Storm water from the site discharges in sheet flow from the east ends of the borrow area. The site drains to an unnamed tributary of Big Creek. During land disturbance and borrow soil removal activities, the majority of storm water generated from the site will drain through one of two sedimentation basins prior to entering that tributary. **Figures 1 and 2** detail the site boundary and storm water flow directions at the site.

2.1 SAMPLING REQUIREMENTS & EFFLUENT LIMITATIONS

Under the site's **MDNR Land Disturbance Permit**, included in **Appendix A**, discharges shall not violate General Water Quality Standards 10 CSR 20 7.031. There are no regular sampling requirements for the permit; however, MDNR may require sampling and reporting.

If such an action is needed, the MDNR will specify in writing any sampling requirements including such information as location, extent, and parameters**.** **Appendix B** contains the **Inspection and Maintenance Form** used to record any visual observations made at the outfall locations.

2.2 SIGNIFICANT SPILLS AND LEAKS

The Lee's Summit RRP Borrow Area, to date, has had no significant leaks or spills at the site as no fuels, solvents, liquids, etc. are stored on the property. If release of a hazardous substance occurs, it should be reported as required in the permit.

2.3 EXISTING ENVIRONMENTAL PLANS

There are no petroleum tanks located at the site; therefore the site is not subject to Spill Prevention, Control, and Countermeasure (SPCC) regulations. No other environmental plans exist for the site.

3 SITE MANAGEMENT

Summit Waste employees will be removing soil from the site. They will be responsible for implementing the requirements of this SWPPP prior to and during excavation activities. Should a third-party contractor or City employees plan to perform work at the site, they would be required to review this SWPPP, acknowledge the SWPPP contents, and implement the BMPs described in this SWPPP.

3.1 SWPPP COORDINATOR

The SWPPP Coordinator will be responsible for ensuring the implementation and maintenance of the BMPs associated with the soil removal are in accordance with this SWPPP. The SWPPP Coordinator will be a person familiar with the area and of the requirements pertaining to the SWPPP. The SWPPP Assistant will be responsible for day-to-day site activities, implementation and maintenance of BMPs, inspections, recordkeeping, and corrective action. Either the SWPPP Coordinator or SWPPP Assistant may employ a team of additional personnel to provide assistance with the SWPPP program.

SWPPP Coordinator	**SWPPP Assistant**
Chris Bussen	Rick Crider
Solid Waste Superintendent City of Lee's Summit	General Manager Summit Waste Systems
816-969-1981	970-355-4919

3.2 SWPPP CERTIFICATION

Prior to initiation of excavation activities, the SWPPP Coordinator and designated personnel will be required to review this SWPPP and document their review on the **SWPPP Certification Form** presented in **Appendix C**. As the facility operator and third-party contractor conducting the land disturbance activities at the site, the SWPPP Assistant will also be required to sign a copy of this form.

4 SOIL REMOVAL ACTIVITIES

The BMPs described herein will address the prevention of impacts to storm water from excavation at the borrow site. Disturbed areas are those that have been altered from the natural landscape where vegetation has been removed. Two sedimentation basins will be constructed on site to reduce sediment leaving the land disturbance activity area. The only non-storm water discharge expected to occur during excavation activities is site watering to establish vegetation.

4.1 EROSION AND SEDIMENT CONTROLS

A series of temporary and permanent BMPs will be implemented as necessary to control storm water runoff associated with excavation of the borrow area. As appropriate, the temporary BMPs will be implemented prior to and during excavation. The temporary BMPs will primarily include surface roughening, surface stabilization, perimeter control, and sedimentation basins. Temporary diversion berms may be used to direct water towards vegetated areas or detention features to minimize the impact of storm water runoff during excavation.

4.1.1 Site Preparation

4.1.1.1 Tree and Vegetation Protection

The removal of trees and vegetation should be limited only to the areas of planned excavation. When practical, vehicle and equipment traffic should be limited to excavated areas to prevent disturbing vegetation outside of the work area. Due to the excavation plan for the Browning Property, a number of walnut trees will be removed from the property to facilitate construction of the pond and excavation of the soil. Many trees along the bank of the unnamed tributary to Big Creek will remain in place unimpacted by the excavation activities. Details for protecting trees that are not required to be removed can be found in **Appendix D**.

4.1.1.2 Surface Roughening

During soil removal activities, equipment will periodically scarify the working surface to increase infiltration and slow overland flow. Details for surface roughening can be found in **Appendix D**.

4.1.1.3 Topsoil Stockpiling

Topsoil will be separated from borrow material and stockpiled separately. The topsoil will be used post-construction to facilitate vegetation establishment. Details for topsoil removal and stockpiling can be found in **Appendix D**.

4.1.2 Good Housekeeping

Good housekeeping practices are common sense practices designed to maintain a clean and orderly work environment. The facility should implement, if not already implemented, the following BMPs to eliminate or minimize storm water pollution.

- Construction equipment shall be consolidated to one area when not in use or moved off site.
- During construction activities, vegetation at the site shall be preserved when possible to reduce runoff flow velocities, and to increase sediment retention at the site.
- Maintain a clean work environment by disposing of trash at the landfill.
- Complete preventative maintenance on equipment as identified in the SWPPP for the Resource Recovery Park.

4.1.3 Erosion Controls

In areas where soil disturbing activities have temporarily ceased for more than 14 days, interim stabilization BMPs shall be established. Additionally, where soil disturbing activities have permanently ceased on any portion on the site, final stabilization of the disturbed areas must be initiated immediately and completed within 14 calendar days. If the completion period for temporary or final stabilization exceeds 14 calendar days due to weather or equipment malfunctions, the exceedance shall be documented. Areas on-site that have been finally stabilized must be inspected at least once per month. Surface stabilization BMPs are as follows and will be used as necessary.

4.1.3.1 Seeding

Temporary and permanent seeding will occur as necessary. Details for temporary and permanent seeding can be found in **Appendix D**. Seeding of in the day-to-day operation of the facility shall occur within 14 days once a disturbed area will no longer be used. The growing season will be dependent on the particular type of seed being utilized. Temporary seeding will be installed by conventional drilling or hydroseeder and will require a mulch

cover or erosion control blanket installed within 24 hours of seeding. Permanent seeding will be applied as early as is practical and may require multiple applications. Upon completion of use at the site SWS personnel will revegetate all disturbed areas as soon as is reasonably possible.

Prior to seeding, soil testing should be conducted to determine the need for fertilizer, lime and/or organic matter. Soil amendments should be incorporated to a depth of six inches using a disk. Following seeding, the areas seeded should be monitored on a weekly basis and after periods of heavy rainfall until grasses are well established. Monitoring frequencies should continue on a quarterly basis thereafter. Should monitoring reveal areas of erosion or slow growth, those areas should be regraded and reseeded. Details for temporary and permanent seeding can be found in **Appendix D**.

4.1.3.2 Mulch

Mulching can be applied to seeded areas to help establish plant cover or may be used to protect against erosion over the winter or until revegetation can be accomplished. Straw or wood cellulose mulch should be crimped, tacked with a liquid tackifier, or covered with anchored netting to hold in place. The area should be regularly monitored for erosion and promptly seeded as described above. Details for mulch can be found in **Appendix D**.

4.1.4 Runoff and Sediment Controls

4.1.4.1 Sediment Fence

Made of geotextile fabric, this temporary barrier contains storm water to allow the entrained sediment to settle out. The fabric is placed into the ground with a silt fence machine, is attached to supporting posts, and is staked to the ground. Monitoring should occur in accordance with Section 6 and should include checking for damage, deterioration, sediment build up, undercutting or sidecutting. The fence should be repaired or replaced, as necessary. If a significant amount of sediment begins to accumulate behind the silt fencing at any point, the sediment will be removed and additional BMPs should be considered. Details for sediment fencing and bales can be referenced in **Appendix D**.

The Browning 1 generally sheds water by sheet flow to grassy areas and two existing drainage swales. The area is currently surrounded with well-established vegetation. Prior to borrow activities, sediment fence will be placed downslope of the construction activities to intercept storm water runoff.

4.1.4.2 Grass/Rip-Rap-Lined Channels

These devices handle concentrated surface water run-off to prevent damage from erosion and siltation. Typical uses include roadside ditches, channels at property boundaries, outlets for diversions and stabilizing concentrated flow areas. Rip-rap is a suitable channel liner for higher flow rates, while grass-lined channels are sufficient for low velocity water flow. Side slopes for the drainage should be of structurally sound grade. The channel should be inspected after significant storm events. Accumulations of sediment and debris should be removed. Repairs to grass or rip-rap should be made immediately. Details for grass-lined or rip-rap lined channels can be found in **Appendix D**.

4.1.4.3 Rock Check Dams

Rock check dams will be utilized where necessary in drainage channels to reduce sediment from leaving the construction site. These structures slow water down behind the dam and allows sediment to settle out before the water flows through the rock check dam. Check dams need to be cleaned out when sediment accumulates behind the dam. Details for rock check dams can be found in **Appendix D**.

4.1.4.4 Ditches, Berms, and Swales

These diversionary measures should be installed to direct storm water flow to the sedimentation basin where possible. If diversionary measures are utilized, monitoring should check for channel erosion, overtopping or other damage in accordance with Section 6. Repairs should be completed promptly. Details for temporary and permanent diversionary structures are detailed in **Appendix D**.

4.1.4.5 Buffer Zones

Buffer zones are areas of unmowed grassy vegetation left between areas of sheet flow run-off and natural drainages. The buffer zones serve to decrease flow velocities and accumulate sediment. They are well suited for storm water ditches and stream embankments. A 100-foot vegetated buffer has been designed for the borrow activities at the site. Details of buffer zones can be found in **Appendix D**. Vegetation in other areas shall be preserved when possible to reduce run-off flow velocities of storm water and to increase the retention of sediments.

4.1.5 Permanent Best Management Practices

Two sedimentation basins will be constructed at the site. A sedimentation basin will be constructed prior to disturbing Phase 1, while a second sedimentation basin will be constructed prior to beginning Phase 2 soil removal activities. The sedimentation basins will be constructed by excavation to prevent scouring of the banks or the receiving stream and the outfall will utilize riprap below the spillway. The outfall for the southernmost basin will be identified as Outfall 001-A. The outfall for the northernmost basin will be identified as Outfall 001-B. Outfall locations shall be identified in the field. The general locations of the sedimentation basins and outfalls are shown on **Figures 2 and 3**.

Interim and final grading will be designed to direct storm water to the constructed basin. As per MDNR requirements, the sedimentation basin will provide storage for a 2-year, 24-hour storm event.

The sedimentation basin inlets will be inspected in accordance with Section 6 to ensure proper drainage and to determine the need for structural repairs. Material eroded from earthen embankments will be replaced immediately. Sediment shall be removed when it has accumulated to one-half of the storage depth. Disturbed areas of the site not paved or graveled will be reclaimed (e.g., final grading and seeding) upon completion of construction to minimize erosion and sediment transport. These areas will be maintained and inspected as part of the overall site management program.

4.2 OTHER CONTROLS

4.2.1 Building Material Removal

Various buildings/sheds and farm equipment is located on site. The buildings and equipment may be removed or demolished if the current or future property owner deems necessary. If applicable, building materials and fencing will be collected and removed from the site. A Phase I Environmental Site Assessment and an Asbestos and Lead-Based Paint Assessment were conducted in May 2009 for the Browning property. In August 2009, asbestos abatement occurred during demolition of the farmhouse. These reports should be referenced if additional demolition is planned.

4.3 Site Watering

In order to establish vegetation and reduce dust, site watering may occur. Site watering will be controlled, monitored, and only occur during normal business operating hours.

5 SCHEDULE

Prior to excavation, appropriate BMPs will be in place in preparation for soil removal. Excavation will be completed in two general phases to reduce the amount of land disturbed at one time. Borrow activities will occur followed by grading to final or near final elevations first for the southern portion (Phase 1 area). After Phase 1 area is complete or near complete, soil removal activities will begin on the northern portion of the property (Phase 2). This schedule is dependent on site conditions and landfill soil needs and is subject to change.

6 INSPECTIONS AND MAINTENANCE

All major events related to storm water control should be recorded on inspection sheets, including the following items at a minimum:

- Start dates of vegetation removal
- Temporary cessation of activities
- Implementation of BMPs
- Dates of storm events
- Initiation of erosion control measures.
- Inspections
- Corrective actions

MDNR inspection requirements are contained on page 8 of the MDNR Land Disturbance Permit. In accordance with the permit, all BMPs must be inspected in accordance with one of the two schedules listed below:

Option 1:

a. At least once every seven calendar days and
b. Within 48 hours after any storm event equal to or greater than a 2-year, 24-hour storm has ceased during a normal work day and
c. Within 72 hours if the rain event ceases during a non-work day such as a weekend or holiday.

Option 2:

a. At least once every 14 calendar days and
b. Within 24 hours of the occurrence of a storm event of 0.25 inches of precipitation or greater, or the occurrence of runoff from snowmelt. A properly maintained rain gauge must be kept onsite to determine if a 0.25 inch or greater rain event occurred, or obtain the storm event information from a weather station for Lee's Summit.
c. Inspections are only required during the project's normal working hours.
d. Inspections must be conducted within 24 hours once a storm event has produced 0.25 inches within 24 hour period, even if the storm is still coming.

e. If a rain event continues for multiple days, and each day of the storm produce 0.25 inches or more of rain, an inspection must be conducted within 24 hours of the first day of the storm and within 24 hours after the end of the storm.

Any changes to frequency of inspections, including switching between the options listed above, must be documented and maintained with the SWPPP.

Areas on-site that have been finally stabilized must be inspected at least once per month and documented.

Structures used for temporary erosion and runoff control must be inspected in accordance with one of the two schedules listed above. The inspections will be conducted by the SWPPP Coordinator, Assistant, or a member of the designated team. These inspections, in general, will verify that the structures are still in good condition and that the sediment is not freely passing through.

Routine inspection and maintenance of the sedimentation basins is essential to its continued effectiveness. The basins will be inspected to ensure proper drainage from the collection pool and to identify the need for structural repairs. Material eroded from the earthen embankment or stones moved from rock dams will be replaced immediately. Sediment will be removed from the basins when the storage capacity has been reduced approximately 50 percent. Trash and debris will be removed from the sedimentation basin promptly after rainfall events. The receiving stream of the outfalls shall also be inspected for 50 feet downstream of the outfalls, when practicable.

An inspection and maintenance form will be completed after each inspection. A copy of the **Inspection and Maintenance Form** to be completed by the SWPPP Coordinator or SWPPP Assistant is provided in **Appendix B**. Completed forms will be kept with the SWPPP for a period of three years from the date of the Letter of Termination of the permit.

The stockpiles of topsoil located at the site shall be inspected weekly in accordance with an option outlined above to check for signs of erosion or ponding. Slopes created during stockpiling and excavation shall be as shallow as possible to limit run-off velocities, and shall promote positive drainage. Native vegetation in the area shall be preserved whenever possible to limit run-off velocities and increase sediment retention from the site.

Corrective actions for BMPs shall be completed within seven calendar days. Corrective actions shall be documented and photographed. If corrective actions cannot be completed within seven days due to weather, the delay in corrective actions shall be documented and photographs. Corrective action documentation should be kept with the inspection report and maintained with the SWPPP.

7 RECORDKEEPING AND INTERNAL REPORTING

Records should be kept of the following items related to the SWPPP:

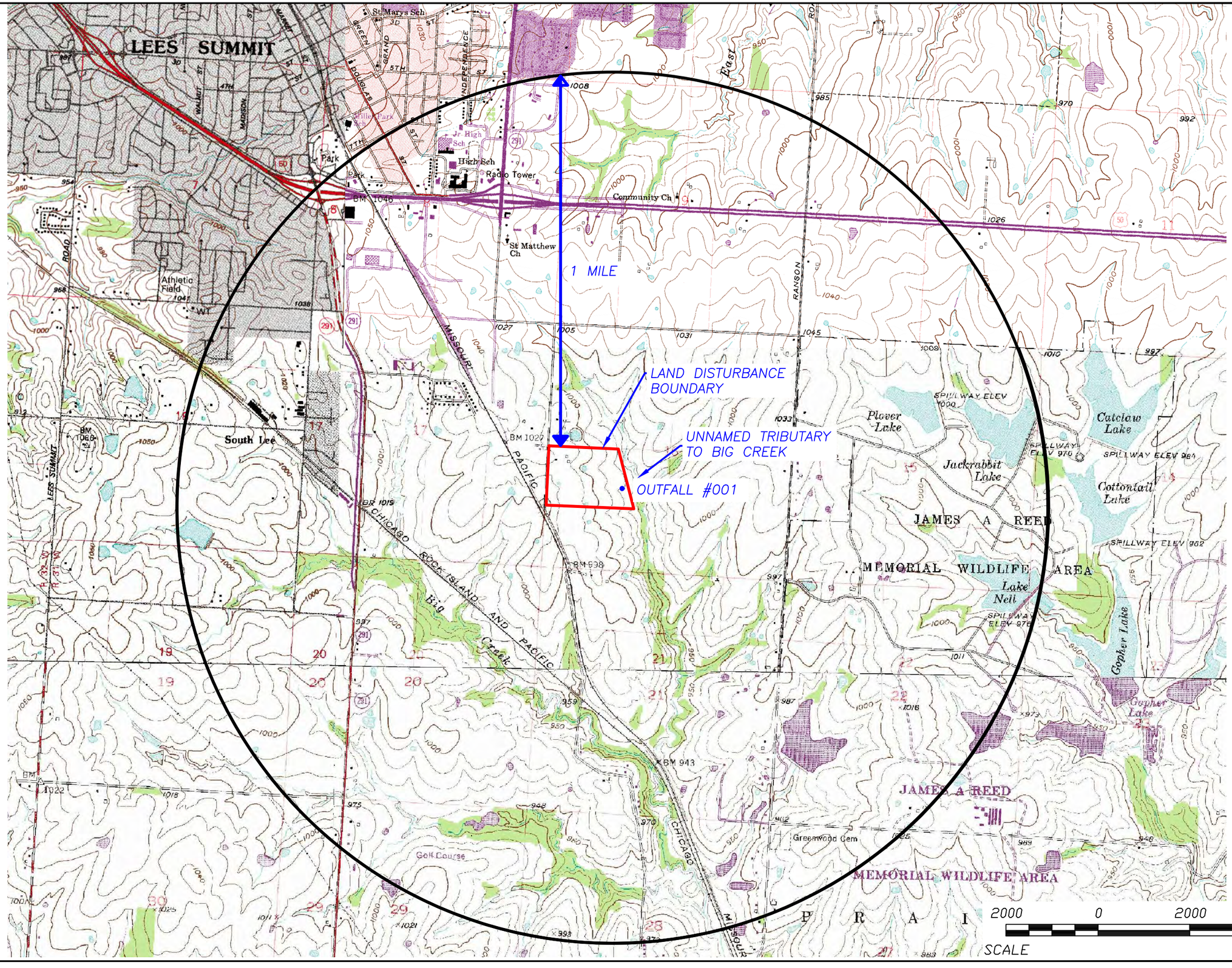
- Inspection and Maintenance Forms (located in **Appendix B**)
- SWPPP meeting summaries as applicable (meeting notes)
- Modifications to the SWPPP

All records should be maintained by the facility for at least three years the date of the Letter of Termination of the permit.

8 PUBLIC NOTIFICATION

A copy of the public notification sign described by MDNR shall be posted at the site entrance. The sign must be visible from the public road that provides access to the main entrance. The sign must remain posted at the site until the land disturbance permit has been terminated.

Figures



REV.	DATE	BY	DESCRIPTION
R6	--	6BY	--
R5	--	5BY	--
R4	--	4BY	--
R3	--	3BY	--
R2	--	2BY	--
R1	04/04/17	BDR	SWPPP UPDATE

SCS ENGINEERS
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

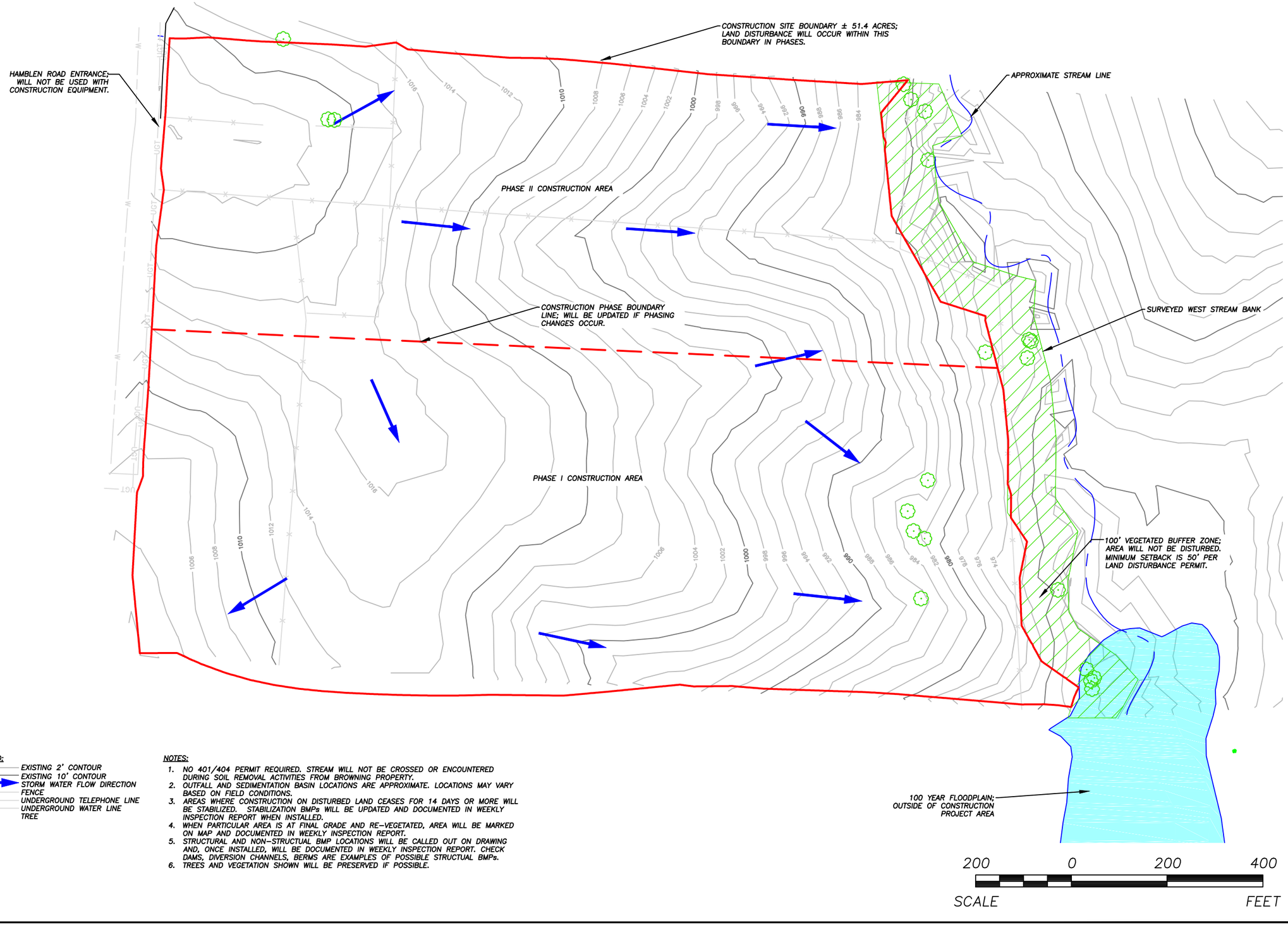
CLIENT:
CITY OF LEE'S SUMMIT
LEE'S SUMMIT RRP
LEE'S SUMMIT, MISSOURI

DRAWN BY: RLS | DESIGNED BY: RLS | PROJECT MGR: AJW | DATE: 5/4/17
ELECTRONIC FILE NAME: FIGURE 1 - SITE LOCATION MAP.DWG

FIGURE 1 - SITE LOCATION MAP
BROWNING PROPERTY

PROJECT NUMBER: 27216270.13
DRAWING NUMBER: 1
SHT. 1 OF 4
REV.: 1

N:\Lee's Summit\Projects\27216270.13 - Browning Property Land Disturbance Permit and SWPPP\DWG\Figure 1 - Site Location Map.dwg May 04, 2017 - 10:00am Layout Name: Figure 1 By: 3780bdr



LEGEND:

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- STORM WATER FLOW DIRECTION
- FENCE
- UNDERGROUND TELEPHONE LINE
- UNDERGROUND WATER LINE
- TREE

NOTES:

1. NO 401/404 PERMIT REQUIRED. STREAM WILL NOT BE CROSSED OR ENCOUNTERED DURING SOIL REMOVAL ACTIVITIES FROM BROWNING PROPERTY.
2. OUTFALL AND SEDIMENTATION BASIN LOCATIONS ARE APPROXIMATE. LOCATIONS MAY VARY BASED ON FIELD CONDITIONS.
3. AREAS WHERE CONSTRUCTION ON DISTURBED LAND CEASES FOR 14 DAYS OR MORE WILL BE STABILIZED. STABILIZATION BMPs WILL BE UPDATED AND DOCUMENTED IN WEEKLY INSPECTION REPORT WHEN INSTALLED.
4. WHEN PARTICULAR AREA IS AT FINAL GRADE AND RE-VEGETATED, AREA WILL BE MARKED ON MAP AND DOCUMENTED IN WEEKLY INSPECTION REPORT.
5. STRUCTURAL AND NON-STRUCTUAL BMP LOCATIONS WILL BE CALLED OUT ON DRAWING AND, ONCE INSTALLED, WILL BE DOCUMENTED IN WEEKLY INSPECTION REPORT. CHECK DAMS, DIVERSION CHANNELS, BERMS ARE EXAMPLES OF POSSIBLE STRUCTUAL BMPs.
6. TREES AND VEGETATION SHOWN WILL BE PRESERVED IF POSSIBLE.

REV.	DATE	BY	DESCRIPTION
R6	-	6BY	-
R5	-	5BY	-
R4	-	4BY	-
R3	-	3BY	-
R2	-	2BY	-
R1	4/6/17	BDR	SWPPP UPDATE

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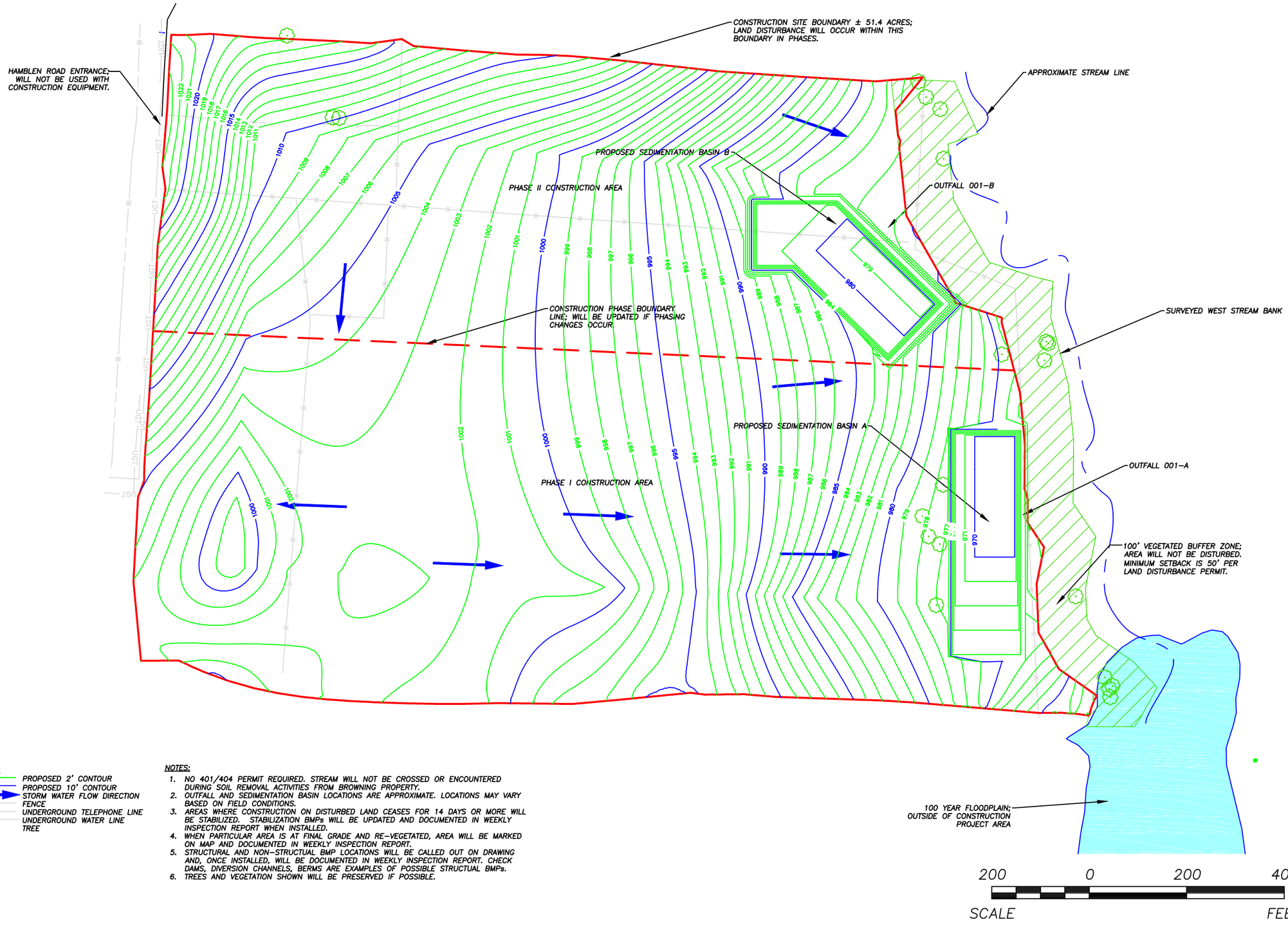
CLIENT: CITY OF LEE'S SUMMIT
LEE'S SUMMIT RRP
LEE'S SUMMIT, MISSOURI

DRAWN BY: BDR | DESIGNED BY: BDR | PROJECT MGR: AJW | DATE: 5/4/17
ELECTRONIC FILE NAME: FIGURE 2+3 - BROWNING PROP GRADES.DWG

FIGURE 2 - EXISTING CONDITIONS
BROWNING PROPERTY (BROWNING 1)

REV.: 1 | DRAWING NUMBER: 2 | PROJECT NUMBER: 27216270.13 | 2 OF 4



REV.	DATE	BY	DESCRIPTION
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R5	–	5BY	–
R4	–	4BY	–
R3	–	3BY	–
R2	–	2BY	–
R1	04/06/17	BDR	SWPPP UPDATE

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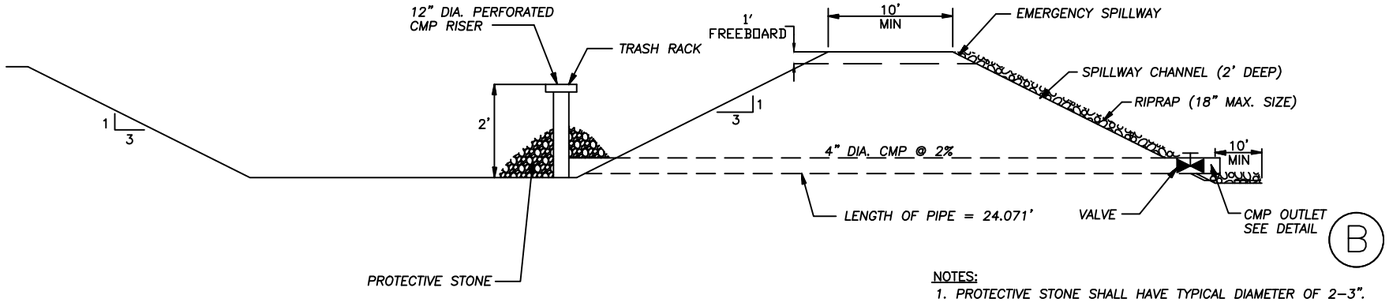
CLIENT: CITY OF LEE'S SUMMIT
LEE'S SUMMIT RRP
LEE'S SUMMIT, MISSOURI

DRAWN BY: BDR | DESIGNED BY: BDR | PROJECT MGR: AJW | DATE: 5/4/17
ELEVATIONS FILE NAME: FIGURE 2+3 – BROWNING PROP. GRADES.DWG

FIGURE 3 – PROPOSED FINAL CONDITIONS
BROWNING PROPERTY (BROWNING 1)

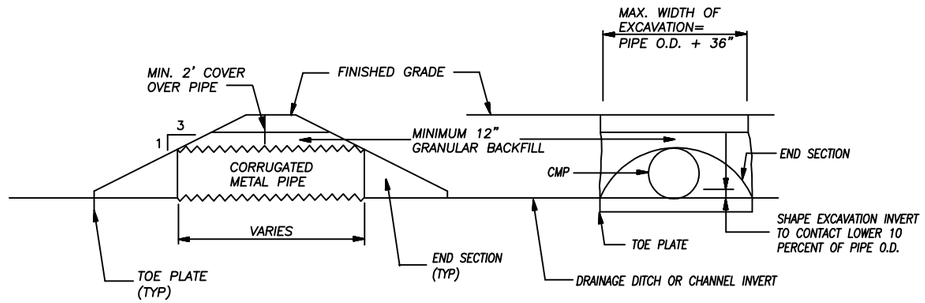
REV.: 1 | DRAWING NUMBER: 3 | PROJECT NUMBER: 27216270.13 | 3 OF 4

N:\Lee's Summit\Projects\27216270.13 - Browning Property Land Disturbance Permit and SWPPP\DWG\[Figure 2+3 - Browning Prop Grades.dwg May 04, 2017 - 9:46am Layout Name: FIG 3FINAL GRADE SW FLOW By: 3780bdr



NOTES:
1. PROTECTIVE STONE SHALL HAVE TYPICAL DIAMETER OF 2–3".

A TYPICAL SEDIMENTATION BASIN
SCALE: NOT TO SCALE



B TYPICAL CULVERTS WITH END SECTIONS
SCALE: NOT TO SCALE

REV.	DATE	BY	DESCRIPTION
R6	-	6BY	-
R5	-	5BY	-
R4	-	4BY	-
R3	-	3BY	-
R2	-	2BY	-
R1	04/06/17	1BY	SWPPP UPDATE

SCS ENGINEERS
7311 West 130th Street, Suite 100
Overland Park, Kansas 66213

CLIENT: CITY OF LEE'S SUMMIT
LEE'S SUMMIT RRP
LEE'S SUMMIT, MISSOURI

DRAWN BY: BDR | DESIGNED BY: BDR | PROJECT MGR: AJW | DATE: 5/4/17 | ELECTRONIC FILE NAME: FIGURE 4.DWG

SEDIMENTATION BASIN DETAILS
BROWNING PROPERTY (BROWNING 1)

REV: 1 | DRAWING NUMBER: 4 | PROJECT NUMBER: 27216270.13 | SHT. 4 OF 4

N:\LEE'S SUMMIT\PROJECTS\27216270.13 - BROWNING PROPERTY LAND DISTURBANCE PERMIT AND SWPPP\DWG\FIGURE 4.DWG

Appendix A

Land Disturbance Permit

STATE OF MISSOURI
Eric R. Greitens, Governor • Carol S. Comer, Acting Director
DEPARTMENT OF NATURAL RESOURCES
dnr.mo.gov

Lee's Summit Borrow Area
MORA10308, Jackson County
City of Lee's Summit
220 SE Green Street
Lee's Summit, MO 64063

Enclosed please find your Missouri State Operating Permit which authorizes land disturbance activities for MORA10308. This permit has been issued as requested and is based upon application information entered in the Missouri Department of Natural Resources' (department) ePermitting program. This permit contains several requirements and should be thoroughly read and understood. Please reference General Operating Permit number MORA10308 for future correspondences with the department with regards to this land disturbance activity.

Acquisition of the permit does not imply that the requirements or ordinances of other local, state or federal permits are replaced or superseded. This permit does not authorize land disturbance activity in jurisdictional waters of the United States as defined by the Army Corps of Engineers (Corps), unless the permittee has obtained the required Clean Water Act Section 404 Permit. Not all land disturbance projects will require a 404 permit; however, if a 404 permit is required, land disturbance activities are not to be conducted in the jurisdictional area of the project until the 404 permit has been obtained.

Please contact the applicable Regional Office if you would like to Schedule a Compliance Assistance Visit (CAV). Regional Office contact information is contained with the documents issued with the operating permit. During the visit, department staff will review the requirements of the permit and answer questions pertaining to Land Disturbance activities.

Sincerely,

Water Protection Program

David J Lamb
Acting Director

DJL

Lee's Summit Borrow Area
MORA10308

ePermitting Certification and Signature Document

Missouri State Operating General Permit number MORA10308 was issued on 04/06/2017 based on information entered into the Missouri Department of Natural Resources' electronic Permitting (ePermitting) system. Missouri Regulation 10 CSR 20-6.010(2)(B) requires that all applications for construction and operating permits be signed. Please print, review, sign, and mail this document to the Missouri Department of Natural Resources (Department) within 30 days of the Issue Date (04/06/2017).

If the Department does not receive this document with signature within 30 days, this general operating permit may be considered not valid and subsequently revoked.

Lee's Summit Borrow Area, Jackson County
1745 SE Hamblen Road
LEE'S SUMMIT, MO 64082
Total Permitted Area: 51.72 Acres
Total Number of Permitted Features: 1

The below Certifications were electronically certified in the ePermitting system by:
Name: Bryan Ross
Title:
Date: 04/06/2017

Based upon the selection you made on the 'New Permit' screen; it was indicated that a single polygon was drawn indicating the entire disturbance area.

Is any part of the area that is being disturbed in a jurisdictional water of the United States? If yes, you must also receive a Clean Water Act, Section 404 Permit for this site from the United States Army Corp of Engineers.
No

I understand there may be an established Local Authority Erosion Control Plan in the city or the unincorporated area of the county where land disturbance activities covered under this general permit will occur. (Note - you may want to contact your local authority to determine if there are any requirements).
Agreed

A Storm Water Pollution Prevention Plan (SWPPP) must be developed for this site. This plan must be developed in accordance with requirements and guidelines specified within the general permit for storm water discharges from land disturbance activities. The application, as completed in ePermitting is considered incomplete if the SWPPP has not been developed.
Agreed

I certify that I am familiar with the information contained in the application, that to the best of my knowledge and belief such information is true, complete and accurate, and being granted this permit, I agree to abide by the Missouri Clean Water Law and all rules, regulations, orders and decisions, and terms of this permit, subject to any legitimate appeal available to an applicant under the Missouri Clean Water Commission.
Agreed

_____ _____
Signature Date

The above must be signed by the Owner, Continuing Authority, or Main Facility Contact. Please send this document with original signature to the Water Protection Program, PO Box 176, Jefferson City, MO 65102. If you do not agree with the above Certifications, please contact the Department by phone at (573) 751-1300.

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

General Operating Permit

In compliance with the Missouri Clean Water Law, (chapter 644 R.S. Mo as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No.:	MORA10308
Owner Address:	City of Lee's Summit 220 SE Green Street Lee's Summit, MO 64063
Continuing Authority:	City of Lee's Summit 220 SE Green Street Lee's Summit, MO 64063
Facility Name: Facility Address:	Lee's Summit Borrow Area 1745 SE Hamblen Road LEE'S SUMMIT, MO 64082
Legal Description: UTM Coordinates: Receiving Stream: First Classified Stream - ID#: USGS# and Sub Watershed#:	Sec. 16, T 47N, R 31W, Jackson County 382382.112 / 4305031.983 Tributary to Big Cr. (U) Big Cr. (C) 3698.00 10290108 - 0302

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein.

FACILITY DESCRIPTION All Outfalls SIC # 1629

All Outfalls - Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading, filling and other activities that result in the destruction of the root zone and/or land disturbance activity that is reasonably certain to cause pollution to waters of the state).

This permit authorizes only wastewater, including storm water, discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System, it does not apply to other regulated areas. This permit may be appealed in accordance with RSMo Section 644.051.6 and 621.250, 10 CSR 20-6.020, and 10 CSR 20-1.020.

04/06/2017
Issue date

Steven Feeler, Acting Director, Division of Environmental Quality

02/07/2022
Expiration date

David J Lamb, Acting Director, Water Protection Program

APPLICABILITY

1. This general permit authorizes the discharge of stormwater and certain non-stormwater discharges from land disturbance sites that disturb one or more acres or disturb less than one acre when part of a larger common plan of development or sale that will disturb a cumulative total of one or more acres over the life of the project. This general permit also authorizes the discharge of stormwater and certain non-stormwater discharges from smaller projects where the Missouri Department of Natural Resources (Department) has exercised its discretion to require a permit [10 CSR 20-6.200 (1)(B)].

   A Missouri State Operating Permit that specifically identifies the project must be issued before any site vegetation is removed or the site disturbed.

   Any site owner/operator subject to these requirements for stormwater discharges and who disturbs land prior to permit issuance from the Department is in violation of both State and Federal Laws.

   The legal owner of the property or the holder of an easement on the property, and operator on which the site is located are responsible for compliance with this permit.

2. This permit authorizes non-stormwater discharges from the following activities provided that these discharges are addressed in the permittee's specific Stormwater Pollution Prevention Plan (SWPPP) required by this general permit:
   a. De-watering activities if there are no contaminants other than sediment present in the discharge, and the discharge is treated as specified in Requirements, Section C.8.m. of this permit;
   b. Flushing water hydrants and potable water lines;
   c. Water only (i.e., without detergents or additives) rinsing of streets and buildings; and
   d. Site watering to establish vegetation.

3. This general permit does not authorize the placement of fill materials in flood plains, the obstruction of stream flow, directing stormwater across private property not owned or operated by the permittee, or changing the channel of a defined drainage course. This general permit addresses only the quality of the stormwater runoff and the minimization of off-site migration of sediments and other water contaminants.

4. This permit does not authorize land disturbance activity in jurisdictional waters of the United States as defined by the U.S. Army Corps of Engineers, unless the permittee has obtained the required Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers and its associated Section 401 Water Quality Certification from the department. Land disturbance activities may not begin in the affected waters of the United States until the required 404 permit and 401 certification have been obtained.

5. This general permit prohibits any discharge of wastewater generated from air pollution control equipment or the containment of scrubber water in lined ponds to waters of the state.

6. This general permit prohibits any discharge of sewage or pollutants to waters of the state including but not limited to:
   a. Any hazardous material, oil, lubricant, solid waste or other non-naturally occurring substance from the site, including fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;
   b. Soaps or solvents used in vehicle and equipment washing;
   c. Hazardous substances or petroleum products from an on-site spill or handling and disposal practices;

APPLICABILITY (continued)

d. Wash and/or rinse waters from concrete mixing equipment including ready mix concrete trucks, unless managed by an appropriate control. Any such pollutants must be adequately treated and addressed in the SWPPP, and cannot be discharged to waters of the state;
e. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;
f. Domestic wastewaters, including gray waters; or
g. Industrial stormwater runoff.

6. The Department reserves the right to revoke or deny coverage under this general permit to applicants for stormwater discharges from land disturbance activities at sites that have contaminated soils that will be disturbed by the land disturbance activity or where such materials are brought to the site to use as fill or borrow. A site-specific permit may be required to cover such activities.

7. Discharges to waters of the state shall not cause violations of the Water Quality Standards 10 CSR 20-7.031, including both specific and general criteria. If at any time the Department determines that the quality of waters of the state may be better protected by requiring the owner/operator of the permitted site to apply for a site-specific permit, the Department may require any person to obtain a site-specific operating permit [10 CSR 20-6.010(13)(C)].

   The Department may require the permittee to apply for and obtain a site-specific or different general permit if:
   a. The permittee is not in compliance with the conditions of this general permit;
   b. The discharge no longer qualifies for this general permit due to changed site conditions and/or regulations; or
   c. Information becomes available that indicates water quality standards have been or may be violated.

   The permittee will be notified in writing of the requirement to apply for a site-specific permit or a different general permit. When a site-specific permit or different general permit is issued to the authorized permittee, the applicability of this general permit to the permittee is automatically terminated upon the effective date of the site specific or different general permit.

8. Any owner/operator authorized by a general permit may request to be excluded from the coverage of the general permit and apply for a site-specific permit [10 CSR 20-6.010(13) (D)].

9. This operating permit does not affect, remove, or replace any requirement of the National Environmental Policy Act, the Endangered Species Act; the National Historic Preservation Act; the Comprehensive Environmental Response, Compensation and Liability Act; or the Resource Conservation and Recovery Act. Determination of applicability to the above mentioned acts is the responsibility of the permittee.

10. This permit does not supersede any requirement for obtaining project approval under an established local authority.

11. This permit is not transferable to other owners or operators.

EXEMPTIONS FROM PERMIT REQUIREMENTS

1. Facilities that discharge all stormwater runoff directly to a combined sewer system are exempt from stormwater permit requirements.

2. Land disturbance activity as described in 10 CSR 20-6.200(1) (B) and 10 CSR 20-6.010(1) (B) where water quality standards are not exceeded.

3. Oil and gas related activities as listed in 40 C.F.R § 122.26(a) (2) (ii) where water quality standards are not exceeded.

REQUIREMENTS

1. This permit is to ensure the design, installation and maintenance of effective erosion and sediment controls to minimize the discharge of pollutants. At a minimum, such controls must be designed, installed and maintained to:
   a. Control stormwater volume and velocity within the site to minimize soil erosion;
   b. Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion;
   c. Minimize the amount of soil exposed during construction activity;
   d. Minimize the disturbance of steep slopes;
   e. Minimize sediment discharges from the site. Design, install and maintain erosion and sediment controls that address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle size expected to be present on the site;
   f. Provide and maintain natural buffers around surface waters as detailed in 8.f, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration and filtering, unless infeasible; and
   g. Minimize soil compaction and, unless infeasible, preserve topsoil.
   h. Capture or treat a 2-year, 24-hour storm event. A 2-year, 24-hour storm event shall be determined for the project location using the National Oceanic and Atmospheric Administration's National Weather Service Atlas 14 which can be located at http://hdsc.nws.noaa.gov/hdsc/pfds/.

2. Installation of Best Management Practices (BMP) necessary to prevent soil erosion at the project boundary must be complete prior to the start of all phases of construction.

3. Install sediment controls along any perimeter areas of the site that will receive pollutant discharges.
   a. Remove any sediment per the manufacturer's instructions or before it has accumulated to one-half of the above-ground height of any perimeter control.
   b. For sites where perimeter controls are infeasible, other practices shall be implemented to minimize discharges to perimeter areas of the site.

4. BMPs shall be maintained and remain in effective operating condition during the entire duration of the project, with repairs made within the timeframe specified elsewhere in this permit, until final stabilization has been achieved.

5. Minimize sediment trackout from the site.
   a. Restrict vehicle traffic to properly designed exit points.
   b. Use appropriate stabilization techniques at all points that exit onto paved roads.
   c. Remove any sediment that has been tracked out within the same business day or by the end of the next business day if trackout occurs on a non-business day.

REQUIREMENTS (continued)

6. The primary requirement of this permit is the development and implementation of a SWPPP which incorporates site specific practices to best minimize the soil exposure, soil erosion, and the discharge of pollutants. The permittee shall fully implement the provisions of the SWPPP required under this part as a condition of this general permit throughout the term of the land disturbance project. **The SWPPP must be developed prior to issuance of the permit and must be specific to the land disturbance activities at the site.** A permit must be issued before any disturbance of root zone of the existing vegetation or other land disturbance activities may begin. Either an electronic copy or a paper copy of the SWPPP must be accessible to anyone on-site at all times when land disturbance operations are in progress, or other operational activities that may affect the maintenance or integrity of the BMP structures and made available made available as specified under the Records Section of this permit.

7. The SWPPP must:
   a. List and describe all outfalls;
   b. Incorporate required practices identified below;
   c. Incorporate erosion control practices specific to site conditions;
   d. Provide for maintenance and adherence to the plan;
   e. Discuss whether or not a 404/401 Permit is required for the project; and
   f. Name the person responsible for inspection, operation and maintenance of BMPs.

   The purpose of the SWPPP is to ensure the design, implementation, management and maintenance of BMPs in order to prevent sediment and other pollutants in stormwater discharges associated with the land disturbance activities; compliance with the Missouri Water Quality Standards; and compliance with the terms and conditions of this general permit.

   The permittee shall select, install, use, operate and maintain appropriate BMPs for the permitted site. The following manuals are acceptable resources for the selection of appropriate BMPs. *Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites*, (Document number EPA 833-R-06-004) published by the United States Environmental Protection Agency (USEPA) in May 2007. This manual as well as other information, including examples of construction SWPPPs, is available at the USEPA internet site at https://www3.epa.gov/npdes/pubs/industrial_swppp_guide.pdf; and

   The latest version of *Protecting Water Quality: A field guide to erosion, sediment and stormwater best management practices for development sites in Missouri,* published by the Missouri Department of Natural Resources. This manual is available on the Department's internet site at: http://www.dnr.mo.gov/env/wpp/wpcp-guide.htm.

   The permittee is not limited to the use of these guidance manuals. Other guidance publications may be used to select appropriate BMPs. However, all BMPs should be described and justified in the SWPPP.

8. SWPPP Requirements: The following information and practices shall be provided for in the SWPPP:
   a. Nature of the Construction Activity: The SWPPP briefly must describe the nature of the construction activity, including:
      1) The function of the project (e.g., low density residential, shopping mall, highway, etc.);
      2) The intended sequence and timing of activities that disturb the soils at the site;
      3) Estimates of the total area expected to be disturbed by excavation, grading, or other construction activities including off-site borrow and fill areas; and
      4) A general map (e.g., United States Geological Survey quadrangle map, a portion of a city of county map, or other map) with enough detail to identify the location of the construction site and waters of the State within one mile of the site.

REQUIREMENTS (continued)

b. Site Map: The SWPPP must contain a legible site map showing the site boundaries and outfalls and identifying:
   1) Direction(s) of stormwater flow and approximate slopes anticipated after grading activities;
   2) Areas of soil disturbance and areas that will not be disturbed (or a statement that all areas of the site will be disturbed unless otherwise noted);
   3) Location of major structural and non-structural BMPs identified in the SWPPP;
   4) Locations where stabilization practices are expected to occur;
   5) Locations of off-site material, waste, borrow or equipment storage areas;
   6) Locations of all waters of the state (including wetlands);
   7) Locations where stormwater discharges to a surface water; and
   8) Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.

c. Site Description: In order to identify the site, the SWPPP shall include facility and outfall information. The SWPPP shall have sufficient information to be of practical use to contractors and site construction workers to guide the installation and maintenance of BMPs.

d. Selection of Temporary and Permanent BMPs: The permittee shall select appropriate BMPs for use at the site and list them in the SWPPP.

e. The SWPPP shall require existing vegetation and trees to be preserved where practical.

f. For surface waters of the state, defined as "all waters within the jurisdiction of this state, including all rivers, streams, lakes and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common, located on or adjacent to the site, the permittee must:
   1) Provide and maintain a 50-foot undisturbed natural buffer;
   2) Provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer; or
   3) If infeasible to provide and maintain an undisturbed natural buffer of any size, implement erosion and sediment controls to achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.
   4) Where you are retaining a buffer of any size, the buffer should be measured perpendicularly from any of the following points, whichever is further landward from the water:
      i. The ordinary high water mark of the water body, defined as the line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, and/or the presence of litter and debris; or
      ii. The edge of the stream or river bank, bluff, or cliff, whichever is applicable.

g. Description of BMPs: The SWPPP shall include a description of both structural and non-structural BMPs that will be used at the site.

   The SWPPP shall provide the following general information for each BMP which will be used one or more times at the site:
   1) Physical description of the BMP;
   2) Site conditions that must be met for effective use of the BMP;
   3) BMP installation/construction procedures, including typical drawings; and
   4) Operation and maintenance procedures for the BMP.

REQUIREMENTS (continued)

The SWPPP shall provide the following information for each specific instance where a BMP is to be installed:

1) Whether the BMP is temporary or permanent;
2) Where, in relation to other site features, the BMP is to be located;
3) When the BMP will be installed in relation to each phase of the land disturbance procedures to complete the project; and
4) Site conditions that must be met before removal of the BMP if the BMP is not a permanent BMP.

h. Disturbed Areas: Slopes for disturbed areas must be defined in the SWPPP. A site map or maps defining the sloped areas for all phases of the project must be included in the SWPPP.

For soil disturbing activities that have been temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days:

1) The permittee shall construct BMPs to establish interim stabilization; and
2) Stabilization must be initiated immediately and completed within 14 calendar days.

For soil disturbing activities that have been permanently ceased on any portion of the site, final stabilization of disturbed areas must be initiated immediately and completed within 14 calendar days.

Allowances to the 14 day completion period for temporary and final stabilization may be made due to weather and equipment malfunctions. The use of allowances shall be documented in the SWPPP.

Interim stabilization shall consist of well-established and maintained BMPs that are reasonably certain to protect waters of the state from sediment pollution over an extended period of time. This may require adding more BMPs to an area than is normally used during daily operations. These BMPs may include a combination of sediment basins, check dams, sediment fences and mulch. The types of BMPs used must be suited to the area disturbed, taking into account the number of acres exposed and the steepness of the slopes. If the slope of the area is greater than 3:1 (three feet horizontal to one foot vertical) or if the slope is greater than 3% and greater than 150 feet in length, then the permittee shall establish interim stabilization within seven days of ceasing operations on that part of the site.

If vegetative stabilization measures are being implemented, stabilization is considered "installed" when all activities necessary to seed or plant the area are completed.

i. Installation: The permittee shall ensure the BMPs are properly installed at the locations and relative times specified in the SWPPP. Peripheral or border BMPs to control runoff from disturbed areas shall be installed or marked for preservation before general site clearing is started. Note that this requirement does not apply to earth disturbances related to initial site clearing and establishing entry, exit and access of the site, which may require that stormwater controls be installed immediately after the earth disturbance. For phased projects, BMPs shall be properly installed as necessary prior to construction activities. Stormwater discharges from disturbed areas which leave the site shall pass through an appropriate impediment to sediment movement such as a sedimentation basin, sediment traps and silt fences prior to leaving the land disturbance site. A drainage course change shall be clearly marked on a site map and described in the SWPPP.

j. Sedimentation Basins: The SWPPP shall include a sedimentation basin for each drainage area with ten or more acres disturbed at one time. The sedimentation basin shall be sized to treat a local 2-year, 24-hour storm. Accumulated sediment shall be removed from the basin when basin is 50% full. Utilize outlet structures that withdraw water from the surface when

REQUIREMENTS (continued)

discharging from basins and impoundments unless infeasible. Discharges from the basin shall not cause scouring of the banks or bottom of the receiving stream. The SWPPP shall require the basin be maintained until final stabilization of the disturbed area served by the basin.

Where use of a sediment basin is infeasible, the SWPPP shall evaluate and specify other similarly effective BMPs to be employed to control erosion and sediment delivery. These similarly effective BMPs shall be selected from appropriate BMP guidance documents authorized by this permit. The BMPs must provide equivalent water quality protection to achieve compliance with this permit. The SWPPP shall require both temporary and permanent sedimentation basins to have a stabilized spillway to minimize the potential for erosion of the spillway or basin embankment.

k. Pollution Prevention Measures: The SWPPP shall include BMPs for pollution prevention measures. At minimum such measures must be designed, installed, implemented and maintained to:
   1) Minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other wash waters. Wash waters must be treated in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge;
   2) Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste, and other materials present on the site to precipitation and to stormwater;
   3) Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures. Included but not limited to the installation of containment berms and use of drip pans at petroleum product and liquid storage tanks and containers; and
   4) Prevent discharges from causing or contributing to an exceedance of water quality standards including general criteria.

l. Roadways: Where applicable, upon installation of or connection to roadways, all efforts should be made to prevent the deposition of earth and sediment onto roadways through the use of proper BMPs. Stormwater inlets susceptible to receiving sediment from the permitted land disturbance site shall have curb inlet protection. Where stormwater will flow off the end of where a roadway terminates, a sediment catching BMP such as gravel berm or silt fence shall be provided. Curb inlets shall be cleaned weekly or following a rainfall that generates a run-off.

m. Dewatering: Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, are prohibited unless managed by appropriate controls. The SWPPP shall include a description of any anticipated dewatering methods. An estimation of the volume of water discharged from these dewatering activities shall be kept with the SWPPP after each discharge has ended along with the type and maximum capacity (e.g., flow rate) of equipment used. The SWPPP shall call for specific BMPs designed to treat water pumped from trenches and excavations and in no case shall this water be pumped off-site without being treated by the specified BMPs.

9. Good housekeeping practices shall be maintained at all times to keep waste from entering waters of the state. Solid and hazardous waste management include providing trash containers and regular site cleanup for proper disposal of solid waste such as scrap building material, product/material shipping waste, food containers and cups, and providing containers and proper disposal of waste paints, solvents and cleaning compounds. The provision of portable toilets for proper disposal of sanitary sewage and the storage of construction materials should be kept away from drainage courses and low areas.

REQUIREMENTS (continued)

10. All fueling facilities present shall at all times adhere to applicable federal and state regulations concerning underground storage, above ground storage and dispensers.

11. Hazardous wastes that are transported, stored, or used for maintenance, cleaning, or repair shall be managed according to the provisions of the Missouri Hazardous Waste Laws and Regulations.

12. All paint, solvents, petroleum products, petroleum waste products and storage containers such as drums, cans, or cartons shall be stored according to BMPs. The materials exposed to precipitation shall be stored in watertight, structurally sound, closed containers. All containers shall be inspected for leaks or spillage during the inspection of BMPs.

13. Amending/Updating the SWPPP: The permittee shall amend and update the SWPPP as appropriate during the term of the land disturbance activity. The permittee shall amend the SWPPP at a minimum whenever the:
    a. Design, operation, or maintenance of BMPs is changed;
    b. Design of the construction project is changed that could significantly affect the quality of the stormwater discharges;
    c. Permittee's inspections indicate deficiencies in the SWPPP or any BMP;
    d. Department notifies the permittee in writing of deficiencies in the SWPPP;
    e. SWPPP is determined to be ineffective in minimizing or controlling erosion and sedimentation (e.g., there is visual evidence of excessive site erosion or excessive sediment deposits in streams or lakes); and/or
    f. Department determines violations of water quality standards may occur or have occurred.

14. An individual shall be designated by the permittee as the lead for environmental matters. The lead individual for environmental matters shall have a thorough and demonstrable knowledge of the site's SWPPP and sediment and erosion control practices in general. The lead individual for environmental matters or a designated inspector knowledgeable in erosion, sediment and stormwater control principles shall inspect all structures that function to prevent pollution of waters of the state.

15. Site Inspections Reports: The permittee (or a representative of the permittee) shall conduct regularly scheduled inspections. These inspections shall be conducted by a qualified person, one who is responsible for environmental matters at the site, or a person trained by and directly supervised by the person responsible for environmental matters at the site. For disturbed areas that have not been finally stabilized, all installed BMPs and other pollution control measures shall be inspected for proper installation, operation and maintenance. All stormwater outfalls shall be inspected for evidence of erosion or sediment deposition. When practicable the receiving stream shall also be inspected for 50 feet downstream of the outfall. Any structural or maintenance problems shall be noted in an inspection report and corrected as soon as possible but no more than seven calendar days after the inspection. All BMPs must be inspected in accordance to one of the two schedules listed below, and any changes to the frequency of inspections, including switching between the options listed below, must be documented in the SWPPP:
    a. At least once every seven calendar days and within 48 hours after any storm event equal to or greater than a 2-year, 24-hour storm has ceased during a normal work day and within 72 hours if the rain event ceases during a non-work day such as a weekend or holiday; or
    b. Once every 14 calendar days and within 24 hours of the occurrence of a storm event of 0.25 inches of precipitation or greater, or the occurrence of runoff from snowmelt. To determine if a storm event of 0.25 inches or greater has occurred on your site, you must either keep a properly maintained rain gauge on site, or obtain the storm event information from a weather station for your location.
        1) Inspections are only required during the project's normal working hours.

REQUIREMENTS (continued)

2) You must conduct an inspection within 24 hours once a storm event has produced 0.25 inches within a 24 hour period, even if the storm event is still continuing.
3) If you have elected to inspect every 14 calendar days and there is a storm event at your site that continues for multiple days, and each day of the storm produces 0.25 inches or more of rain, you are required to conduct an inspection within 24 hours of the first day of the storm and within 24 hours after the end of the storm.

The SWPPP must explain how the person responsible for erosion control will be notified when stormwater runoff occurs. If weather conditions prevent correction of BMPs within seven calendar days, the reasons for the delay must be documented (including pictures) and there must be a narrative explaining why the work cannot be accomplished within the seven day time period. The documentation must be filed with the regular inspection reports. The permittee shall correct the problem as soon as weather conditions allow. Areas on-site that have been finally stabilized must be inspected at least once per month.

A log of each inspection and copy of the inspection report shall be kept readily accessible and must be available upon request by the Department. Electronic logs are acceptable as long as reports can be provided in a timely manner. If inspection reports are kept off-site, your SWPPP must indicate where they are stored. The inspection report shall be signed by the permittee or by the person performing the inspection if duly authorized to do so. The inspection report is to include the following minimum information:

a. Inspector's name;
b. Date of inspection;
c. Observations relative to the effectiveness of the BMPs;
d. Actions taken or necessary to correct the observed problem; and
e. Listing of areas where land disturbance operations have permanently or temporarily stopped.

16. Notification to All Contractors: The permittee shall be responsible for notifying each contractor or entity (including utility crews and city employees or their agents) who will perform work at the site of the existence of the SWPPP and what action or precautions shall be taken while on-site to minimize the potential for erosion and the potential for damaging any BMP. The permittee is responsible for any damage a subcontractor may do to established BMPs and any subsequent water quality violation resulting from the damage.

17. Public Notification: The permittee shall post a copy of the public notification sign described by the Department at the main entrance to the site. The public notification sign must be visible from the public road that provides access to the site's main entrance. An alternate location is acceptable provided the public can see it and it is noted in the SWPPP. The public notification sign must remain posted at the site until the permit has been terminated.

OTHER DISCHARGES

1. Release of a hazardous substance must be reported to the department in accordance with 10 CSR 24-3.010. A record of each reportable spill shall be retained with the Stormwater Pollution Prevention Plan (SWPPP) and made available to the department upon request. The department may also require the submittal of a written or electronic report detailing measures taken to clean up the spill within five (5) days of the spill. Such a report must include the type of material spilled, volume, date of spill, date clean-up was completed, clean-up method, and final disposal method. If the spill occurs outside of normal business hours, or if the permit holder cannot reach regional office staff for any reason, the permit holder is instructed to report the spill to the department's 24 hour Environmental Emergency Response hotline at (573) 634-2436 at the earliest practicable moment after discovery. Leaving a message on a department staff member voice-mail does not satisfy this reporting requirement.

REQUIREMENTS (continued)

2. Removed substances: Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

SAMPLING REQUIREMENTS AND EFFLUENT LIMITATIONS

The Department may require sampling and reporting as a result of illegal discharges, compliance issues, complaint investigations, or other such evidence of contamination from activities at the site. If such an action is needed, the Department will specify in writing any sampling requirements, including such information as location, extent and parameters.

RECORDS

1. The permittee shall retain copies of this general permit, the SWPPP and all amendments for the site named in the State Operating Permit, results of any monitoring and analysis and all site inspection records required by this general permit. The records shall be accessible during normal business hours. The records shall be retained for a period of at least three years from the date of the Letter of Termination.

2. The permittee shall provide a copy of the SWPPP to the Department, USEPA, or any local agency or government representative if they request a copy in the performance of their official duties.

3. The permittee shall provide a copy of the SWPPP to those who are responsible for installation, operation, or maintenance of any BMP. The permittee, their representative, and/or the contractor(s) responsible for installation, operation and maintenance of the BMPs shall have a current copy of the SWPPP with them when on the project site.

LAND PURCHASE AND CHANGE OF OWNERSHIP

1. Federal and Missouri stormwater regulations [10 CSR 20-6.200(1) (B)] require a stormwater permit and erosion control measures for all land disturbances of one or more acres. These regulations also require a permit for less than one acre lots if the lot is part of a larger common plan of development or sale where that plan is at least one acre in size.

2. If the permittee sells any portion of the permitted site to a developer for commercial, industrial, or residential use, this land remains a part of the common sale and the new owner must obtain a permit prior to conducting any land disturbance activity. Therefore, the original permittee must amend the SWPPP to show that the property has been sold and therefore no longer under the original permit coverage.

3. Property of any size which is part of a larger common plan of development where the property has been stabilized and the original permit terminated will require application of a new land disturbance permit for any future land disturbance activity.

4. If the entire tract is sold to a single entity, then this permit shall be terminated when the new owner obtains a new land disturbance permit for the site.

5. If a portion of a larger common plan of development is sold to an individual for the purpose of building his or her own private residence, a permit is required if the portion of land sold is equal to or greater than one acre while no permit is required for less than one acre of land sold.

TERMINATION

1. This permit may be terminated when the project is stabilized. The project is considered to be stabilized when perennial vegetation, pavement, buildings, or structures using permanent materials cover all areas that have been disturbed. With respect to areas that have been vegetated, vegetation cover shall be at least 70% over 100% of the site. In order to terminate the permit, the permittee shall notify the Department by submitting Form H Request for Termination of a General Permit.

2. The Cover Page (Certificate Page) of the Master General Permit for Land Disturbance specifies the "effective date" and the "expiration date" of the Master General Permit. The "issued date" along with the "expiration date" will appear on the State Operating Permit issued to the applicant. This permit does not continue administratively beyond the expiration date.

3. Due to the nature of the electronic permitting system, a period of 60 days will be granted at the discretion of the department in order to apply for a new permit after the new version is effective. Applicants must maintain appropriate best management practices during the discretionary period.

DUTY TO REAPPLY

If the project or development completion date will be after the expiration date of this general permit, then the permittee must reapply to the Department for a new permit. This permit may be applied for and issued electronically once made available by the director in accordance with Section 644.051.10, RSMo.

MODIFICATION, REVOCATION, AND REOPENING

1. If at any time the Department determines that the quality of waters of the state may be better protected by reopening this permit, or revoking this permit and requiring the owner/operator of the permitted site to apply for a site-specific permit, the Department may revoke a general permit and require any person to obtain such an operating permit as authorized by 10 CSR 20-6.010(13) and 10 CSR 20-6.200(1) (B).

2. If this permit is reopened, modified or revoked pursuant to this Section, the permittee retains all rights under Chapter 536 and 644 Revised Statutes of Missouri upon the Department's reissuance of the permit as well as all other forms of administrative, judicial, and equitable relief available under law.

STANDARD CONDITIONS

These Standard Conditions incorporate permit conditions as required by 40 CFR 122.41 or other applicable state statutes or regulations. These minimum conditions apply unless superseded by requirements specified in the permit.

1. Other Information
   a. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

2. Duty to Comply
   a. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Missouri Clean Water Law and Federal Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

STANDARD CONDITIONS (continued)

3. Duty to Provide Information
   a. The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

4. Inspection and Entry
   a. The permittee shall allow the Department, or an authorized representative (including an authorized contractor acting as a representative of the Department), upon presentation of credentials and other documents as may be required by law, to:
      i. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;
      ii. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
      iii. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
      iv. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Federal Clean Water Act or Missouri Clean Water Law, any substances or parameters at any location.

5. Signatory Requirement
   a. All permit applications, reports required by the permit, or information requested by the Department shall be signed and certified. (See 40 CFR 122.22 and 10 CSR 20-6.010)
   b. The Federal Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six (6) months per violation, or by both.
   c. The Missouri Clean Water Law provides that any person who knowingly makes any false statement, representation or certification in any application, record, report, plan, or other document filed or required to be maintained pursuant to sections 644.006 to 644.141 shall, upon conviction, be punished by a fine of not more than ten thousand dollars, or by imprisonment for not more than six months, or by both.

Missouri Department of Natural Resources
Fact Sheet
MO-RA00000

The Federal Water Pollution Control Act [Clean Water Act (CWA)] Section 402 of Public Law 92-500 (as amended) established the National Pollution Discharge Elimination System (NPDES) permit program. This program regulates the discharge of pollutants from point sources into the waters of the United States, and the release of stormwater from certain point sources. All such discharges are unlawful without a permit (Section 301 of the CWA). After a permit is obtained, a discharge not in compliance with all permit terms and conditions is unlawful. Missouri State Operating Permits (permit) are issued by the Missouri Department of Natural Resources (department) under an approved program, operated in accordance with federal and state laws (Federal CWA and Missouri Clean Water Law Section 644 as amended). Permits are issued for a period of five (5) years unless otherwise specified.

Per 40 CFR 124.56, 40 CFR124.8, and 10 CSR 20-6.020(1)(A)2., a Fact Sheet shall be prepared to give pertinent information regarding the applicable regulations, rationale for the development of effluent limitations and conditions, and the public participation process for the permit. A Fact Sheet is not an enforceable part of an MSOP.

This Fact Sheet is for a:

- ☐ Major
- ☐ Minor
- ☐ Industrial Facility
- ☐ Variance
- ☒ Master General Permit
- ☐ Permit with widespread public interest

Definitions

Common Promotional Plan: A plan undertaken by one (1) or more persons, to offer lots for sale or lease; where land is offered for sale by a person or group of persons acting in concert, and the land is contiguous or is known, designated or advertised as a common unit or by a common name or similar names, the land is presumed, without regard to the number of lots covered by each individual offering, as being offered for sale or lease as part of a common promotional plan.

Immediately: For the purposes of this permit, immediately should be defined as within 24 hours.

Infeasible: Infeasible means not technologically possible, or not economically practicable and achievable in light of best industry practices.

Larger Common Plan of Development or sale: A contiguous area where multiple separate and distinct construction activities are occurring under one plan.

Ordinary High Water Mark: The line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation and/or the presence of litter and debris.

Peripheral: For the purposes of this permit, peripheral should be defined as the outermost boundary of the area that will be disturbed.

Permanently: For the purposes of this permit, permanently should be defined as any activity that has been ceased without any intentions of future disturbance.

Waters of the state: Section 644.016.1(27) RSMo. defines waters of the state as, "All waters within the jurisdiction of this state, including all rivers, streams, lakes and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common."

Part I – Facility Information

Facility Type:	Industrial Stormwater
Facility Description:	Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading, filling, and other activities that result in the destruction of the root zone and/or land disturbance activity that is reasonably certain to cause pollution to waters of the state).

This permit establishes a SWPPP requirement to minimize pollutants of concern from this type of facility or for all facilities covered under this permit. 10 CSR 20-6.200(6)(A)7. specifies that "general permits shall contain BMP requirements and/or monitoring and reporting requirements to keep the stormwater from becoming contaminated." Local conditions are not considered when developing conditions for a general permit. A facility may apply for a site-specific permit if they desire a review of site-specific conditions.

While drafting this permit for renewal, the department hosted four public meetings held on January 27, February 24, April 18, and May 19, 2016, which allowed stakeholders to voice concerns about conditions within the permit and submit comments during the period of initial stakeholder involvement. These concerns were taken into consideration when drafting the permit. In addition to these meetings, the department also held an informal review period for stakeholders to review the draft prior to the 30 day public comment period.

Part II – Receiving Stream Information

APPLICABLE DESIGNATIONS OF WATERS OF THE STATE:
Per Missouri Effluent Regulations (10 CSR 20-7.015), the waters of the state are divided into seven (7) categories. This permit applies to facilities discharging to the following water body categories:

Please mark all appropriate designated waters of the state categories of the receiving stream.

- ☒ Missouri or Mississippi River [10 CSR 20-7.015(2)]
- ☒ Lakes or Reservoirs [10 CSR 20-7.015(3)]
- ☒ Losing Streams [10 CSR 20-7.015(4)]
- ☒ Metropolitan No-Discharge Streams [10 CSR 20-7.015(5)]
- ☒ Special Streams [10 CSR 20-7.015(6)]
- ☐ Subsurface Waters [10 CSR 20-7.015(7)]
- ☒ All Other Waters [10 CSR 20-7.015(8)]

Missouri Water Quality Standards (10 CSR 20-7.031) defines the Clean Water Commission water quality objectives in terms of "water uses to be maintained and the criteria to protect those uses." The receiving stream and/or 1st classified receiving stream's beneficial water uses shall be maintained in accordance with 10 CSR 20-7.031(4). The BMP requirement established by this permit are intended to be protective of all streams that fall within the categories of receiving water bodies indicated above. A general permit does not take into consideration site-specific conditions.

Part III – Applicability

Condition number 8 was expanded to include a more comprehensive list of state and federal requirements that must be taken into consideration.

If the proposed project encounters and will potentially affect a species of concern, please report it to the Missouri Department of Conservation and the United States Fish and Wildlife Service. For more information about requirements of the Endangered Species Act, please visit the following links:

1. To determine the potential for species of concern within or near a project, please visit the United States Fish and Wildlife Services' "Information, Planning and Conservation" website at http://ecos.fws.gov/ipac/.
2. If there are listed species in the county or township, check to see if critical habitat has been designated and if that area overlaps or is near the project area. Critical habitat designations and associated requirements may also be found at 50 CFR Parts 17 and 226. For additional information, use the map view tool at http://criticalhabitat.fws.gov/crithab/ to find data specific to your state and county.

The Missouri Department of Conservation's internet site for the Natural Heritage Review may be very helpful and can be found at the following link, http://mdcgis.mdc.mo.gov/heritage/newheritage/heritage.htm.

Part IV – Exemptions

Condition Number 2 was added to cite all state exemptions from permitting requirements, combining several previous cited exemptions into one condition and reference. This includes an exemption for linear construction where the entire disturbance, including clearing of land to access the linear disturbance, is less than two feet in width.

Condition Number 3 was added to cite federal regulations that exclude land disturbance projects as related to the installation or maintenance work for oil and gas related activities.

Part V – Rationale of Technology Based Limitations & Permit Conditions

303(d) LIST & TOTAL MAXIMUM DAILY LOAD (TMDL):
Section 303(d) of the Federal CWA requires that each state identify waters that are not meeting Water Quality Standards and for which adequate water pollution controls have not been required. Water Quality Standards protect such beneficial uses of water as whole body contact, maintaining fish and other aquatic life, and providing drinking water for people, livestock, and wildlife. The 303(d) list helps state and federal agencies keep track of waters that are impaired but not addressed by normal water pollution control programs.

ANTI-BACKSLIDING:
A provision in the Federal Regulations [CWA Section 303(d) (4); CWA Section 402(c); 40 CFR Part 122.44(I)] that requires a reissued permit to be as stringent as the previous permit with some exceptions.

☒ Applicable: Backsliding proposed in this permit conforms to the anti-backsliding provisions of Section 402(o) of the CWA and 40 CFR 122.44. The department has determined that technical mistakes were made in the previous permit [CWA 402(o)(2)(B)(ii)]. The Settleable Solids limitation was removed since has been determined to not be adequate in protecting water quality in all areas of the state. Increased technology based best management practices will protect water quality at a similar if not more protective level.

ANTIDEGRADATION:
Antidegradation policies ensure protection of water quality for a particular water body on a pollutant by pollutant basis to ensure Water Quality Standards are maintained to support beneficial uses such as fish and wildlife propagation and recreation on and in the water. This also includes special protection of waters designated as an Outstanding National Resource Water or Outstanding State Resource Water [10 CSR 20-7.031(3) (C)]. Antidegradation policies are adopted to minimize adverse effects on water. The department has determined that the best avenue forward for implementing the Antidegradation requirements into general permits is by requiring the appropriate development and maintenance of a SWPPP. The SWPPP must identify all Best Management Practices (BMPs) that are reasonable and effective, taking into account environmental impacts and costs. This analysis must document why no discharge or no exposure options are not feasible at the facility. This selection and documentation of appropriate control measures will then serve as the analysis of alternatives and fulfill the requirements of the Antidegradation Rule and Implementation Procedure 10 CSR 20-7.031(3) and 10 CSR 20-7.015(9)(A)5.

Any facility seeking coverage under this permit, which undergoes expansion or discharges a new pollutant of concern, must update their SWPPP and select new BMPs that are reasonable and cost effective. New facilities seeking coverage under this permit are required to develop a SWPPP that includes this analysis and documentation of appropriate BMPs. Renewal of coverage for a facility requires a review of the SWPPP to assure that the selected BMPs continue to be appropriate.

☒ Applicable: The main pollutant of concern in this permit is sediment. Compliance with the technology based limitations established in this permit for the protection of General Criteria, along with the evaluation and implementation of BMPs as documented in the SWPPP, meets the requirements of Missouri's Antidegradation Review [10 CSR 20-7.031(3), 10 CSR 20-7.031 Table A, and 10 CSR 20-7.015(9)(A)5].

STORMWATER POLLUTION PREVENTION PLAN (SWPPP):
In accordance with 40 CFR 122.44(3)(k) Best Management Practices (BMPs), BMPs are implemented to control or abate the discharge of pollutants when: (1) Authorized under Section 304(e) of the CWA for the control of toxic pollutants and hazardous substances from ancillary industrial activities: (2) Authorized under Section 402(p) of the CWA for the control of stormwater discharges; (3) Numeric effluent limitations are infeasible; or (4) The practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA.

In accordance with Developing Your Stormwater Pollution Prevention Plan, a Guide for Construction Sites (EPA 833-R-06-004; https://www3.epa.gov/npdes/pubs/sw_swppp_guide.pdf) published by the United States Environmental Protection Agency (EPA) in May 2007, BMPs are measures or practices used to reduce the amount of pollution entering waters of the state. BMPs may take the form of a process, activity, or physical structure. EPA developed resources and tools related to construction stormwater along with the BMPs to control and minimize stormwater (https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources). Along with EPA's resources and tools, the International Stormwater BMP database (www.bmpdatabase.org/index.htm) may provide guidance on BMPs appropriate for specific industries.

Additionally in accordance with Stormwater Management, a SWPPP is a series of steps and activities to (1) identify sources of pollution or contamination, and (2) select and carry out actions which prevent or control the pollution of stormwater discharges.

☒ Applicable: A SWPPP shall be developed and implemented for each site and shall incorporate required practices identified by the department with jurisdiction, incorporate erosion control practices specific to site conditions, and provide for maintenance and adherence to the plan.

The new permit has been revised to allow permittees to store SWPPP documents electronically as long as they can be provided in an expedient manner.

WATER QUALITY STANDARDS:
Per 10 CSR 20-7.031(4), General Criteria shall be applicable to all waters of the state at all times, including mixing zones. Additionally, 40 CFR 122.44(d)(1) directs the department to include in each NPDES permit conditions to achieve water quality established under Section 303 of the CWA, including state narrative criteria for water quality.

General Criteria. The following water quality criteria shall be applicable to all waters of the state at all times. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions:

(1) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits, or prevent full maintenance of beneficial uses;
(2) Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
(3) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses;
(4) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life;
(5) There shall be no significant human health hazard from incidental contact with the water;
(6) There shall be no acute toxicity to livestock or wildlife watering;
(7) Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community;
(8) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment, and solid waste as defined in Missouri Solid Waste Law, Section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to Section 260.200-260.247, RSMo.

The settelable solids requirement was removed from this permit and was replaced with additional, more specific, BMP requirements. The settelable solids limit was determined not to be protective of all waters across the state, therefore, it was removed.

Additional BMPs added to the permit will provide for more consistency across the state. Examples of these BMPs include requirements to:

- Install and maintain perimeter controls along areas of the site that will receive pollutant discharges;
- Minimize sediment trackout from the site;
- Capture or treat runoff up to and including a 2-year, 24-hour storm event; and
- Direct stormwater to vegetated areas.

The minimum buffer width was increased from 25 feet to 50 feet. Studies have shown that a 50 foot vegetative buffer more adequately treats sediment from stormwater discharges. This appears to be standard in EPA's permit as well as in many other states.

In order to design controls that match the sediment removal efficiency of a 50- foot buffer, first you must know what this efficiency is for your site. The sediment removal efficiencies of natural buffers vary according to a number of site-specific factors, including precipitation, soil type, land cover, slope length, width, steepness, and the types of sediment controls used to reduce the discharge of sediment prior to the buffer.

Sediment removal efficiencies are based on the U.S. Department of Agriculture's RUSLE2 (Revised Universal Soil Loss Equation 2) model for slope profiles using a 100-foot long exposed slopes.

Sediment removal is defined as the annual sediment delivered at the downstream end of the 50-foot natural buffer (tons/yr/acre) divided by the annual yield from cleared area (tons/yr/acre).

Sediment removal is in part a function of (1) a perimeter control (i.e., silt fence) located between the disturbed portion of the site and the upland edge of the natural buffer and (2) stormwater flows traveling through a 50-foot buffer of undisturbed natural vegetation.

Additional guidance may be found at https://www.epa.gov/sites/production/files/2015-10/documents/cgp2012_appendixg.pdf.

Inspection frequencies: Site inspection frequencies have been changed from the previous permit based upon guidance from the US EPA and from stakeholder discussions. These frequencies will allow flexibility but will still allow for frequent enough inspections to ensure that all BMPs are adequately functioning.

Part VI – Effluent Limitations Determination

In this general permit, Technology-Based Effluent Limitations are established through the SWPPP and BMP requirements. Effective BMPs may have to be designed on a site-specific basis. The concurrent implementation of monitoring and benchmarks provides a tool for each facility to evaluate the effectiveness of BMPs to ensure protection of water quality.

Part VII – Land Purchase and Change of Ownership

A **"larger common plan of development or sale"** is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. This term is used in conjunction with common promotional plan, as defined in §644, RSMo.

Any portion of a project that is sold to a developer is still considered part of a larger common plan of development or sale and will require a permit.

If a portion of a site is sold to an individual for the purpose of building his or her private residence:

- A permit is required if the portion of land sold is equal to or greater than one acre.
- A permit is not required if the portion of land sold is less than one acre.

Part VIII – Termination

The word 'plant density' was removed from the first paragraph since the department determined that percent of vegetative cover more accurately describes the vegetative requirements of this permit. This decision was made after discussion within the department and with stakeholders.

It is preferable that temporary BMPs such as sediment fence be removed prior to permit termination to eliminate potential solid waste issues that may occur as a result of unnecessary and unmaintained BMPs.

Part IX – Duty to Reapply

This section has been revised to reflect the current applicable statutes which require applicants to submit an application for coverage electronically as soon as they are made available by the director. The determination was made that facilities do not need to submit an application 30 days prior to expiration because this permit does not administratively continue. Additionally, due to limitations within the electronic system currently used to issue permits, the department will use its discretion to allow existing permit holders a period of 60 days to reapply after the new version of the permit is effective. The department will announce the availability status of the new permit and the process to reapply at least 30 days prior to the expiration of the existing permit.

Part X – Standard Conditions

This section was revised to only include the specific standard conditions that apply to this permit. All other conditions have been removed.

Part XI – Administrative Requirements

On the basis of preliminary staff review and applicable standards and regulations, the department, as administrative agent for the Missouri Clean Water Commission, proposes to issue a permit(s) subject to certain effluent limitations, schedules, and special conditions contained herein and within the permit. The proposed determinations are tentative pending public comment.

PUBLIC NOTICE:
The department shall give public notice that a draft permit has been prepared and its issuance is pending. Additionally, public notice will be issued if a public hearing is to be held because of a significant degree of interest or because of water quality concerns related to a draft permit. No public notice is required when a request for a permit modification or termination is denied; however, the requester and facility must be notified of the denial in writing.

The department must give public notice of a pending permit or of a new or reissued Missouri State Operating Permit. The public comment period is a length of time not less than thirty (30) days following the date of the public notice, during which interested persons may submit written comments about the proposed permit.

For persons wanting to submit comments regarding this proposed permit, please refer to the Public Notice page located at the front of this draft permit. The Public Notice page gives direction on how and where to submit appropriate comments.

☒ The Public Notice period seeking comments on this permit occurred from September 2, 2016 to October 3, 2016.

DATE OF FACT SHEET: 8/23/2016; REVISED 11/30/2016

COMPLETED BY:
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ENVIRONMENTAL SPECIALIST
MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
OPERATING PERMITS SECTION
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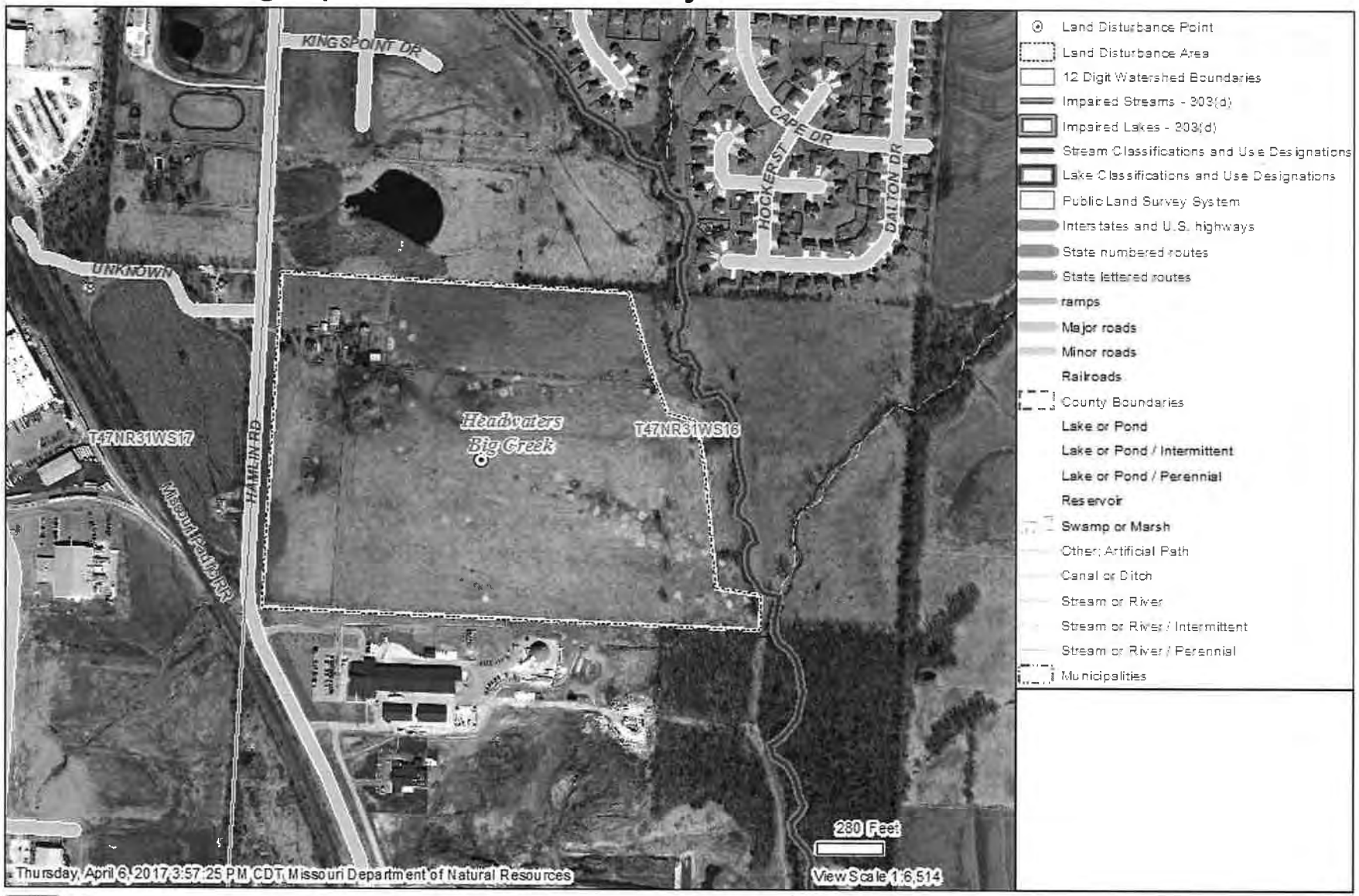
MoDNR Geographic Information System Editor



Missouri Department of Natural Resources

Missouri
Department of
Natural Resources

STORMWATER DISCHARGES FROM THIS LAND DISTURBANCE SITE ARE AUTHORIZED BY THE MISSOURI STATE OPERATING PERMIT NUMBER:

ANYONE WITH QUESTIONS OR CONCERNS ABOUT STORMWATER DISCHARGES FROM THIS SITE, PLEASE CONTACT THE MISSOURI DEPARTMENT OF NATURAL RESOURCES AT

1-800-361-4827

MISSOURI DEPARTMENT OF NATURAL RESOURCES
REGIONAL AND SATELLITE OFFICES

Kansas City Area

Kansas City Regional Office
500 NE Colbern Rd.
Lee's Summit, MO 64086-4710
816-251-0700
FAX: 816-622-7044

Northwest Missouri Satellite Office
Northwest Missouri State University
Environmental Services Building,
800 University Dr.
Maryville, MO 64468-6015
660-562-1876 or 660-562-1877
FAX: 660-562-1878

Truman Lake Satellite Office
Harry S Truman State Park
28761 State Park Road West
Warsaw, MO 65355
660-438-3039
FAX: 660-438-5271

Southwest Area

Southwest Regional Office
2040 W. Woodland
Springfield, MO 65807-5912
417-891-4300
FAX: 417-891-4399

Lake of the Ozarks Satellite Office
Lake of the Ozarks Satellite Office
5570 Osage Beach Parkway
Osage Beach, MO 65065
573-348-2442
FAX: 573-348-2568

Newton County Satellite Office
Crowder College
601 Laclede, Smith Hall, Room 201
Neosho, MO 64850
417-455-5180 or 417-455-5158
FAX: 417-455-5157

Northeast Area

Northeast Regional Office
1709 Prospect Drive
Macon, MO 63552-2602
660-385-8000
FAX: 660-385-8090

Kirksville Satellite Office
Truman State University
Magruder Hall, Room 3068
100 E. Normal St.
Kirksville, MO 63501
660-785-4610

Department Central Offices
P.O. Box 176
Jefferson City, MO 65102-0176
573-751-3443
www.dnr.mo.gov/shared/map-jeffcity.htm

St. Louis Area

St. Louis Regional Office
7545 S. Lindbergh, Ste 210
St. Louis, MO 63125
314-416-2960
FAX: 314-416-2970

Franklin County Satellite Office
Meramec State Park
Hwy. 185 S./115 Meramec Park Drive
Sullivan, MO 63080
573-860-4308
FAX: 573-468-5051

Jefferson County Satellite Office
Eastern District Parks Office
2901 Hwy. 61
Festus, MO 63028
636-931-5200
FAX: 636-931-5204

Lincoln County Satellite Office
Cuivre River State Park
678 State Rt. 147
Troy, MO 63379
636-528-4779
FAX: 636-528-8362

Southeast Area

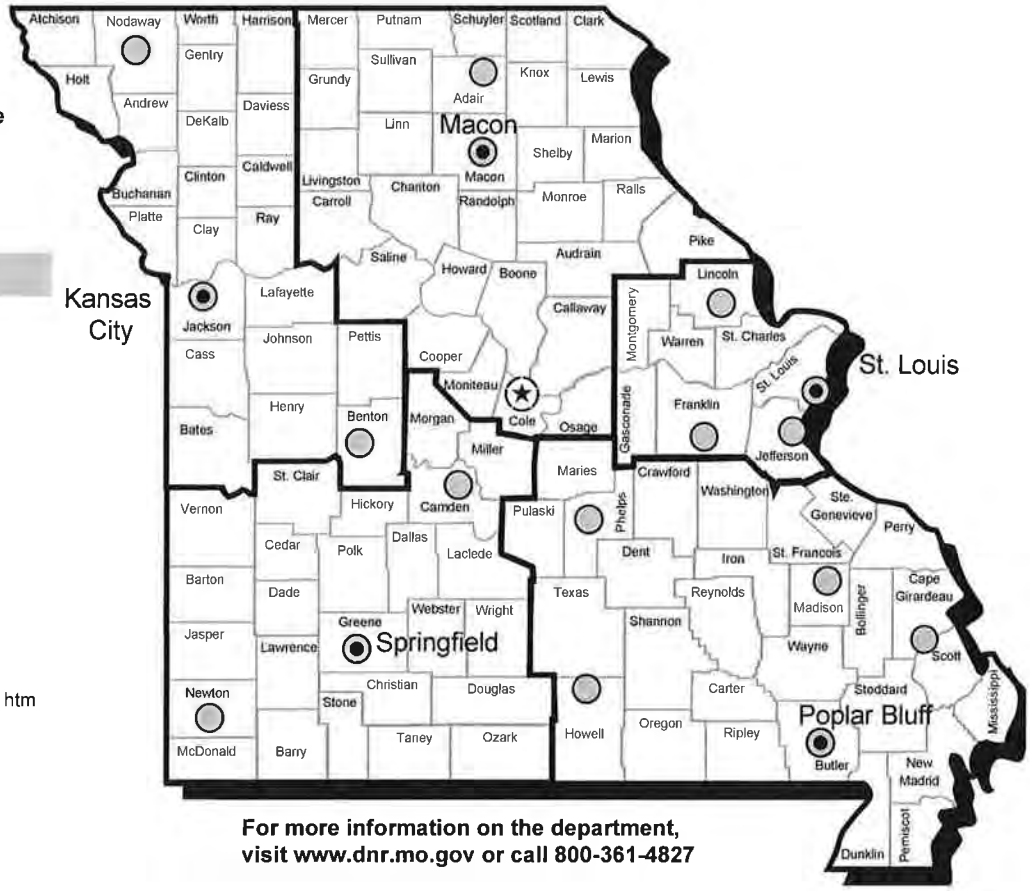
Southeast Regional Office
2155 North Westwood Blvd.
Poplar Bluff, MO 63901
573-840-9750
FAX: 573-840-9754

Cape Girardeau County Satellite Office
2007 Southern Expressway
Cape Girardeau, MO 63701
573-651-3008 (phone and FAX)

Howell County Satellite Office
700 W. Main St.
Willow Springs, MO 65793
417-469-0025 (phone and FAX)

Madison County Satellite Office
120 W. Main St.
Fredericktown, MO 63645
573-783-2385
FAX: 573-783-6294

Rolla Satellite Office
111 Fairgrounds Rd.
Rolla, MO 65402
573-368-3625
FAX: 573-368-3912



For more information on the department, visit www.dnr.mo.gov or call 800-361-4827

Appendix B

Inspection and Maintenance Form

INSPECTION AND MAINTENANCE FORM

Storm Water Pollution Prevention Plan
Browning Property Borrow Area
City of Lee's Summit, MO

Inspector: _____ Date: _____
Signature: _____

Inspection Type: ____ Weekly Check
____ After- 2 Year, 24 – Hour Rainfall Check
(rainfall amount: ___ inches)

Location	Properly Secured?	Erosion, Leaks or Sediment?	Corrective Action Necessary? (describe)	Date of Action
Site Entrance				
Sediment Fence/Straw Bales				
Check Dams				
Equipment				
Vegetation				
Sedimentation Basin				
Stockpiles/Slopes				
Channels				
Berms				
Buffer Zone				

Summary of Maintenance Requirements (include location and required maintenance)

_____

_____

_____

Additional Comments (including any changes to site layout)

_____

_____

Appendix C

SWPPP Certification Form

SWPPP CERTIFICATION FORM

Storm Water Pollution Prevention Plan
Browning Property Borrow Area
City of Lee's Summit, MO

I certify that I have personally examined and am familiar with the information presented in this Storm Water Pollution Prevention Plan (SWPPP). I will accordingly implement the storm water Best Management Practices (BMPs) identified in the SWPPP. I will perform required inspections and maintenance of the BMPs as required by the SWPPP and directed by the designated SWPPP Coordinator.

Signature _____ Date _____

Name (Print) _____

Signature _____ Date _____

Name (Print) _____

Signature _____ Date _____

Name (Print) _____

Signature _____ Date _____

Name (Print) _____

Appendix D

Detailed Information on BMPs from "Protecting Water Quality"

Temporary Rock Construction Exit Pad

Figure 6.1 A temporary rock construction exit can reduce sediment and resulting safety hazards on public streets. This pad needs maintenance due to sediment filling the void spaces between the rocks making the rock exit pad ineffective. Source: ABC's of BMP's, LLC

Practice Description

A temporary rock construction exit is a stone base installed to provide an exit area where construction vehicles can drop the mud and caked soil from their tires to avoid transporting it onto public roads. The mud and dirt that ends up on the street is called "track out" and is the number one complaint associated with construction projects. The rock will jar and flex the tire treads so dirt and mud on the tires will become dislodged and collect in the voids of the rock exit pad. This device should be incorporated anywhere traffic will be leaving a construction site and moving directly onto a public road or other paved area.

The rock exit pad is often not effective by itself and requires a lot of maintenance. High-clay content soils may not adequately separate from the tires, and the rocks must be reconditioned as void space is filled with sediment. You may need to install additional practices, some of which are described below. Superior practices may be available in the construction industry, although the temporary rock construction exit pad is most commonly used.

Prior to the start of construction, temporary rock construction exit pads should be designed by a qualified professional. The site superintendant and field personnel should refer to plans and specifications throught the construction process.

The design professional should give consideration to the following:

- Limit the points of entrance and exit to the site.
- Designate combination or single purpose access points to the construction site, and require all employees, subcontractors and others to use them.
- Properly grade each construction entrance and exit to prevent runoff from leaving the construction site.
- Route runoff from a stabilized pad through a sediment-trapping device before discharge.
- Design the pad to support the heaviest vehicles and equipment that will use it.
- Avoid placing the exit pad in low areas where stormwater accumulates or discharges off-site.

Recommended Minimum Requirements

Aggregate Size

2- to 3-inch washed stone.

Pad Design

- Thickness: 6 inches minimum.
- Width: 12 feet minimum or full width of roadway, whichever is greater.
- Length: 50 feet minimum.

Signage

Clearly designate these areas to be used for exiting the construction site and make sure everyone involved with the project is aware that track out is not tolerated.

Wheel Wash (Optional)

Level the area with a minimum of 3 inches of washed stone. Remember if a wheel wash station is installed, all wash water must be collected and treated before it is discharged from the construction site. A simple sediment trap can be added next to the rock pad to collect the wash water and allow it to discharge over a check dam and into the road ditch. See additional information on wheel wash devices later in this section.

Geotextile Fabric

An underliner of woven geotextile (fabric) should be used under the rock to provide stability.

Construction

Avoid locating on steep slopes or at curves on public roads. If possible, locate where permanent roads will eventually be constructed. Limit the number of access roads to limit the inspection and maintenance of these devices and areas where sediment could be tracked onto public roads.

Site Preparation

Remove all vegetation and other unsuitable material from the foundation area; grade and crown for positive drainage. If wheel washing is indicated, provide a sediment trap adjacent to the rock pad to collect the discharged wash water for treatment before it is released off-site.

Grading

- If the slope towards the road exceeds 2 percent, construct a 6- to 8-inch high ridge with 3:1 side slopes across the foundation approximately 15 feet from the entrance to divert runoff away from the public road.
- Place geotextile filter fabric on the graded foundation to improve stability.

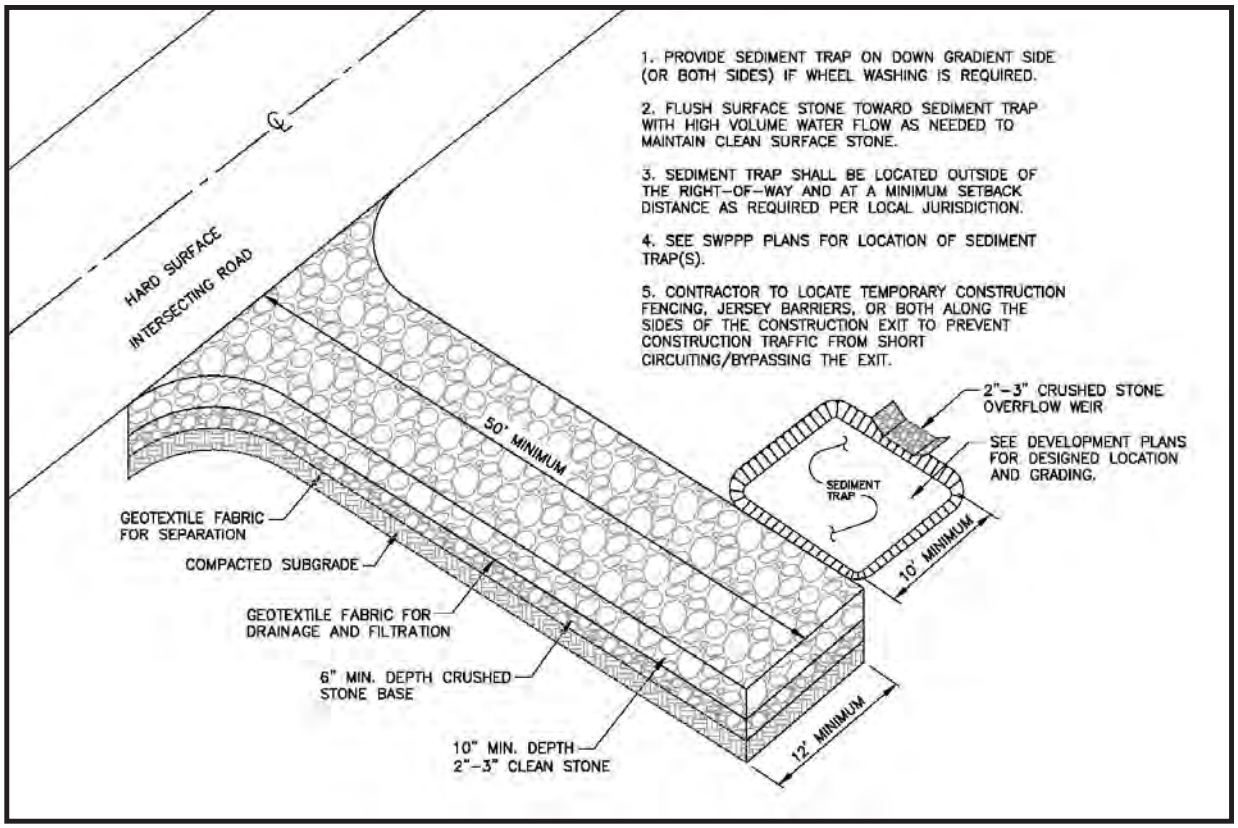


Figure 6.2 Typical Temporary Rock Construction Exit. Source; BFA Inc.

- Place stone to dimensions and grade shown on plans. Stone size should not be less than 2 inches or greater than 3 inches. Stones in the dimensions of 4- to 6-inches may become trapped between the dual tires on some construction vehicles and be transported off-site to later be thrown from the trucks tires and cause damage to vehicles or their drivers. Leave the surface smooth and sloped for drainage.
- Divert all surface runoff and drainage from the stone pad to a sediment trap or basin.

Maintenance, Inspection and Removal

- Inspect stone pad and sediment disposal areas weekly and after storm events or heavy use. When the voids between stones are filled with sediment or the pad becomes smooth and does not function to jar the truck and flex the rubber, it is not functioning properly and should be repaired. Add more rock or turn the existing stone over to move sediment below the stone so the stone pad will again have proper roughness and void spaces.
- Reshape pad as needed for drainage and runoff control.
- Topdress with clean 2- to 3-inch stone as needed.
- Immediately remove mud or sediment tracked or washed onto public road within 24 hours.
- Keep all temporary roadway ditches clear.
- Repair any broken road pavement immediately.
- Remove this temporary device and stabilize the site stabilized prior to filing *Form H: Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Common Problems and Solutions

Problem	Solution
Inadequate runoff control; sediment washes onto public road.	Install diversions or other runoff control measures.
Stone too small, pad too thin or geotextile fabric absent; results in ruts and muddy conditions as stone is pressed into soil.	Increase stone size or pad thickness, or add geotextile fabric. Stone should not be more than 4-inches in diameter, to avoid rocks being caught and thrown from dual tires.
Pad too short for heavy construction traffic.	Extend pad beyond the minimum 50-foot length as necessary.

Tree Protection

Practice Description

Tree protection preserves and protects trees during construction. Trees provide aesthetic and economic value, and aid in energy conservation, landscaping, air purification and erosion control. This practice applies to any construction site where desirable trees are present and need to be protected.

Trees can be damaged or killed by direct contact with construction equipment, compaction of the soil within the root zone of the tree, changes in the elevation of the water table due to site grading, and by construction chemicals and refuse. Although damage may be unseen, it can result in tree death within three or four years. Damage to the root zone is the leading factor in the unintentional destruction of trees.

Recommended Minimum Requirements

Prior to start of construction, desirable trees (including sensitive species) should be selected and marked for protection by a registered design professional. A grading plan that indicates the location of protected trees, utility trenches and other protected areas (e.g., floodplains, steep slopes, wetlands and streambanks) should be made available to field personnel. Areas for parking equipment should be designated away from the canopy (drip line) to protect the root zones of desired trees, shrubs, stream buffer vegetation and other protected areas. The root zone of plants is generally as broad as the drip line.

Temporary Fences

Placement

Around the dripline or tree canopy perimeter to restrict traffic, excavation, parking, storing materials and filling under the tree canopy. (For tree species sensitive to root damage, place the fence at the critical root radius to ensure tree's survival.)

Materials

Snow, board, plastic or cord fence.

Restricted Activities

Use temporary fence to restrict traffic, excavation, parking, storing materials and filling under the tree canopy (or at the critical root radius to ensure survival of sensitive species).

Permanent Drains

Install permanent drains in areas where site grading may be expected to cause water table saturation of the root zone (See Subsurface Drain).

Grading

Minimize cut and fill near trees by following the natural contours, and locating roadways, storage areas and parking pads away from desired tree stands.

Trenching

Minimize trenching near tree canopy perimeter and place several utilities in one trench when possible.

Up to 90 percent of trees' roots may be in the top 12 inches of soil. Typically, roots spread out from two to three times the width of the canopy or tree's branches.

Build a barrier at the dripline (or at the critical root radius for sensitive species) to prevent damage from soil compaction, cut and fill operations physical wounds.

To calculate the critical root radius: measure the tree's diameter in inches at breast height (4.5 feet above the ground), multiply that number by 1.5 feet. This will provide you with the critical root radius in feet.

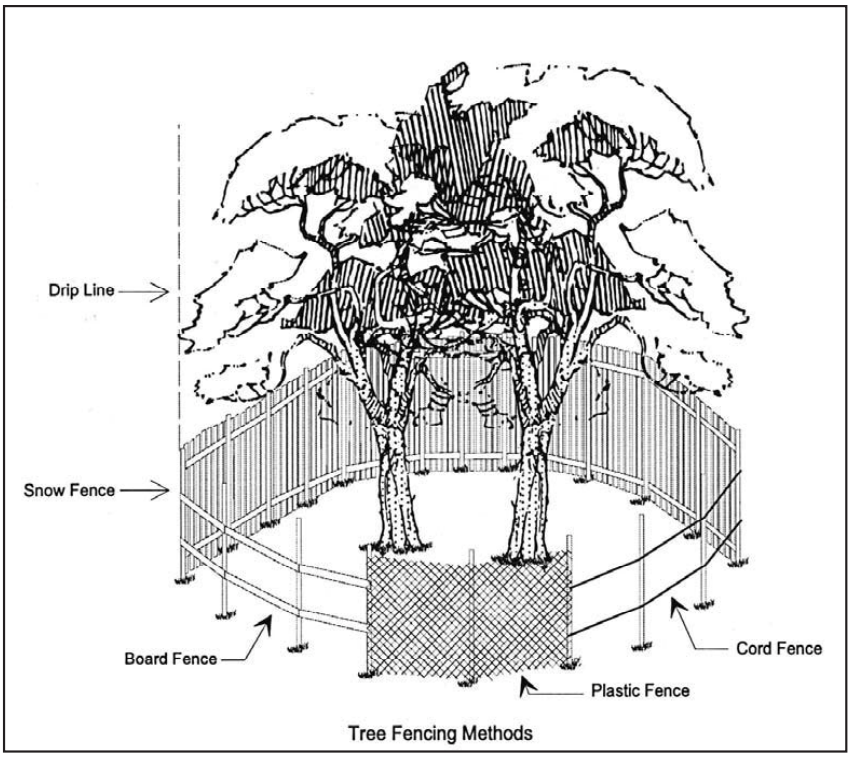


Figure 6.8 Erecting Barriers for Tree Protection Source: *Adapted from MU Guide 6885*

For example, a tree with a diameter (breast height) of 20 inches will have a critical root radius of 30 feet (60 foot diameter).

Construction

- Install temporary fences at tree driplines (at the critical root radius for sensitive tree species). To avoid compaction of the soil around desired trees, keep traffic, equipment and supplies off of the root systems. Figure 6.8 shows the correct method of erecting barriers for tree protection.
- Route the underground utilities according to plan. If possible, combine in one trench and route away from trees and potential planting sites.
- Use a brush cutter, rotary axe, or cut by hand instead of grading off brush to maintain the area within the tree canopy perimeter.

  Note: If grading beneath a tree's canopy is indicated on the plan:

  - Prior to construction activities, prune low hanging branches that may be damaged by equipment. To avoid tearing the bark from the tree while pruning, remove large branches with a stub-cut method. Figure 6.9 illustrates correct methods of pruning.
  - Minimize grading beneath the tree canopy. Avoid placing fill, or removing leaf litter or soil in the ungraded areas. Cut large roots instead of tearing them with equipment.

Stub-cut Method

First, make an undercut about one foot from the trunk. Then, cut through the branch near the first cut. Leave the tree's branch collar intact during the final cut to promote healing. Source: *Adapted from MU Guide 6866*

Construction Verification

Check the construction site to verify protective measures are being observed.

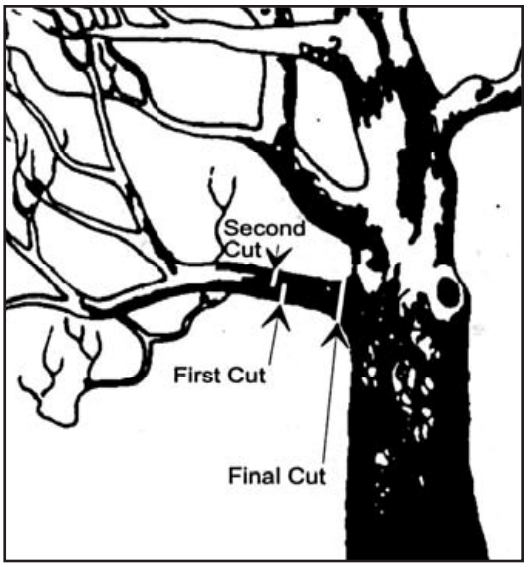


Figure 6.9 Proper Method of Pruning
Source: *Adapted from MU Guide 6866*

Troubleshooting

Consult with registered design professional such as an arborist or silviculturist if any of the following occur:

- A protected tree is accidentally injured by construction activities.
- If grade around a protected tree must be raised.

Maintenance, Inspection and Removal

- Remove fence around protected trees only after all construction is complete and all disturbed soil is stabilized.
- In spite of these precautionary steps some damage may occur to desired trees. If minor damage occurs, repair it immediately. Repair damage to limbs or roots by cutting off the damaged areas. Repair damage to bark by trimming the perimeter of the damaged area. If there is any question about the correct course of action, enlist the service of a professional arborist or silviculturist.
- Inspect trees for signs of stress, such as insect, disease and drought damage. Stressed trees should be watered during dry periods. Soak area under the canopy to a depth of 12- to 18-inches. Avoid fertilizing severely stressed trees until they become reestablished a year or two later. Treat insect and disease problems with a pesticide, if necessary, but be sure to follow instructions on the label. Or, employ a certified pesticide applicator to treat the problem.
- Remove temporary devices and stabilize the site prior to filing *Form H - Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Common Problems and Solutions

Problem	Solution
Trees show signs of damage such as wilting, early leaf drop in the fall or slow growth often caused by compaction.	Aerate the soil by pulling 12- to 18- inch deep cores in the soil within the dripline to assist movement of moisture and oxygen into the soil, then backfill with compost.
Trees killed during construction.	Remove after site completion and replace with new trees.

Slope Breaks and Surface Roughening

Figure 6.13 Lot benching can shorten slope length and prevent erosion while improving the homeowner's yard. Source: *C. Rahm, NRCS, St. Charles County*

Practice Description

Slope breaks and surface roughening are practices that reshape the ground surface during construction to slow the surface overland stormwater flow and reduce slope length to reduce surface runoff velocities, therefore minimizing soil erosion and sedimentation during construction. Slope breaks and surface roughening are inexpensive ways to provide erosion control during construction prior to establishment of permanent vegetative cover.

Slope breaks, such as diversions or benches, can be used to reduce the length of continuous slopes and reduce erosion (See Diversions).

Recommended Minimum Requirements

Prior to start of construction, the site grading plan should be designed by a qualified professional. The grading plan should show disturbed areas, cuts, fills and finished elevations for all graded areas. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. During construction and reshaping of the topography a slope can be roughened once it has been graded out and prior to reaching final grade and vegetation establishment.

Schedule construction activities so the least amount of area is disturbed at one time.

Slope Breaks

Refer to plan. Table 6.1 provides suggested guidelines for spacing of slope breaks.

Soil Surface Roughening

There are many types of surface roughening techniques such as track walking with a dozer up and down a slope or using a sheep's foot to create dimples in the soil surface. This increases infiltration and slows overland flow.

Table 6.1 Guidelines for Spacing Slope Breaks

Slope	Spacing (ft.)
33-50%	20
25-33%	40
15-25%	60
10-15%	80
6-10%	120
3-6%	200
< 3%	300

Source: Adapted from North Carolina Field Manual, 1991

Surface Runoff

Avoid disturbing natural drainage ways, if possible. At each slope break, intercept runoff and channel it to storm drains or stabilized watercourses. If runoff contains sediment, protect drain inlets with a filter or divert water to a sediment trap or basin according to the site grading plan (See Inlet Protection, Temporary Sediment Trap and Sediment Basin).

Erosion Control

Graded areas should be stabilized with mulch, vegetation, crushed stone, riprap or other measures as soon as work is completed, or if work is interrupted for 14 or more working days. Soil surface roughening is both an erosion and sediment control technique and should not be combined with devices such as erosion control blankets. Blankets should be applied to smooth, fine-graded soil surfaces and will fail if used to cover roughened soil surfaces.

Slopes to be Vegetated

2:1 or flatter; 3:1 or flatter where maintained by tractor or other equipment. Slopes should be roughened during grading operations to retain water, increase infiltration and promote vegetative growth. Slopes should be protected from surface runoff while vegetation is being established (See Diversions, Perimeter Protection).

Borrow and Disposal Areas

As shown on the grading plan; these should be no closer than 100 feet to a streambank or sensitive area (e.g., wetland, spring, cave, sinkhole) in the absence of a specification and should not be placed in an area of stormwater conveyance. Stockpiles should be stabilized if not being used for 14 or more days according to the state and local regulatory requirements. If borrow or disposal locations are off-site, they should also be permitted and have a copy of the permit authorization on-site at all times. This is necessary if the off-site borrow or disposal area is used for this construction project only and disturbs one acre or greater requiring permit coverage.

Outlets for Breaks and Diversions

Stabilized outlets should be provided for runoff from the disturbed area in order to retain sediment on-site.

Construction

Site Preparation

- Erosion and sedimentation control measures should be installed as specified and in the sequence shown on the design plan.
- Prior to excavation activities of any type, call1-800-DIG-RITE (344-7483) to obtain utility locations.
- Remove and stockpile topsoil (see Topsoiling) if subsoils will not support plant growth.
- Clear and grub areas to be filled and remove trees, vegetation, roots and other debris.
- Check fill to make sure it is does not contain brush, rubbish, oversized rocks or other objectionable material.
- Place fill in layers and compact as specified by the grading plan. Do not use frozen, excessively soft or high organic content material.
- Do not place fill on frozen subgrade, as it may cause an unstable condition due to potential differential settlement when the soil thaws.

Grading

- Construct slope breaks as shown on the grading plan, or in accordance with the recommendations of Table 6.1. A typical slope break is illustrated in Figure 6.14.
- Keep diversions and other water conveyance measures free of sediment during all phases of development.
- Avoid grading and building in areas of seepage. If this cannot be avoided, then install subsurface drains (See Subsurface Drains) in areas where seepage interferes with the grading operations, or where required to improve slope stability or soil bearing capacity.
- Permanently stabilize graded areas immediately after final grading is complete. Use temporary stabilization measures on graded areas when work is to be interrupted or delayed for 14 working days or longer.

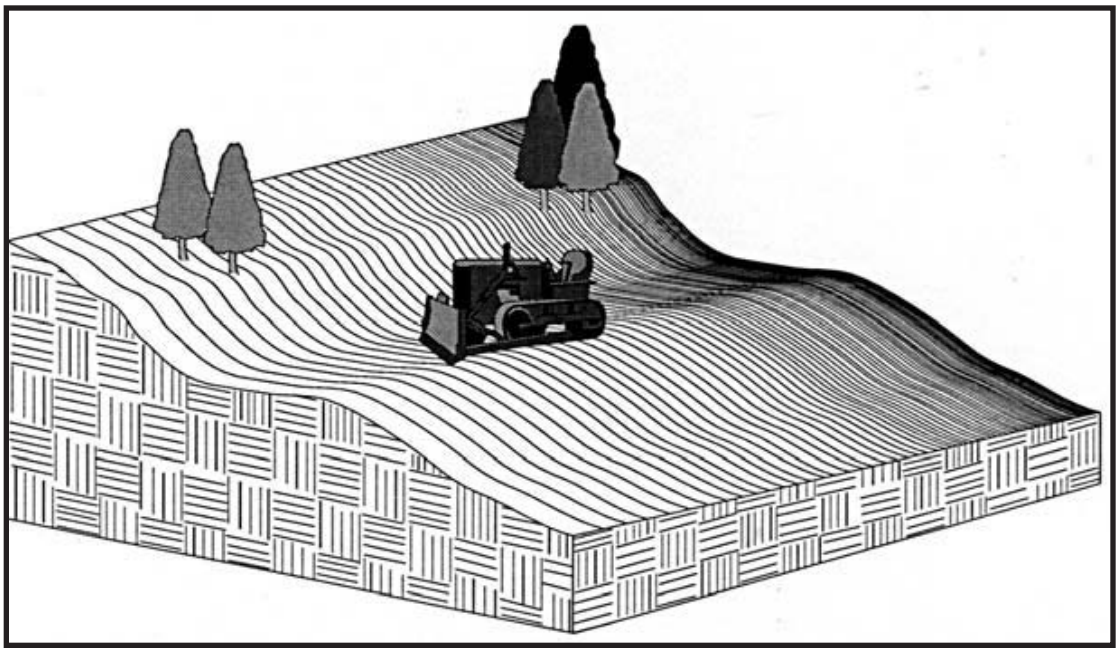


Figure 6.14 Typical Slope Break

Construction Verification

Check all finished grades for conformance with grading plan and correct as necessary.

Figure 6.15 Track walking with a dozer up and down the slope provides horizontal grooves to reduce stormwater flow volumes and velocity therefore reduces potential for erosion of the slope. Source: *ABC's of BMP's, LLC*

Maintenance, Inspection and Removal

- Periodically inspect all graded areas and the related erosion and sedimentation control practices, as required by the construction general permit, especially after heavy rainfalls. Clean sediment out of diversions and other structures as needed. If washouts or breaks occur, repair them immediately.
- Remove this is a temporary device and stabilize the site *Form H - Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Common Problems and Solutions

Problem	Solution
Variations in topography on-site indicate grading plan will be ineffective or unfeasible.	Consult with design professional
Seepage is encountered during construction.	It may be necessary to install drains. Dewatering shall be performed in accordance with regulatory requirements.
Design specifications for seed variety, seeding dates, erosion control materials or timeframes cannot be met.	Substitutions may be required. Unapproved substitutions could result in erosion and lead to failure of erosion control measures.
Prominent rill and gully erosion caused by slope breaks being too far apart.	Construct intermediate slope breaks.
Difficulties achieving proper compaction of fill caused by subgrade being soft, contains oversized rocks or has high organic content.	Undercut and replace unsuitable subgrade soil.
Slope is unstable or has reduced bearing capacity caused by a high water table	Install subsurface drains to lower water table.

Topsoiling: Removal, Stockpiling and Replacement

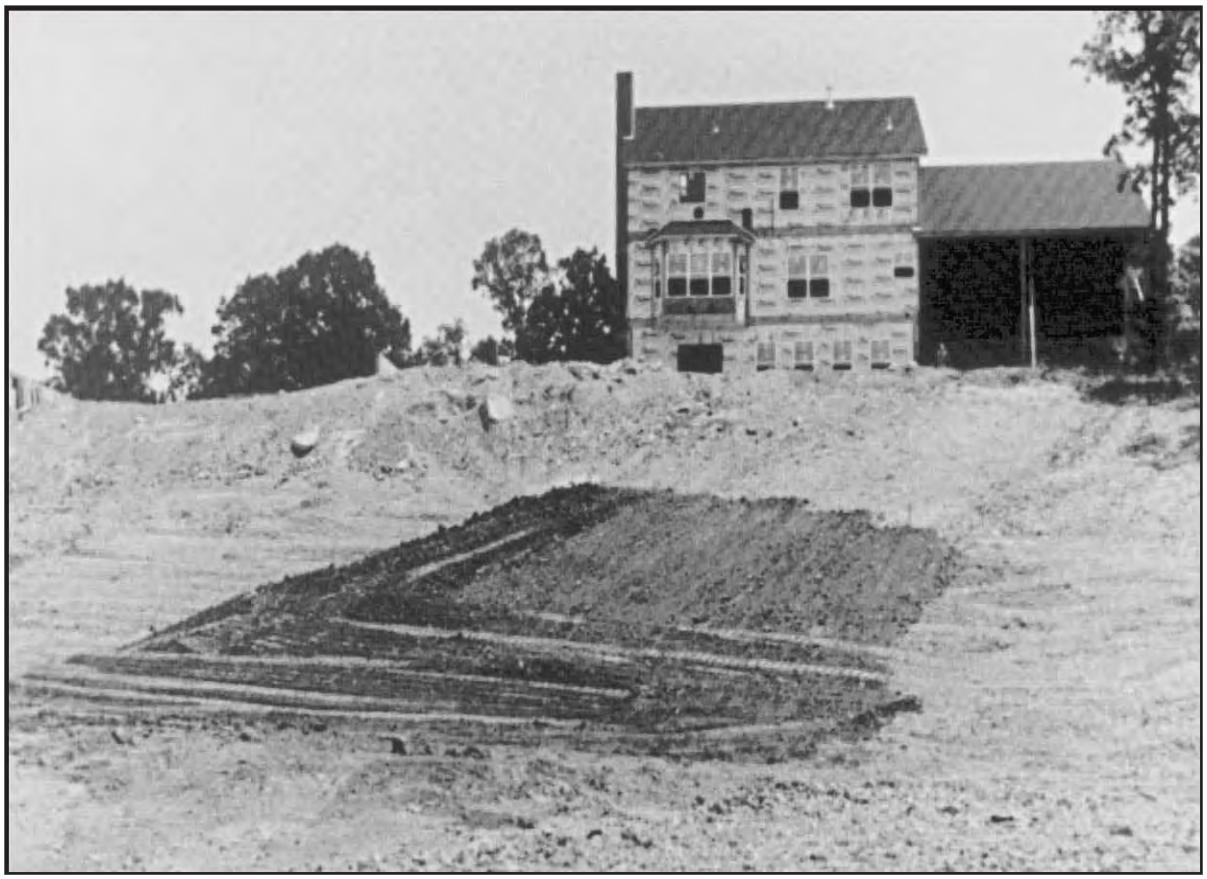


Figure 6.16 It's important to mix or incorporate topsoil with the underlying subsoil to prevent sloughing on sloping soils.
Source: *C. Rahm, NRCS. St. Louis Co.*

Practice Description

Topsoiling is a method of preserving the topsoil prior to construction, stockpiling it and using it after construction to help establish vegetation on a construction site. Stockpiling is also used for storage of other soils and construction material such as fill material. These practices apply to areas on a site to be disturbed by excavation, compaction or filling, and where vegetation is to be reestablished.

Recommended Minimum Requirements

Prior to the start of construction, topsoiling should be designed by a qualified professional. The existing soil should be tested to ensure the material to be saved is topsoil and helps with vegetation establishment and long-term, permanent growth. The location of other material to be stockpiled on the site should be shown on the site map and stabilized according to the regulations. Refer to the plans and specifications throughout the construction process.

Topsoil

- Surface soil or top layer of undisturbed soil, usually richest in organic matter and nutrients.
- Should be free of debris, trash, stumps, large rocks, roots and noxious weeds. It should contain no substance potentially toxic to plant growth.

Minimum Soil Depth

- 24 inches of total soil depth over bedrock (combined topsoil and subsoil); from 8- to 12-inches of total soil depth over loose sand or rock.
- The top 4- to 6-inches of soil must be good topsoil, rich with organic matter, microorganisms and not more than 50 percent clay content to ensure good vegetation establishment and growth on a permanent basis.

pH Range

- From 6.0 to 7.5.
- If the pH is less than 5.2, lime should be incorporated in accordance with soil test results.

Construction

Site Preparation

- Establish all perimeter erosion and sediment control practices, (e.g., sediment barriers, diversions, grade stabilization structures, berms, dikes, sediment basins) before stripping.

Stripping

- Strip topsoil from areas that will be disturbed by excavation, filling or compaction by equipment.
- Determine depth of stripping by taking soil cores at several locations within each area to be stripped.
- Make sure the soil being saved is topsoil. It should have a minimum of five percent organic material and a clay content of less than 50 percent.

Stockpiling

- Do not place topsoil or other stockpiles near areas of water (e.g., conveyances, ditches, swales).
- Do not place stockpiles on impervious surfaces or within 50 feet of storm drain inlets.
- Avoid placing topsoil or stockpiling other material on steep slopes. Side slopes of stockpile should not exceed 2:1.
- Use sediment fences or other barriers where necessary to retain sediment.
- Protect topsoil and other stockpiles with temporary seeding or other soil stabilization techniques as soon as possible, but not more than 14 working days after formation of the stockpile. If stockpiles will not be used within 12 months, they should be stabilized by permanent vegetation to control erosion and weed growth.

Grading

Established grades should be maintained according to the approved plan and should not be altered by adding topsoil.

Liming of Subsoil

Where the pH of the existing subsoil is below 5.2, incorporate agricultural limestone in amounts indicated by soil tests or specified for the seeding mixture to be used (See Temporary or Permanent Seeding). Incorporate lime into the subsoil to a depth of at least two inches by disking. Retest the soil to determine the pH and if pH is not 5.2 or higher, repeat the process.

Roughening

Immediately prior to spreading topsoil, loosen the subgrade by disking or scarifying to a depth of at least two inches to ensure bonding of the topsoil and subsoil.

Spreading Topsoil

- Spreading frozen or muddy topsoil can prevent proper grading or seeding. Uniformly spread topsoil to a minimum compacted depth of four inches. For long-term growth of vegetation without irrigation, minimum soil depth (subsoil and topsoil) should be 8- to 12-inches over loose sand or rock fragments, and 24 inches over bedrock.
- Prior to the establishment of final vegetation, the topsoil should be final graded so it is smooth with no clods greater than one inch in diameter.

Construction Verification

Verify that topsoil was spread evenly and incorporated with underlying subsoil.

Maintenance and Inspection

- Maintain erosion control devices over topsoil until vegetation is fully established with a density of 70 percent over the entire area.
- Inspect topsoiled areas frequently until vegetation is established.
- Repair eroded or damaged areas and revegetate.

Common Problems and Solutions

Problem	Solution
Poor or no vegetation establishment caused by topsoil pH too low.	Add agricultural limestone to adjust pH.
Poor or no vegetation establishment caused by topsoil containing sterilants or toxic chemicals.	Remove contaminated topsoil and replace.
Poor or no vegetation establishment caused by topsoil being too high in clay content or too low in organic material and microorganisms.	Add organic material.
Poor vegetation establishment caused by topsoil being compacted too much during application.	Loosen by disking or scarifying and reseed.
Poor drainage and possible sloughing on steep slopes caused by topsoil not properly bonded to subsoil.	Remove topsoil, roughen subgrade and respread topsoil.
Inadequate vegetation establishment caused by topsoil removed during construction and not replaced.	Add topsoil with a minimum of 5 percent organic material, a clay content under 50 percent, fertilize according to soil test results, reseed or sod site, and apply water to establish vegetation.

General Housekeeping Reminders

Some general reminders of information provided in this pollution prevention and good housekeeping section, include:

- An effort should be made to store only enough product to do the job. All materials stored on-site should be stored in a neat, orderly manner in their appropriate containers and, if applicable, under a roof or other enclosure.
- Products should be kept in their original containers with the original manufacturer's label. If a replacement container is used, it must be clearly labeled and the original label retained.
- Whenever possible, all of a product should be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal of contents and containers must be followed. Refer to the Material Safety Data Sheets.
- The site superintendent should inspect daily to ensure proper usage, storage and disposal of materials.
- Fertilizers need to be applied only in the minimum amounts recommended by the manufacturer.
- All paint containers need to be tightly sealed and stored when not required for use. Excess paint may not be dumped into the storm sewer system but should be properly disposed of according to manufacturer's instructions, Material Safety Data Sheets and State and local regulations. (See Petroleum and Hazardous Waste Management). Non hazardous non bulk household products are allowed by regulation to be disposed of sanitary landfills. However, landfill operators may impose more stringent restrictions. Contact the local government for more information and refer to Solid Waste Management.
- Disposal of waste oil. If used oil has come into contact with hazardous materials, it is considered to be waste oil. It must be disposed of according to hazardous waste regulations. (See Petroleum and Hazardous Waste Management).
- Used oil (non hazardous) should be disposed of at the nearest used-oil recycling center. For more information, check with the local government and refer to the Missouri Solid Waste Management webpage at www.dnr.mo.gov/env/swmp/index.html or call 800-361-4827.
- Mudtracking is a common problem at construction sites. Refer to Site Preparation for proper exit pad installation and maintenance.

SECTION 3: SURFACE STABILIZATION - EROSION CONTROLS

Temporary Seeding

Figure 6.24 Temporary vegetation is a relatively inexpensive way to stabilize construction sites in a hurry. As grass grows, the roots hold soil in place and the plant protects the soil surface from raindrop impacts. Source: N. Klopfenstein, NRCS. St. Charles Co.

Practice Description

Temporary seeding is the establishment of fast-growing annual vegetation to provide economical erosion control for up to 6 months and reduce the amount of sediment moving off the site. Annual plants that germinate rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover.

This practice applies where short-lived vegetation needs to be established before final grading or in a season not suitable for permanent seeding.

Recommended Minimum Requirements

A qualified professional should specify plant materials, seeding rates and times of planting. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. To ensure emergence, vigorous growth of seedlings and continued plant growth, prepare the seedbed and add soil amendments according to soil tests. Protect the soil and seed with mulch or other erosion control until the vegetation is fully established to a density of 70 percent over the entire vegetated area.

Soil
Make sure there is a minimum of three inches of topsoil with a sufficient percentage of organic material to sustain vegetative growth.

Seedbed Preparation
Loosen soil to depth of 3-inches for broadcast seeding or drilling. If compacted, loosen soils for no till drilling. Avoid excessively wet conditions.

Amendments
Incorporate fertilizer and lime (if soil pH is less than 5.3) incorporated 3- to 6-inches into the soil. See Table 6.2.

Seed Quality
Use certified seed, tested within the past nine months.

Plants
Select recommended temporary erosion control plant species. Rate of application and seeding dates are listed in Tables 6.3 and 6.4.

Erosion Control
Cover the seeded area with approved mulching materials or other erosion control devices to protect the soil and seed until vegetation is fully established.

General
Inspect seeded areas 2 to 4 weeks after seeding for seed germination, vegetation establishment, erosion control and weed control. Repair and reseed as necessary.

Reseed
After six months if the site is not in permanent vegetation over the entire disturbed area to a density that impedes erosion.

Installation
Successful vegetative establishment is directly dependent on the nutrients in the soil. For optimum results, take soil samples from the top 6-inches in each area to be seeded. Submit samples to a soil testing laboratory for liming and fertilizer amendment recommendations.

Seedbed Preparation
- Seedbed preparation is essential for the seed to germinate and grow.
- For broadcast seeding and drilling, loosen the soil to a depth of approximately 3-inches.
- For no-till drilling, the soil surface does not need to be loosened unless the site has surface compaction.
- Use a disk, ripper, chisel, harrow or other acceptable tillage equipment to loosen compacted, hard or crusted soil surfaces. Avoid preparing the seedbed under excessively wet conditions.

Liming
- Acid soils with an extremely low pH can prevent seeding success. However, most of the recommended temporary vegetation is tolerant of low pH soils and will establish on all but the lowest pH soils.
- If soil pH in the region is known to be extremely low, conduct a soil pH test to determine if limestone is necessary for temporary seeding. Amend soils with lime according to information in Table 6.2. Soils with a pH above 7.0 should not be limed.

Table 6.2 Liming Requirements for Temporary Sites

pH Test	Plant Response	Recommended Application of Agricultural Limestone
Below 6.0	Poor growth	Lime according to soil test
6.0 - 6.5	Adequate growth	No lime recommended
Greater than 6.5	Optimum	No lime recommended

Fertilizer

- The soil will most likely be deficient in nutrients required for growth. A soil test will provide the best guide for the amount and types of fertilizer to apply for optimum plant growth.
- A general recommendation is to broadcast Ntirogen, Phosphorus and Potassium at 90 lbs./acre for areas receiving more than 30 inches of precipitation and 50 lbs./acre in areas receiving less than 30 inches of precipitation.

  For example, to compute the bulk pounds of product to use - For 100 pounds of a 10-10-10 fertilizer mix you have 10 percent or 10 pounds of actual Nitrogen, Phosphorus and Potassium. The remaining 70 percent or 70 pounds of product in the bag is inert material that improves application consistency. You would need to apply 900 pounds of product per acre to provide 90 pounds of actual Nitrogen per acre.
- For best results incorporate the fertilizer into the top 3- to 6-inches before seeding.

Seeding

- Apply seed evenly with a broadcast seeder, drill, cultipacker seeder or hydroseeder. Plant small grains no more than 1½ inches deep. Plant grasses and legumes no more than ½ inch deep.
- Prior to mulching, harrow, rake or drag a chain to lightly incorporate broadcast seed into the soil to enhance germination. Cover applied seed with mulch (See Mulching).

Table 6.3 Temporary Seeding Plant Materials and Minimum Seeding Rate *

Species	Seeding Rate		Plant Characteristics
	lbs. per Acre	lbs. per 1,000 ft.^{2}	
Oats	80 lbs.	2 lbs	Not cold tolerant, height up to 2 feet
Cereals: Rye/Wheat	90 / 120	2 / 2.5	Cold tolerant, height up to 3 feet, low pH tolerant
Millets, Sudangrass	45 / 60	1 / 1.25	Warm season annual, aggressive growth, height up to 5 feet
Annual Ryegrass	75	2	May be added to mix, not heat tolerant, height up to 16 inches
Annual Lespedeza** plus Tall Fescue	15 plus 45	0.5 plus 1	Warm season annual legume, makes own nitrogen, tolerated low pH

* In areas receiving less than 30 inches of precipitation, use 75 percent of these rates.

** If there is any possibility the seeding will be required to control erosion for more than one year, then consider the addition of fescue or another permanent species as part of a mixture when seeding.

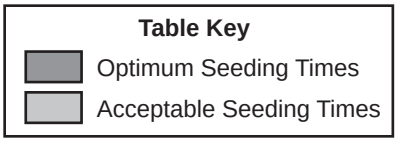
Planting Dates

- Plant according to the design plan. In absence of a plan, choose a recommended temporary species or mixture appropriate for the season from Tables 6.3 and 6.4.
- Plant during optimum seeding dates if at all possible. Always use mulch or other erosion control practices to cover and protect seed and soil during vegetation establishment. Roll and cultipack broadcast seed for good soil-to-seed contact.
- Use high quality seed and for best results, use certified seed. When using uncertified seed, use the highest recommended seeding rate.

Table 6.4 Seeding Dates for Temporary Seeding

Species	Seeding Dates Optimum and Acceptable											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oats												
Cereals: Rye/Wheat												
Millets, Sudangrass												
Annual Ryegrass												
Annual Lespedeza plus Tall Fescue[1]												

[1] If site may not be developed within one year, consider permanent species listed in Table 6.5.



Mulching

- Mulching conserves moisture and reduces erosion during seed germination and vegetation establishment.
- Evenly cover a minimum of 75 percent of the ground surface with mulch material specified in the design plan. Tack or tie down the mulch according to plan (See Mulching).

Construction Verification

Check materials and installation for compliance with specifications.

Maintenance and Inspection

- Check temporary seeding during each weekly inspection to monitor germination, growth and to see if stands are of adequate thickness (more than 70 percent density of the ground surface vegetation over the entire area to be stabilized). Stands should be uniform and dense for best results. Fertilize, reseed and mulch bare and sparse areas immediately to prevent erosion.
- Mowing is not recommended for cereals seeded alone. Cereals seeded with a grass can be mowed when height is greater than 12-inches. However, to prevent damage to grasses, do not mow shorter than 4-inches.
- Mow millets and sudangrass before height is greater than 6-inches to allow regrowth and continued erosion protection.
- Annual lespedeza and tall fescue may be mowed after height exceeds 8-inches. Do not mow shorter than 4-inches.
- Replant temporary or permanent vegetation within 12 months as annual plants die off and no longer provide erosion control (see Permanent Seeding). Consider no-till planting

where possible.

Common Problems and Solutions

Problem	Solution
Design specifications for seed variety, seeding dates or mulching cannot be met.	Substitutions may be required. Unapproved substitutions could lead to failure.
Vegetation is not sustainable as a permanent cover caused by a lack of topsoil resulting in a lack of organic material, nutrients and water holding capacity.	Add topsoil with a minimum of three percent organic material.
Poor seedling emergence and growth with erosion of the soil caused by inadequate seedbed preparation.	Repair gullies, prepare seedbed, fertilize, lime (if necessary), mulch and reseed.
Unsuitable choice of plant materials; resulting in poor germination or inadequate stand (less than 70 percent of the ground surface covered).	Choose plant materials appropriate for season, prepare seedbed and replant.
Poor or spotty stands of vegetative cover caused by inadequate mulching, washing away of the seed and erosion of the soil surface.	Poor plant vigor, yellow color and short height caused by a lack of nitrogen - add 50 lbs. of nitrogen fertilizer per acre. Do not apply over the top of existing plants from June 1 to Aug. 15 or on frozen ground.
Poor plant vigor, yellow color and short height caused by a lack of nitrogen.	Add 50 lbs. of nitrogen fertilizer per acre. Do not apply over the top of existing plants from June 1 to Aug. 15 or on frozen ground.
Dying plants caused by a lack of topsoil or soil compaction that limits root growth and water availability to plants.	Add organic material and loosen soil if reseeding is necessary or before seeding permanent vegetation.

Permanent Seeding

Figure 6.25 Permanent vegetation can be used to stabilize many structures, such as this grassed waterway, ensuring that runoff is relatively sediment-free.

Practice Description

Permanent seeding is the establishment of perennial vegetation on disturbed areas for periods longer than 12 months. Permanent vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used when vegetation is desired to permanently stabilize the soil or if future phases of a construction site will remain dormant for a significant period of time after grading. It is necessary to protect earthen structures such as dikes, channels and embankments. Particular care is required to establish a good, thick cover of permanent grass.

Recommended Minimum Requirements

A qualified professional should specify plant materials, seeding rates and times prior to start of construction. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. To ensure germination and growth, prepare seedbed, add soil amendments according to soil tests, mulch all seeded areas and follow the seeding dates.

Seedbed Preparation

For broadcast seeding or drilling, loosen soil to depth of 3-inches. For no till drilling, loosen the soil if it's compacted. Avoid excessively wet conditions.

Soil Amendments

Incorporate fertilizer and lime (if soil pH is less than 6.0) incorporated 3- to 6-inches into the soil.

Seed Quality
Use certified seed, tested within the past 9 months.

Planting Dates
Coordinate the construction schedule with planting dates appropriate for region and species (See Table 6.5).

Plants
Select from recommended erosion control plants (grass or grass/legume mixtures) as shown in Tables 6.5 and 6.6. Rate of application and seeding dates are shown in Tables 6.4, 6.7 and 6.8.

Mulch
Cover a minimum of 75 percent of the ground surface with approved material (See Mulching).

Inspection
Inspect seeded areas during each weekly inspection. Repair and reseed as necessary.

Installation
During final grading, take soil samples from the top 6-inches in each area to be seeded. Submit sample to a soil testing laboratory for liming and fertilizer recommendations.

Seedbed Preparation
- Seedbed preparation is essential for the seed to germinate and grow.
- For broadcast seeding and drilling, loosen the soil to a depth of approximately 3-inches.
- For no-till drilling, the soil surface does not need to be loosened unless the site has surface compaction.
- Loosen compacted, hard or crusted soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment.
- Avoid preparing the seedbed under excessively wet conditions.

Liming
- Follow the recommendations resulting from the soil test. Apply ground agricultural limestone unless a soil test shows a pH of 6.5 or greater.
- Incorporate lime into the top 3- to 6-inches of soil.
- Do not add lime if the pH is 7.0 or greater.

Fertilizer
Remember: Phosphorus helps roots grow and develop to get the grass plants established. Nitrogen will only be taken up after the seed has germinated and the vegetation is growing. It may wash down stream if applied heavily during seeding.

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.

For establishment and long-term growth, apply a complete fertilizer at rates recommended by soil tests or as specified in the design plan. In the absence of soil tests, use the following as a guide:

- A typical fertilizer blend for lawn grass mixes: Apply 10-24-18 which represents 10 percent of actual nitrogen – 24 percent of actual phosphorus and 18 percent of actual potassium within the fertilizer compound. If you had 100 pounds of a 10-24-18 blend you would have 10 pounds of actual nitrogen, 24 pounds of actual phosphorus and 18 pounds of actual potassium within the bag.

- A typical application rate of fertilizer for initial establishment of vegetation after seeding is approximately 1 pound of actual nitrogen per 1,000 square feet. With the 10-24-18 fertilizer this would require the application of approximately 435 pounds of this fertilizer mix per acre since there are 43,500 square feet in an acre. This fertilizer would also provide more than 2 pounds of phosphorus per acre.
- Incorporate lime and fertilizer to a depth of 3- to 6-inches by disking or chiseling on slopes of up to 3:1.
- Grade soil to a smooth firm surface to enhance rooting of seedlings and reduce rill erosion.
- Subsequent fertilization with an additional 2 pounds per 1,000 square feet of actual Nitrogen approximately one month after initial seeding will help grass growth after germination to achieve the density of vegetation to prevent or minimize erosion. A typical fertilizer for a second application once vegetation is established would be a 20-10-5 mix at 435 pounds of fertilizer per acre.

Plant Selection

If not specified in the design plan, choose a suitable species of grass or a grass/legume mixture from Tables 6.5 and 6.6 appropriate for the season. Consider site conditions including soils, plant characteristics, region of the state and desired level of maintenance. The species shown are adapted for lawns and erosion control. If there are questions on species selection and how they may be adapted in wildlife habitat or wetland applications, contact your local Natural Resources Conservation Service or Extension office.

Developing a Mixture

A pure stand of grass provides the best erosion control. The advantage of a grass/legume mix is the legume provides nitrogen to the grass and often grows during hotter and drier months when the grass is dormant. Usually one grass and one or two legumes is sufficient in a mixture. More grasses can be mixed together, but may be of little use. Refer to Tables 6.5 and 6.6 for information about each grass and legume to determine the correct species for your site.

Nurse Crops (Temporary or Annual Species)

Nurse crops are temporary grains that have one growing season such as wheat, rye and oats and are sometimes used in a seeding mixture. These annuals can reduce weeds, control erosion and provide protection to young seedlings until the perennial species become established.

Plant nurse crops about 1-inch deep. Most permanent grasses and legumes are sown 1/4 inch deep. Permanent seedings should not be planted deeper than ¼ to ½ inch.

Aesthetic Plantings

A wide variety of native forbs and grasses are available that add diversity and beauty to permanent plantings (e.g., switchgrass as an accent). Contact your local Natural Resources Conservation Service office for species selection and seeding rates.

Planting Dates

If seeding dates are not specified in the design plan or construction has not proceeded according to schedule, use the seeding calendar shown in Table 6.5.

Plant during optimum seeding dates if at all possible. Always use mulch or other erosion control measures to protect the seed and reduce erosion until the vegetation is established. For dormant seeding dates, broadcast seed and immediately roll and cultipack for good soil-to-seed contact.

If unable to seed according to schedule, use temporary seeding until the preferred date for permanent seeding.

Seeding Rates

If seeding rates are not specified in the design plan, use rates in Table 6.8 for grasses alone. Use rates in Table 6.9 for a grass or legume mixture. These rates are based on the poor growing conditions that typically exist on a development site, a need for dense growth and high germination rates.

For best results use certified seed. When using uncertified seed, use the highest recommended seeding rate. Higher seeding rates will not substitute for good seedbed preparation.

- Apply seed uniformly using a cyclone seeder, drop-type spreader, drill, cultipacker seeder or hydroseeder.
- When using a drill seeder, plant rye or other grains about 1-inch deep; plant grasses and legumes no more than ½ inch. Calibrate equipment in the field.
- Cover seed by raking, or dragging a chain, brush or mat. Then firm the soil lightly with a roller. Seed can also be covered with hydro-mulched wood fiber and tackifier or a rolled erosion control product.
- Legumes require inoculation with nitrogen-fixing bacteria to ensure good growth. Purchase inoculum from seed dealer and mix with seed prior to planting.

Table 6.5 Planting Dates Optimum and Acceptable* Planting Dates

Species	Seeding Dates Optimum and Acceptable											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Turf Fescue		*	*		*			*		*		
Tall Fescue		*	*		*			*		*		
Kentucky Bluegrass		*	*		*			*		*		
Perennial Ryegrass		*	*		*			*		*		
Ryetop		*	*		*			*		*		
Reed Canary		*	*		*			*		*		
Bermuda - Common				*			*					
Bermuda- Hybrid				*			*					
Buffalograss[1]			*	*			*					
Zoysia2				*			*					
Birdsfood Trefoil	*	*	*									
Common Lespedeza			*									
Red Clover	*	*	*					*				
White Clover	*	*	*					*				
Wheat/Rye[3]	*							*				
Oats[3,4]		*						*	*			

[1] Can also be sprigged.

[2] Usually sprigged. Space plugs every 6-, 8- or 12-inches; with 4,000, 2,250 or 1,000 sprigs/1000 ft^2 respectively.

[3] Check with your local Noxious Weed Department before planting.

[4] Nurse crop only.

[5] Provides a quick temporary cover or nurse crop even if planted in the fall.

Table Key

Optimum Seeding Times

* With Mulch Cover - Acceptable Seeding Times

Table 6.6 Plant Characteristics

	Species	Kansas Adaptation	Missouri Adaptation	Maintenance	Fertility Needs	Establish-ment Ease
				L - M - H	L - M - H	P - M - G
Cool Season Grasses	Perennial ryegrass	E, C, W*	N, S	L	M	M
	Canada wildrye	E, C, W	N, S	M	L	G
	Tall fescue	E, C, W*	N, S	M	L - H	G
	Crested wheatgrass	E, C, W	N	M	L	M - G
	Kentucky bluegrass	E, C, W*	N, S	H	M - H[1]	M - G
	Bromegrass	E, C, W*	N, S	M	M - H[1]	M - G
	Redtop	S½ E	N, S	L	L	M
	Reed canary[1]	E, C, W*	N, S	H	L - M[3]	P
Warm Season Grasses	Common Bermuda	E, C, W*	S	L	L - M	M
	Hybrid Bermuda	E, C, W*	-	L	L - M	M
	Buffalograss[3]	E, C, W*	N, S	L	L	M
	Blue grama	E, C, W*	N, S	L	L	M
	Zoysia[4]	E, C, W*	-	M	M - H	M
	Sideoats grama	E, C, W*	N, S	M	L	G
	Little bluestem	E, C, W*	N, S	M	L	M
	Big bluestem	E, C, W*	N, S	M	L	M
	Indiangrass	E, C, W*	N, S	M	L	M
	Switchgrass	E, C, W*	N, S	M	L	M
Legumes[5]	Birdsfoot trefoil	E, C, W*	N, S	L	M	P - M
	Crownvetch	E, C, W*	N, S	M	M	P - M
	Annual lespedeza[6]	E, C, W*	N, S	M	M	P - M
	Red clover	E, C, W*	N, S	M	M	G
	White clover	E, C, W*	N, S	L	M	M - G
	Alfalfa	E, C, W*	N, S	M	L	P
Companion Crops/Cereal Grains	Wheat	E, C, W*			M	M
	Rye (cereal)	E, C, W*			M	M
	Oats	E, C, W*			M	M

* Adaptation limited to areas that receive additional moisture enhancement by irrigation, subirrigation or overland flow.

[1] Will be high maintenance in lawn – type or low rainfall (<30") settings.

[2] Adapted to shorelines, wet or frequently flooded areas.

[3] Responds well to fertilizer, but doesn't necessarily require it.

[4] Usually seeded, by can be sprigged.

[5] Usually sprigged, plugged or sodded.

[6] Legumes alone will not provide adequate erosion protection: use with a grass in a mixture.

[7] Will reseed each year if not mowed until after seed shatter in September.

Table Key

L = low
M = moderate,
H = high.
P = poor,
G = good.

Table 6.7 Species Tolerance for Environmental Conditions

Species		Tolerance				
		Shade	Drought	Flooding	Traffic	Soil Wetness
Cool Season Grasses	Perennial ryegrass	L	L	M	M	M
	Canada wildrye	M	M	L	M	P
	Tall fescue	M	M	M	M	P
	Crested wheatgrass	L	H	M	M	G
	Kentucky bluegrass	L	L	M	H	G
	Bromegrass	L	M	L	H	M
	Redtop	L	L	M	H	G
	Reed canary	L	M	H	H	G
Warm Season Grasses	Common Bermuda	L	H	H	H	M
	Hybrid Bermuda	L	H	H	H	M
	Buffalograss	L	H	H	H	G
	Blue grama	L	H	L	M	P
	Zoysia	L	H	M	H	P
	Sideoats grama	L	H	M	H	M
	Little bluestem	L	H	L	L	P
	Big bluestem	L	H	M	L	M
	Indiangrass	L	M	L	M	P
	Switchgrass	L	M	M	M	G
Legumes[5]	Birdsfoot trefoil	L	H	L	M	G
	Annual lespedeza	L	L	M	L	M
	Red clover	L	L	L	M	P
	White clover	L	L	L	H	M
	Alfalfa	L	L	L	L	P

1 Legumes alone will not provide adequate erosion protection: use with a grass in a mixture.

Table Key

L = Low
M = Moderate
H = High
P = Poor
G = Good

Table 6.8 Seeding Rates

Species		Kansas: Full Seeding Rate[1]	Missouri: Full Seeding Rate[1]
		lbs./acre (PLS)[2]	lbs./acre (PLS)[2]
Cool Season Grasses	Perennial ryegrass	150	150
	Canada wildrye	21	24
	Tall fescue	150	150
	Crested wheatgrass	20	16
	Kentucky bluegrass	120	120
	Bromegrass	100	100
	Redtop	8	8
	Reed canary[1]	40	40
Warm Season Grasses	Common Bermuda	2	4
	Hybrid Bermuda	20 bu./acre	-
	Buffalograss[3]	8 (grain)	8 (grain)
	Blue grama	3	6
	Zoysia[4]	20 bu./acre	-
	Sideoats grama	15	15
	Little bluestem	9	13
	Big bluestem	17	16
	Indiangrass	12.5	16
	Switchgrass	8	9
Legumes[5]	Birdsfoot trefoil	5	10
	Annual lespedeza[6]	14	16
	Red clover	8	12
	White clover	3	4
	Alfalfa	9	9
Companion Crops	Wheat	1 bu./acre	1 bu./acre
	Rye (cereal)	1 bu./acre	1 bu./acre
	Oats	1.5 bu./acre	1.5 bu./acre

[1] Note: Rates based on typical construction site conditions where seedbed is normally less than ideal. Planned future use or specific site conditions may dictate an increase or a decrease in rates. Contact your local Natural Resources Conservation Service office or consulting agronomist for specific seeding rates within your county.

[2] PLS or Pure Live Seed = the amount of seed guaranteed to grow.

[3] Legumes alone will not provide adequate erosion protection: use with a grass in a mixture.

Table 6.9 Example Seeding Mixtures for Critical Area Seeding

Grass - Legume Mixture	Seeding Rate (PLS) *	
	lbs./1000 ft.^{2} ***	lbs./acre
Reed canarygrass / White clover	5 + 0.1	40 + 1
Reed canarygrass / Red clover	5 + 0.25	40 + 2
Tall fescue** / Birdsfoot trefoil	10 + 0.25	80 + 2
Tall fescue** / White clover	10 + 0.1	80 + 1
Tall fescue** / Lespedeza	10 + 0.5	80 + 4
Tall fescue** / Lespedeza / White clover	10 + 0.25 + 0.1	80 + 4 + 1
Tall fescue** / Red clover	10 + 0.25	80 + 2
Tall fescue** / Red clover / White clover	10 + 0.25 + 0.1	80 + 2 + 1
Kentucky bluegrass / White clover	3 + 0.1	25 + 1
Kentucky bluegrass / Red clover	3 + 0.25	25 + 2
Kentucky bluegrass / Birdsfoot trefoil	3 + 0.25	25 + 2
Kentucky bluegrass / Lespedeza	3 + 0.5	25 + 4
Perennial ryegrass / Red Clover	8 + 1	70 + 10
Perennial ryegrass / Birdsfoot trefoil	8 + 0.5	70 + 5
Perennial ryegrass / Lespedeza	8 + 3	70 + 25
Big bluestem / Indiangrass / Switchgrass / Sideoats grama / Western Wheatgrass	-	3.4 + 2.5 + 2 + 3 + 4
Wheat / Rye (as nursery crop)	1.5	60
Oats (as nursery crop)	0.75	30

* PLS or Pure Live Seed = the amount of seed guaranteed to grow. To calculate amount of bulk seed needed: Read seed tag and multiply % purity X % germination = % PLS; then divide lbs of PLS recommended by % PLS. Example: 30 lbs of Reed canary is needed to seed a 1 acre waterway; 90% pure X 90% germination = 81% PLS; 30 lbs PLS / .81 = 37 lbs. bulk seed needed.

** Turf fescue may be substituted for fescue at the same rates.

***Note: Use lbs. / 1,000 ft.^{2} rate to establish dense vegetation for lawns.

Erosion Control

- Mulching or a rolled erosion control product is recommended to conserve moisture, reduce erosion and protect the seed.
- Cover at least 75 percent of the area with approved mulch materials. Crimp, tack or tie down mulch with netting. Mulching is extremely important for successful seeding (See Mulching).

Construction Verification

Check materials and installation for compliance with specifications.

Maintenance and Inspection

- Inspect seeded areas weekly and after rain events. Check for erosion and seed wash out.
- Expect emergence of grasses and legumes within 28 days after seeding, with legumes following grasses.
- Check permanent seeding at each regular weekly inspection. Look for:
  - Germination.
  - Vigorous seedlings.
  - Uniform density with at least 70 percent of the ground surface covered.
  - Uniformity with nurse plants, legumes and grasses well intermixed.
  - Green, not yellow, leaves. Perennials should remain green throughout the summer, at least at the plant bases.

Reseeding

- Inspect seedings for die out for at least a year. Inspect the soil for erosional areas. To repair bare and sparse areas, fill gullies, refertilize, reseed and mulch. Consider no-till planting where possible.
- If stand is inadequate or plant cover is patchy, identify the cause of failure and take corrective action (e.g., choice of plant materials, lime and fertilizer quantities, poor seedbed preparation, lack of topsoil or weather.) If vegetation fails to grow, have the soil tested to determine whether pH is in the correct range or nutrient deficiency is a problem.
- Depending on stand conditions, repair with complete seedbed preparation, then overseed or reseed.
- If it's the wrong time of year to plant desired species, overseed with cereal grain or millets to thicken the stand until timing is right to plant perennials or use temporary seeding.

Fertilization

Satisfactory establishment may require refertilizing the stand in the second growing season.

- Do not fertilize cool season grasses in late May through July.
- Grass that looks yellow may be nitrogen deficient. An application of 500 lbs of 10-10-10 Nitrogen, Phosphorus, and Potassium per acre in early spring will help cool season grasses compete against weeds or grow more successfully.

Remember to convert actual pounds of nutrient needed when determining how many pounds of commercial fertilizer to buy.

- Do not use nitrogen fertilizer if stand contains more than 20 percent legumes.

Mowing

- Consider mowing after plants reach a height of 6- to 8-inches.
- Mow grasses tall, at least 3-inches in height and minimize compaction during mowing process.
- Monitor the late winter and early spring growth of nurse crops to be sure that they do not smother the permanent seeding. Mowing in April may reduce the competitiveness of the nurse crop and open the canopy to allow more sunlight to permanent seedlings that are beginning to grow.
- Vegetation on structural practices such as embankments and grass-lined channels need to be mowed only to prevent woody plants from invading.

Troubleshooting

Consult with design professional if the following occurs:

- Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Common Problems and Solutions

Problem	Solution
Poor stand of vegetation caused by inadequate topsoil.	Apply good topsoil with a minimum of 5 percent organic material and reseed.
Poor stand of vegetation caused by inadequate seedbed preparation.	Prepare well-tilled, limed and fertilized seedbed and reseed.
Vegetative stand failures caused by unsuitable choice of plant materials such as seeding Bermuda grass in the north or in the fall.	Select an appropriate species based on plant characteristics in Tables 6.8 and 6.9 and time of seeding.
Perennial vegetation overtaken by nurse crop with too high seeding mixture.	Limit rates to those shown in Table 6.9; eliminate old nurse crop, prepare seedbed and reseed.
Inadequate stand of vegetation caused by seeding at the wrong time of the year.	Consult Table 6.5 and reseed. If timing is not right, use temporary seeding to stabilize soil until preferred seeding dates.
Inadequate stand of vegetation, bare spots or eroded areas caused by inadequate mulching.	Prepare seedbed, reseed, cover seed evenly and tack or tie down mulch, especially on slopes, ridges and in channels (see Mulching).

Hydroseeding

Figure 6.26: Hydroseeding over matt armoring on a steep slope to promote vegetation growth and prevent erosion.
Source: *Florida Erosion and Sediment Control Designer and Reviewer Manual*, June 2007

Hydroseeding is the application of a mixture of water, wood fiber (this could be paper or a 70/30 blend of wood fiber and paper), seed, fertilizer, and a soil stabilizer to temporarily and permanently protect exposed areas of soil from erosion due to wind, rain, and runoff. It is a way to establish grass where grass is the desired cover. This method is most often used in large-scale projects such as highway projects or steep slope areas where straw, sod and blankets are more challenging to use.

Hydroseeding is applied with a mechanical machine. Highway departments often use a boom machine with hoses that can shoot up to 100 feet or more, using soil stabilizers in the seed mix.

For most effective coverage, exposed soil surface should be loose (uncompacted) at time of application. Soil areas can be roughened by rolling the surface with a crimping or punching-type roller or by track walking to increase the soil surface area available for seeding. For best results, cover hydroseed layer (seed with soil stabilizer if used) with a mulch layer to keep applied seeds in place, retain soil moisture, and control soil temperature during seed establishment. The mulch acts as a blanket to protect the seed from wind and erosion.

Fertilizers should be included only when soil tests indicate a lack of adequate nutrients to establish and sustain the selected vegetation. However, there is much debate about whether starter fertilizers should be used at time of seeding. The important factor is to have adequate organic matter in the soil bed so that fertilizing is not necessary. Typically by time the seed

germinates and starts to develop a root system, about 25 percent of the fertilizer has leached out or washed away except when one is using a “cross-linked polymer” or so called “water retention polymer”. The other exception is when you are using a growth stimulator that will increase germination therefore allowing more of the starter fertilizer to still be in the soil. There are also other options to using fertilizers, such as guar, biostimulants and other root inoculants.

- The application of a soil binder may be necessary to further stabilize hydraulic mulch and seed to allow for germination and continued growth of vegetation. Soil binders in this case are sold as a tackifier and dust palliative all in one – not soil specific. The soil binder reacts with the soil, binding the mulch, seed, fertilizer, and other additives to the soil, holding it together until vegetation is established. Open weave matting can be applied before hydroseeding areas, especially in areas with steep slopes or sandy conditions, to provide additional structural support, creating a highly erosion-resistant surface to support vegetation establishment. There are also additive products available that have a fibrous material in them to create the same high performance bonding of soil, seed and mulch which is may be cheaper and more efficiently applied through the hydroseeder. See precautions on WCCs under Chemical Application for Turbidity Reduction.

Loading of soil binders and other additives should be done in accordance with machine manufacturer procedures. The hydroseed mix should be applied to the soil as soon as possible following the loading of additives. Otherwise, slurry may become too thick, and the machine could become clogged – wasting time, product and money. Straw, mulch, matting, or jute cover may be applied over the hydroseed application to further promote the vegetation and prevent erosion, but if too thick, the sun, oxygen and water cannot penetrate into the seed/soil.

Installation

- While construction activities are occurring.
- After construction activities are completed.
- Avoid application of hydroseed on existing vegetation, water bodies, sidewalks and roadways. Hydroseeding should not be used in areas where re-disturbance is expected within four to six weeks.
- In a manner that avoids overspray into water bodies, on sidewalks, and on roadways, where the products can end up polluting the water ways.
- Using appropriate hydroseeder equipment.
- Contact the local street department or the state transportation department for more information.

Inspected

- Inspect area at installation to ensure area is properly covered, and receiving waters are properly protected.
- Inspect area after a precipitation event and/or heavy wind for any removal of vegetation, mulch, or other stabilization material.

Maintenance Activities

- Repair coverage and re-apply hydroseed material as needed to maintain maximum protection against erosion.
- If plant seeds fail to germinate, or established plants die, area must be re-seeded. Consult with product distributor or SWPPP preparer for troubleshooting application problems.
- If the desired permanent seeding type is different from the temporary seed, temporary seeding may have to be removed prior to the application of permanent seeding

Slope Breaks and Surface Roughening

Figure 6.13 Lot benching can shorten slope length and prevent erosion while improving the homeowner's yard. Source: *C. Rahm, NRCS, St. Charles County*

Practice Description

Slope breaks and surface roughening are practices that reshape the ground surface during construction to slow the surface overland stormwater flow and reduce slope length to reduce surface runoff velocities, therefore minimizing soil erosion and sedimentation during construction. Slope breaks and surface roughening are inexpensive ways to provide erosion control during construction prior to establishment of permanent vegetative cover.

Slope breaks, such as diversions or benches, can be used to reduce the length of continuous slopes and reduce erosion (See Diversions).

Recommended Minimum Requirements

Prior to start of construction, the site grading plan should be designed by a qualified professional. The grading plan should show disturbed areas, cuts, fills and finished elevations for all graded areas. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. During construction and reshaping of the topography a slope can be roughened once it has been graded out and prior to reaching final grade and vegetation establishment.

Schedule construction activities so the least amount of area is disturbed at one time.

Slope Breaks

Refer to plan. Table 6.1 provides suggested guidelines for spacing of slope breaks.

Soil Surface Roughening

There are many types of surface roughening techniques such as track walking with a dozer up and down a slope or using a sheep's foot to create dimples in the soil surface. This increases infiltration and slows overland flow.

Table 6.1 Guidelines for Spacing Slope Breaks

Slope	Spacing (ft.)
33-50%	20
25-33%	40
15-25%	60
10-15%	80
6-10%	120
3-6%	200
< 3%	300

Source: Adapted from North Carolina Field Manual, 1991

Surface Runoff

Avoid disturbing natural drainage ways, if possible. At each slope break, intercept runoff and channel it to storm drains or stabilized watercourses. If runoff contains sediment, protect drain inlets with a filter or divert water to a sediment trap or basin according to the site grading plan (See Inlet Protection, Temporary Sediment Trap and Sediment Basin).

Erosion Control

Graded areas should be stabilized with mulch, vegetation, crushed stone, riprap or other measures as soon as work is completed, or if work is interrupted for 14 or more working days. Soil surface roughening is both an erosion and sediment control technique and should not be combined with devices such as erosion control blankets. Blankets should be applied to smooth, fine-graded soil surfaces and will fail if used to cover roughened soil surfaces.

Slopes to be Vegetated

2:1 or flatter; 3:1 or flatter where maintained by tractor or other equipment. Slopes should be roughened during grading operations to retain water, increase infiltration and promote vegetative growth. Slopes should be protected from surface runoff while vegetation is being established (See Diversions, Perimeter Protection).

Borrow and Disposal Areas

As shown on the grading plan; these should be no closer than 100 feet to a streambank or sensitive area (e.g., wetland, spring, cave, sinkhole) in the absence of a specification and should not be placed in an area of stormwater conveyance. Stockpiles should be stabilized if not being used for 14 or more days according to the state and local regulatory requirements. If borrow or disposal locations are off-site, they should also be permitted and have a copy of the permit authorization on-site at all times. This is necessary if the off-site borrow or disposal area is used for this construction project only and disturbs one acre or greater requiring permit coverage.

Outlets for Breaks and Diversions

Stabilized outlets should be provided for runoff from the disturbed area in order to retain sediment on-site.

Construction

Site Preparation

- Erosion and sedimentation control measures should be installed as specified and in the sequence shown on the design plan.
- Prior to excavation activities of any type, call1-800-DIG-RITE (344-7483) to obtain utility locations.
- Remove and stockpile topsoil (see Topsoiling) if subsoils will not support plant growth.
- Clear and grub areas to be filled and remove trees, vegetation, roots and other debris.
- Check fill to make sure it is does not contain brush, rubbish, oversized rocks or other objectionable material.
- Place fill in layers and compact as specified by the grading plan. Do not use frozen, excessively soft or high organic content material.
- Do not place fill on frozen subgrade, as it may cause an unstable condition due to potential differential settlement when the soil thaws.

Grading

- Construct slope breaks as shown on the grading plan, or in accordance with the recommendations of Table 6.1. A typical slope break is illustrated in Figure 6.14.
- Keep diversions and other water conveyance measures free of sediment during all phases of development.
- Avoid grading and building in areas of seepage. If this cannot be avoided, then install subsurface drains (See Subsurface Drains) in areas where seepage interferes with the grading operations, or where required to improve slope stability or soil bearing capacity.
- Permanently stabilize graded areas immediately after final grading is complete. Use temporary stabilization measures on graded areas when work is to be interrupted or delayed for 14 working days or longer.

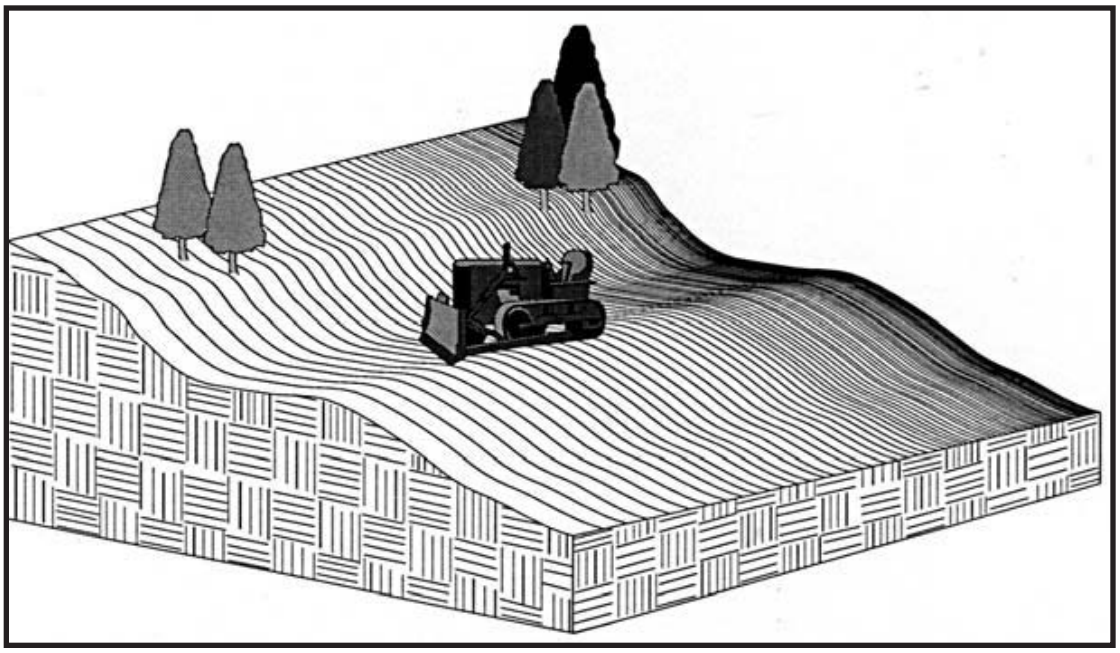


Figure 6.14 Typical Slope Break

Construction Verification

Check all finished grades for conformance with grading plan and correct as necessary.

Figure 6.15 Track walking with a dozer up and down the slope provides horizontal grooves to reduce stormwater flow volumes and velocity therefore reduces potential for erosion of the slope. Source: *ABC's of BMP's, LLC*

Maintenance, Inspection and Removal

- Periodically inspect all graded areas and the related erosion and sedimentation control practices, as required by the construction general permit, especially after heavy rainfalls. Clean sediment out of diversions and other structures as needed. If washouts or breaks occur, repair them immediately.
- Remove this is a temporary device and stabilize the site *Form H - Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Common Problems and Solutions

Problem	Solution
Variations in topography on-site indicate grading plan will be ineffective or unfeasible.	Consult with design professional
Seepage is encountered during construction.	It may be necessary to install drains. Dewatering shall be performed in accordance with regulatory requirements.
Design specifications for seed variety, seeding dates, erosion control materials or timeframes cannot be met.	Substitutions may be required. Unapproved substitutions could result in erosion and lead to failure of erosion control measures.
Prominent rill and gully erosion caused by slope breaks being too far apart.	Construct intermediate slope breaks.
Difficulties achieving proper compaction of fill caused by subgrade being soft, contains oversized rocks or has high organic content.	Undercut and replace unsuitable subgrade soil.
Slope is unstable or has reduced bearing capacity caused by a high water table	Install subsurface drains to lower water table.

Sediment Fence

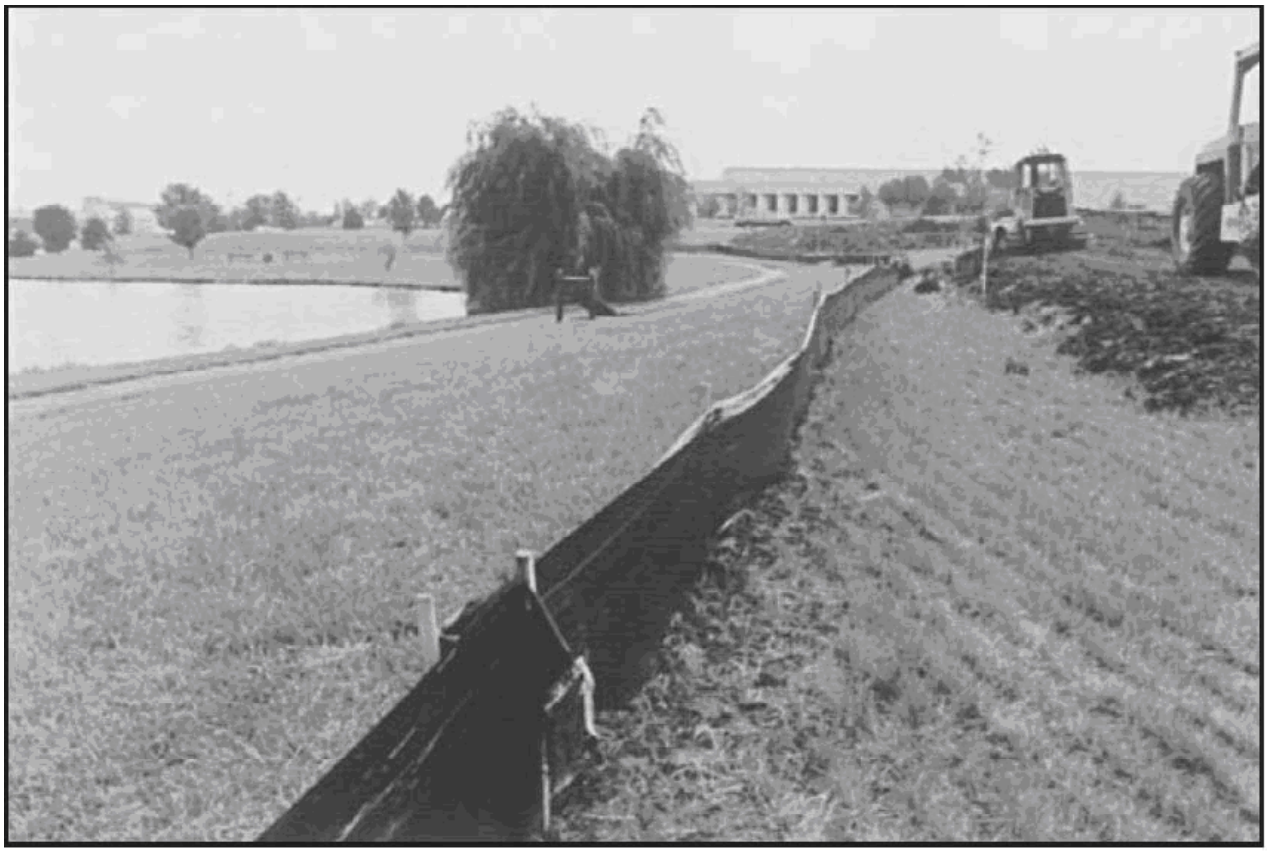


Figure 6.50 A properly installed sediment fence slows water flow long enough for the sediment to settle out. There should be no gaps under fence if heeled in properly. Source: C. Rahm, NRCS. Platte Co.

Practice Description

A sediment fence (often called a silt fence) is a temporary sediment barrier consisting of a geotextile fabric that is attached to supporting posts and trenched into the ground. Sediment-laden runoff ponds uphill from the sediment fence and runoff is temporarily stored to allow sediment to settle out of the water.

This practice applies where sheet erosion occurs on small disturbed areas. Sediment fences are intended to intercept and detain small amounts of sediment from disturbed areas in order to prevent sediment from leaving the site. Sediment fences can also prevent sheet erosion by decreasing the velocity of the runoff. Silt fence is not intended to be used in concentrated flow paths.

Recommended Minimum Requirements

Prior to start of construction, sediment fence placement and installment methods should be designed by a qualified professional. The site superintendant and field personnel should refer to plans and specifications throughout the construction process.

Drainage Area

Limit to ¼ acre per 100 feet of fence. Further restrict the area by slope steepness as shown in Table 5.16.

Location

Fence should be built on a nearly level grade and at least 10 feet from the toe of the slope to provide a broad shallow sediment pool. Install on the contour, where fence can intercept runoff as a sheet flow; not located crossing channels, waterways or other concentrated flow paths; not attached to existing trees; and not located vertically up the slope (at a right angle to the slope.)

J-Hook

Silt fence should not be used around the entire perimeter of the site unless it is a small, flat site. It should only be located at areas where stormwater flow discharges with overland or sheet flow. You can use silt fence to create small catchments of stormwater flow by creating a small J-hook shape with the silt fence. The drainage area should be less than ¼ acre with little or no slope (see Figure 3.83).

Length

Maximum of 600 feet; flare ends of fence uphill to temporarily impound water as shown in Figure 5.32.

Geotextile

Commercially available silt fence fabric is almost exclusively woven geotextile fabric. Non-woven material has better flow through but poorer strength. A higher porosity geotextile would be a mono-filament fabric with larger voids between the woven threads.

Table 6.14 Typical Land Slope and Distance for Sediment Fence

Land Slope (percent)	Maximum Slope Distance* above Fence (feet)
Less than 2	100
2 to 5	75
5 to 10 greater than 10	50*

*** Follow manufacturers' recommendations for proper spacing.**

Spacing of Support Posts

A good minimum stand is 6-feet maximum for geotextile fabric supported by wire and 5-feet maximum for geotextile fabric without supportive wire backing. Follow the local design standards in your area and the site SWPPP.

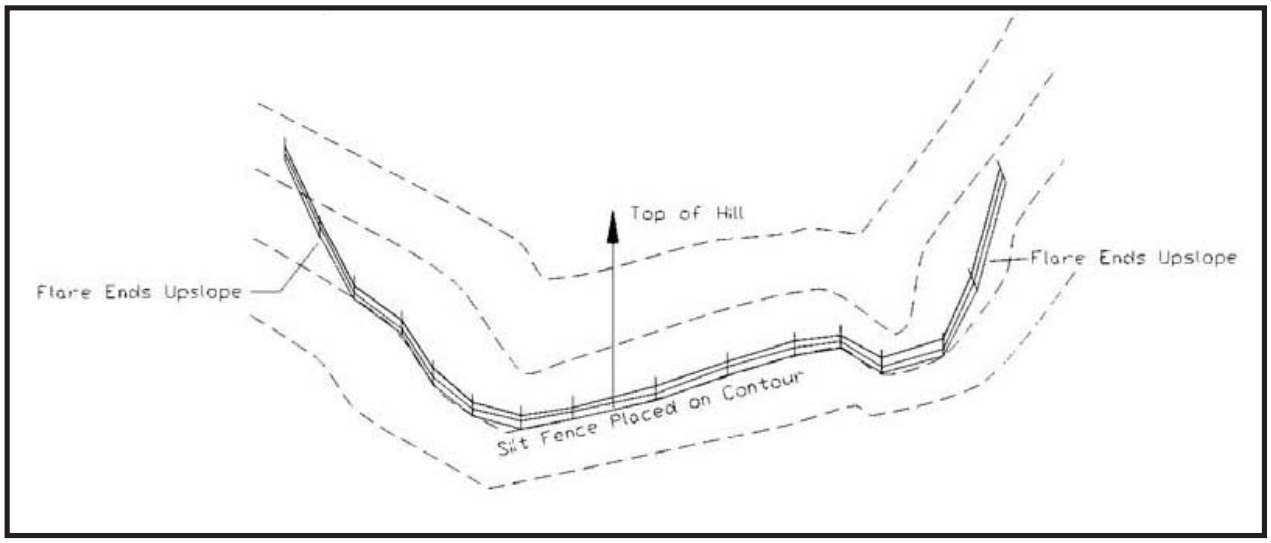


Figure 6.51 Placement of sediment fence

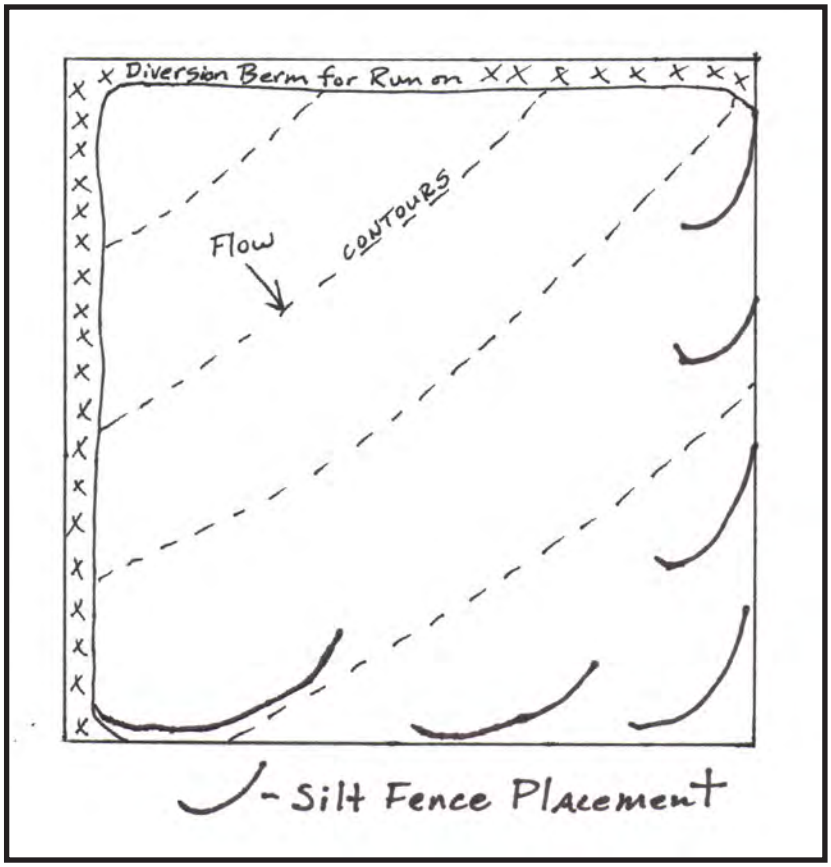


Figure 6.52 Placement of J-hook silt fence along the perimeter of a construction site to slow and pond small areas of stormwater runoff.

Troubleshooting

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

- Variations in topography on-site indicate sediment fence will not function as intended; changes in the plan may be needed.
- Design specifications for geotextile fabric, support posts, support fence, gravel or riprap cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Fence is not installed on the contour or is installed across channels or other concentrated flow areas.
- Installation of sediment fence as designed appears to create a potential flooding hazard or directs runoff overflows into sensitive ecological areas.

Common Problems and Solutions

Problem	Solution
Overtopping, sagging or collapse of fence occurs; caused by the drainage area too large or too much sediment accumulation allowed before cleanout.	Increase sediment storage capacity upslope of fence or remove accumulation more frequently, then repair fence.
Collapse of fence due to high velocity or undercutting of fence; caused by approach too steep.	Reduce slope of approach area, or consult with a registered design professional.
Sagging or collapse of fence; caused by fence not adequately supported.	Add additional supports.
Undercutting of fence; caused by the bottom of fence not buried properly.	Reinstall fence using proper method of trenching.
Sagging, collapse or undercutting of fence; fence installed across drainage way.	Relocate fence away from drainage way. Silt fence should only be used adjacent to drainageway; other devices should be used across or within drainageway (see Rock Check Dam or Ditch Check).
Water runs on both sides of fence; fence installed vertically or at right angle to contour.	Relocate fence along contours.

Fence should never be used as a check dam or in concentrated flow paths.

Turf Swale

Figure 6.116 Turf Swale. Source: N. Klopfenstein, NRCS, Cole County

Practice Description

A turf swale is also referred to as grass-lined channel, grass waterway or grass swale, and it differs from dry or wet bioswales in that no special provisions or materials are included to maximize infiltration or pollution reduction.

Typically, an objective for constructing a turf swale is for the purpose of handling concentrated surface runoff in such a way as to prevent damage from erosion and the resulting sedimentation downgradient. However, turf swales offer the least amount of water quality and volume control when compared to other bioswales or bioretention options.

This practice has historically been used for sites where:

- Concentrated runoff is expected to cause erosion damage.
- Sufficient stability for the channel can be achieved through a vegetative lining.
- Channel grades are generally less than 5 percent.
- Significant space is available to allow for a sufficient channel width for gentle side slopes.

However, this practice is basically a conveyance ditch, which does not serve as a stormwater control measure adequate to control peak flow for water quality or design storms. If used at all, this practice should be limited to linear projects.

Typical uses include roadside ditches, channels at property boundaries, outlets for diversions and stabilizing concentrated flow areas. The grass-lined channel will provide better infiltration and greater root structure if the vegetation is allowed to grow to its full height and not mowed short, serving more as a vegetated dry swale described previously in this section. Selective native or adaptive grasses can provide a functional root depth up to 15 feet, whereas mowed turf grasses provide 1- to 2- inches of root structure. Colored photos and specifications of Missouri native plants are available at www.grownative.org.

Recommended Minimum Requirements

Prior to start of construction, grass-lined channels should be designed by a registered design professional as part of the overall site design for stormwater management. Plans and specifications should be reviewed by the site superintendent and field personnel throughout the construction process. The channel should be built according to planned alignment, grade and cross section. Some of the typical features are:

Cross Section

Trapezoidal or parabolic.

Side Slopes

3:1 or flatter for trapezoidal channels.

Channel Stabilization

Use erosion control blankets, turf reinforcement mats or other appropriate practices as specified in the design plan.

Outlet

Channels should empty into sediment traps, detention/ retention basins or stable outlets.

Subsurface Drain

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

Construction

Site Preparation

Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.

Install sediment traps or drains if needed. Remove brush, trees and other debris from the construction area and dispose of properly.

Grading

Excavate and shape the channel to dimensions shown on the design specification, removing and properly disposing of excess soil so surface water can enter the channel freely.

If a subsurface drain is needed, install it as designated in the plans.

Provide topsoil as needed to enhance the growth of grass within the channel.

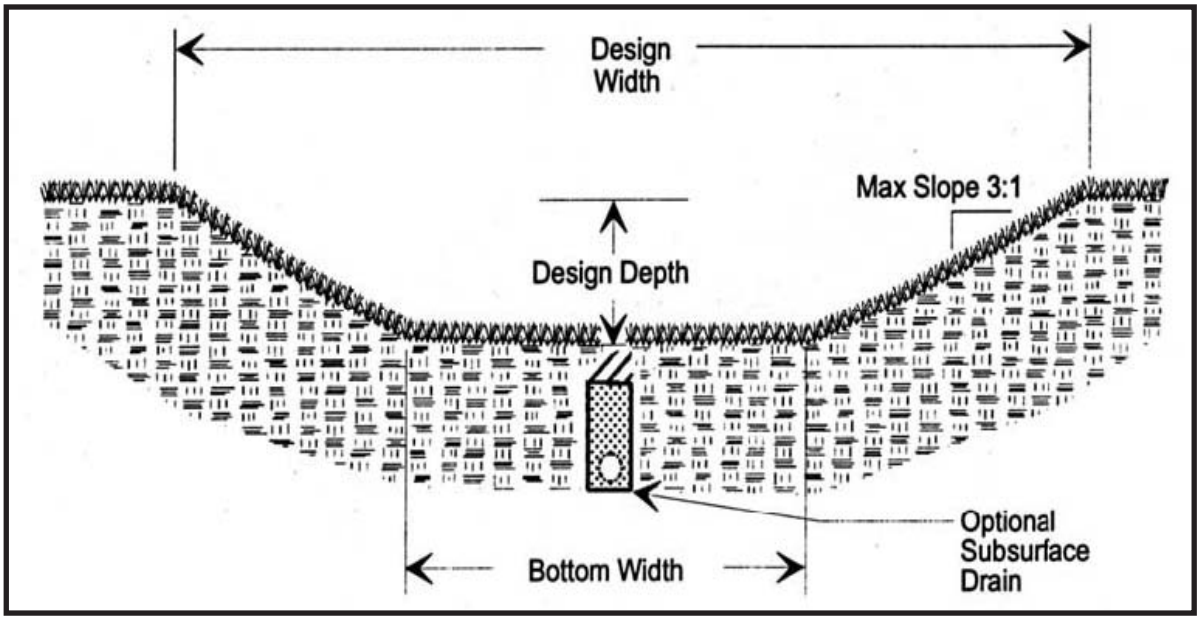


Figure 6.117 Typical Trapezoidal Turf Swale. Source: St. Charles County Soil and Water Conservation District, Missouri

Erosion Control

Protect all concentrated inflow points along the channel with erosion-resistant linings, sod or other appropriate measures.

Fertilize and seed or sod the channel immediately after grading and protect with erosion control blankets, turf reinforcement mats or mulch according to the design plan.

Channel should outlet at a stable location.

Construction Verification

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

Maintenance and Inspection

- Inspect the channel following storm events both during and after grass cover is established; make needed repairs immediately.
- Check the channel outlet and road crossings for blockage, sediment, bank instability, breaks and eroded areas. Remove any blockage and make repairs immediately.
- Remove significant sediment and debris from the channel to maintain design cross section and grade, and to prevent spot erosion.
- A specific operations and maintenance plan should be provided by the design professional and transferred to the person responsible for long-term operations and maintenance. Adequate training should be provided as well.

Common Problems and Solutions

Problem	Solution
Variations in topography on-site indicate the channel will not function as intended. Changes in plan may be needed.	Consult with the registered design professional.
Erosion occurs in the channel before vegetation is fully established, due to lack of adequate controls above the channel.	Establish controls above the channel. Repair, reseed and install erosion control blankets or turf reinforcement mats.
Gullying, head cutting or settling in the channel due to overly steep grade or improperly placed drain.	Refer to design specifications or design professional to ensure proper design or re-design of the channel, use erosion-resistant lining and ensure drain is properly placed (typically on the side for post-construction versus at the bottom during construction.)
Overbank erosion, spot erosion, channel meander or flooding occurs due to instability.	Remove accumulated debris and sediment, stabilize and revegetate trouble spots.
Side slope caves in as a result of unstable, high-water-table soil, steep banks or high-flow velocity. Most likely to occur on the outside of channel curves.	An alternate practice may be more appropriate, such as a wetland or wetland swale. Consult with the design professional.
Ponding along the channel due to improperly graded approach or blocked surface inlets.	Improve the channel grade or remove blockage.
Erosion at the channel outlet due to instability.	Install an outlet stabilization structure.
Sediment deposited at the channel outlet due to unidentified channel or watershed erosion.	Find and repair the source of any channel erosion and stabilize the drainage area with permanent practices professionally designed to protect water quality.
Design specifications for seed variety, seeding dates or erosion control materials cannot be met.	Substitution may be required. Unapproved substitutions could result in channel erosion.

Rock Check Dam

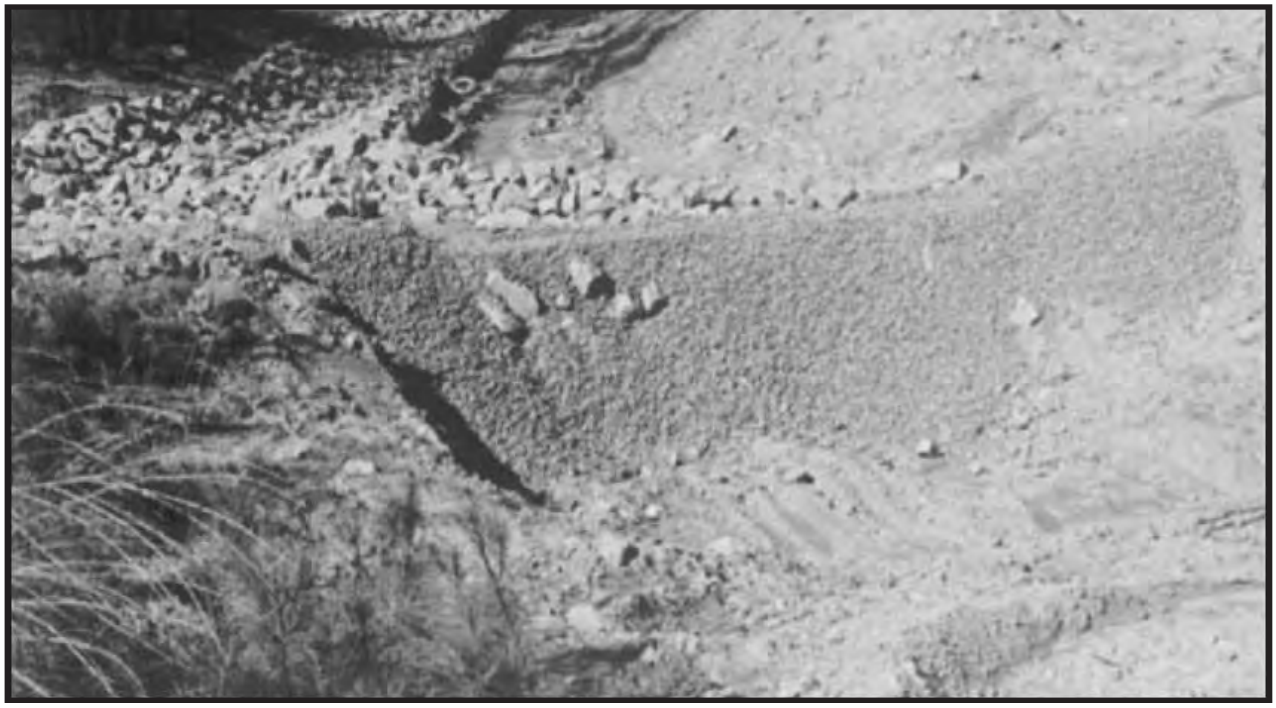


Figure 6.79 Rock check dams can provide sediment control in channels and swales. Source ABC of BMPs, LLC

Practice Description

A rock check dam is a stone dam designed to capture sediment within drainage swales and diversions on the construction site. This practice can be used as an alternative to a standard sediment basin for locations with a drainage area of 20 acres or less. It may be preferred over standard sediment basins for sites where an earthen embankment would be difficult to construct.

Recommended Minimum Requirements

Prior to start of construction, rock check dams should be designed by a registered design professional. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. The rock check dam should be built according to planned grades and dimensions.

The major design elements include:

- Middle of the check dam is the lowest point where stormwater flow will go over the check dam. Make sure the ends are at a higher elevation than the middle.
- The downhill side slope of the check dam has a longer angle of repose to dissipate the energy of the stormwater flow over the dam to prevent scour on the downstream side of the check dam.
- The spacing between check dams is such that the bottom of the upper check dam is at the same elevation as the top of the check dam below it. This will not allow the stormwater flow to increase velocity as it goes down the slope but make the feature more like a stair step journey.

Construction

Site Preparation

- Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.
- Divert runoff from undisturbed areas away from the rock check dam and basin area.
- Do not divert toward existing buildings or houses.
- Stabilize the diversion, swale or channel with vegetation or a turf reinforcement mat to prevent or minimize erosion of the channel.

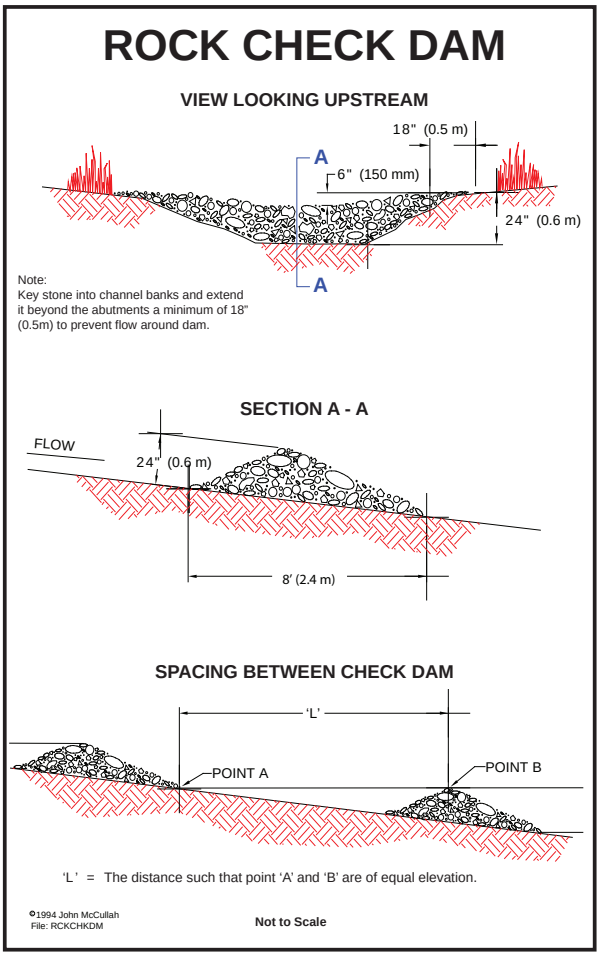


Figure 6.80 Detail of Rock Check Dam

Construct the check dams as shown in the Figure 5.89 and remember the following three design principals:

- The middle of the check dam is the lowest point so the storm water flow is directed to the middle of the channel.
- The down gradient side of each check dam is at a lower angle to allow for energy dissipation of the storm water flow over the check dam to reduce the potential for scour.
- Space the check dams so the elevation of the bottom of the upper check dam at the same elevation as the top of the lower check dam. This allows water to pond back to the check dam above it to reduce velocity and create a stair step cascade of the storm water flow.

Safety

Because rock check dam sediment basins impound water, they should be considered potentially hazardous. Take the following precautions:

- Avoid steep slopes; both cut and fill slopes should be 2.5:1 or flatter; 3:1 where maintained with tractor or other equipment.
- Fence area and post warning signs if trespassing is likely.
- Do not construct directly above structures that could be damaged in the event of failure.

Construction Verification

Check finished grades and dimensions of the rock check dam. Check materials for compliance with specifications.

Maintenance, Inspection and Removal

- Inspect the rock check dams weekly and after each storm event as required by your permit.
- Remove sediment when it accumulates to half the design volume.
- Check the dam and abutments for erosion, piping or rock displacement and repair immediately.
- If the channel does not drain between storms, replace the stone on the upstream face of the dam.

- After the construction site has become permanently stabilized:
  - Remove all temporary check dams and any unstable sediment.
  - Smooth the site to blend with the surrounding area and stabilize.
  - Remove all water and sediment from the basin prior to dam removal.
  - Place the sediment in designated disposal areas and is not allowed to flow into streams or drainage ways during structure removal.
  - Leave check dams in place if they are designed as permanent structures.
- Remove of this temporary rock check dam and stabilize the site prior to filing *Form H: Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Common Problems and Solutions

Problem	Solution
Variations in topography on-site indicate the rock check dam will not function as intended.	Changes in plan may be needed, consult with a registered design professional.
Erosion increased during storm events; caused by the channel not being properly stabilized.	Stabilize the channel immediately with vegetation or turf reinforcement mat.
Storm flow goes around the sides of check dam eroding the bank; caused by the elevation of dam being too high in the middle.	Lower the middle of the check dam so storm water flow goes over the middle, repair damage and stabilize eroded side slopes.
Rock is displaced; caused by the stone size being too small or embankment slope is too steep.	Replace larger size stone or reduce slope.
Rock is displaced; caused by the high velocities because spacing between dams is too long and therefore does not rsufficiently reduce velocity.	Consult the design professional to recalculate the drainage slope and dam heights to determine correct check dam spacing.
Erosion occurs in downstream area; caused by the apron not extended to stable grade.	Repair erosion and extend apron.
Erosion of abutments occurs during spillway flow; caused by the rock not being high enough on the abutment.	Extend rock higher on the abutment.
Sediment is being carried through the spillway or accumulates in excess between clean outs; caused by the drainage area being too large.	Divert runoff from undisturbed areas way from the basin, enlarge basin and clean out basin more frequently or consult the professional designer for other alternatives.
Sediment is lost through the check dam; caused by the layer of gravel aggregate on the upstream face not being thick enough or is too coarse to restrict flow through the dam.	Replace gravel aggregate with material having proper gradation to provide filtration.

Temporary Diversions

Figure 6.55 An unfinished temporary diversion routes sediment-laden storm water to a sediment basin. Temporary diversions should be shaped and protected with a turf reinforcement mat or rock. Establish permanent vegetation if the diversion will be used for one year or more. Source: K. Grimes, Soil and Water Conservation District. St. Charles Co.

Practice Description

A temporary diversion is a temporary ridge or excavated channel or combination ridge and channel. It is designed to either prevent runoff from flowing across the active construction site work areas and discharge it through stable, protected outlets or to divert sediment laden water to sediment traps. Temporary diversions are usually constructed by excavating a channel and using the excavated material to construct a ridge on the down slope side of the channel.

This practice applies wherever storm water runoff must be temporarily diverted to protect disturbed areas and slopes or to retain sediment on-site during construction. When a diversion is needed to direct runoff from undisturbed areas above the construction site around a disturbed area, it must be routed to a stabilized outlet. The diversion must be fully stabilized and non-erodible prior to receivingstorm water flows. Check dams may be installed within the diversion to reduce velocities and control flows better. A diversion of cleanstorm water flow should never be allowed to flow over disturbed areas and create erosion or pick up sediment in the flow. If the untreated flow mixes with sediment ladenstorm water on the construction site, it must be treated through a control device before it discharges off-site.

Recommended Minimum Requirements

Prior to start of construction, temporary diversions should be designed by a registered design professional. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. Temporary diversions should be constructed to minimize erosion at the design flow.

Drainage Area

Less than 5 acres.

Ridge Design

- Side Slope: 2:1 or flatter; 3:1 or flatter where vehicles must cross.
- Top Width: 2.0 ft.
- Freeboard: 0.3 ft.
- Settlement: 10 percent of fill height.

Channel Design

- Side Slope: 2:1 or flatter; 3:1 or flatter where vehicles must cross.
- Grade: Stable, positive grade towards outlet, but not exceeding 2 percent.

Construction

Site Preparation

- Locate and mark the alignment of the diversion as shown on the plans. The alignment should maintain a stable, positive grade toward the outlet. Minor adjustments to the grade and alignment may be required by site conditions. Realign or elevate the diversion as needed to avoid reverse grade.

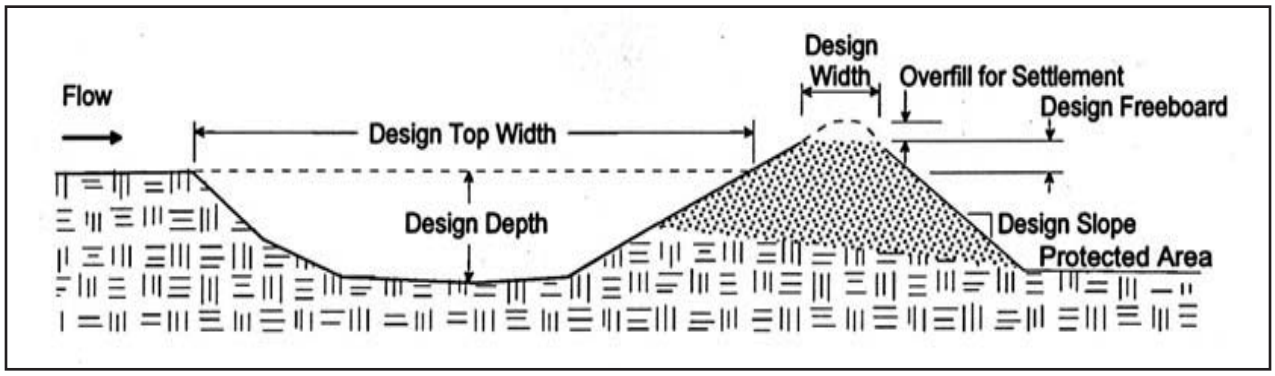


Figure 6.56 Typical temporary combination diversion.

- Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.
- Remove trees, brush, stumps and other unsuitable material from the site.
- Disk the base of the ridge before placing fill.

Grading

- Construct the diversion to the dimension and grades shown on the design.
- Build the ridge 10 percent higher than designed for settlement and compact with wheels of the construction equipment or sheep foot roller.
- Leave sufficient area along the diversion to permit clean out and regrading.

Erosion Control

- Stabilize the outlets in accordance with design plans during construction of the diversion.
- Vehicles should not be allowed to drive across through diversions.
- Stabilize ridges, side slopes and channels with vegetation or synthetic erosion control measures as specified in the design. Do not allow storm water flows to enter the channel until it is fully stabilized especially if it is being used to direct clean storm water around a disturbed area.
- Outlet should be nonerosive for design flow. Divert flow containing sediment to sediment trap or basin.
- Stabilize ridge with vegetation if in place more than 30 working days.
- Diversions should not be installed on slopes greater than 15 percent or where diversion flows are calculated to be greater than 3-feet per second over vegetation. If the diversion is constructed above a steep slope, install temporary slope drains or other stable outlet to control runoff and prevent erosion of the slope (see Temporary Slope Drains, Grass-lined Channel, Riprap-lined Channel or Turf Reinforcement Mats).

Construction Verification

- The field inspector should verify the dimensions shown on the plans for the following: depth, bottom width, top width, side slopes of channel and ridge, grade of channel bottom, ridge height and channel stabilization techniques.
- Check all of the finished grades and configuration of all channels to eliminate constrictions to flow and to ensure final discharge flows to sediment basins or stabilized outlets. Also check all ridges for low spots and stability.

Grading

- Construct the diversion to the dimension and grades shown on the design.
- Build the ridge 10 percent higher than designed for settlement and compact with wheels of the construction equipment or sheep foot roller.
- Leave sufficient area along the diversion to permit clean out and regrading.

Erosion Control

- Stabilize the outlets in accordance with design plans during construction of the diversion.
- Vehicles should not be allowed to drive across through diversions.
- Stabilize ridges, side slopes and channels with vegetation or synthetic erosion control measures as specified in the design. Do not allow storm water flows to enter the channel until it is fully stabilized especially if it is being used to direct clean storm water around a disturbed area.
- Outlet should be nonerosive for design flow. Divert flow containing sediment to sediment trap or basin.
- Stabilize ridge with vegetation if in place more than 30 working days.
- Diversions should not be installed on slopes greater than 15 percent or where diversion flows are calculated to be greater than 3-feet per second over vegetation. If the diversion is constructed above a steep slope, install temporary slope drains or other stable outlet to control runoff and prevent erosion of the slope (see Temporary Slope Drains, Grass-lined Channel, Riprap-lined Channel or Turf Reinforcement Mats).

Construction Verification

- The field inspector should verify the dimensions shown on the plans for the following: depth, bottom width, top width, side slopes of channel and ridge, grade of channel bottom, ridge height and channel stabilization techniques.
- Check all of the finished grades and configuration of all channels to eliminate constrictions to flow and to ensure final discharge flows to sediment basins or stabilized outlets. Also check all ridges for low spots and stability.

Maintenance, Inspections and Removal

- Inspect weekly and following each storm event.
- Remove debris and sediment from the channel and rebuild the ridge as needed.
- Check outlets and make necessary repairs immediately.
- Remove sediment from traps or check dams when they are 50 percent full.
- When the work area has been stabilized, remove the ridge and fill in the channel to blend with the natural ground. Remove temporary slope drains and stabilize all disturbed areas with permanent vegetation or other erosion control practices.
- Remove the temporary deversion and stabilize the site stabilized *Form H: Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).
- Maintain vegetation in channel as shown in the design plan.

Common Problems and Solutions

Problem	Solution
Seepage is encountered during construction.	It may be necessary to install drains.
Variations in topography on-site indicate diversion will not function as intended.	Consult with a registered design professional.
Design specifications for seed variety, seeding dates or erosion control materials cannot be met.	Substitutions may be required. Unapproved substitutions could result in erosion and lead to diversion failure.
Final discharges from diversion channels cause ongoing erosion at the outlets.	Modifications to the diversion system need to be made or energy dissipation devices installed.
Overtopping of channel; caused by sedimentation in channel resulting in grade decreasing or reversing.	Realign or deepen the channel to maintain grade.
Overtopping of ridge due to low point in ridge where diversion crosses a natural depression.	Build up ridge.
Erosion and scour of the channel; caused by high velocity in channel.	Consult a design professional and install velocity dissipators such as check dams.

Breach of ridge caused by uneven channel grade and leading to erosion in channel before vegetation is established.	Repair channel and add more effective erosion control option-erosion control blanket, turf reinforcement mat, transition mat, etc.
Poor vegetation establishment caused by seepage or poor drainage in channel.	Install subsurface drains or stone channel bottom.
Erosion in channel caused by excessive grade in channel.	Consult design professional, repair channel, install an erosion resistant lining and velocity dissipators such as check dams or realign to reduce the grade.
Erosion; caused by excessive velocity at outlet.	Consult a design professional, install an outlet stabilization structure (see Rock Outlets or Energy Dissipators).
Runoff from a storm event causes blow out failure; caused by ridge not being compacted.	Repair and use construction equipment to compact.

Vegetative Buffer Strip

Figure 6.86 Vegetative buffer strips slow surface runoff, reduce sedimentation and help capture pollutants. Depending on the choice of plant materials, they can be low maintenance areas (mow once or twice a year) or provide habitat for wildlife.

Practice Description

A vegetative buffer strip is a wide belt of vegetation designed to provide infiltration, intercept sediment and other pollutants and reduce stormwater flow and velocity. Vegetative buffer strips are similar to grassed swales except they are designed to accept only overland sheet flow. They cannot treat high velocity flows. Surface runoff must be evenly distributed across the vegetative buffer strip. After a channel forms in the vegetative buffer strip, it is no longer effective.

Vegetative buffer strips can consist of grass, woody vegetation or other erosion resistant plants. They can be used adjacent to impervious surfaces and next to stream corridors or wetlands to slow the flow and help remove sediment from runoff. They can also be used in conjunction with infiltration basins, infiltration trenches or alongside streams to provide water quality treatment for post-construction.

Recommended Minimum Requirements

Prior to start of construction, vegetative buffer strips should be designed by a qualified professional. The site superintendant and field personnel should refer to plans and specifications throughout the construction process. The vegetative buffer strip should be built according to planned alignment, grade and cross section. Should any field adjustment to the design and installation be needed, a qualified professional should be consulted in the modification to the original design or specification.

Drainage Area

Less than 5 acres.

Location

Adjacent to low or medium density residential areas on gently sloping ground (less than 5 percent), with length of strip running along the contour, along the perimeter of a site, or any available vegetated area or area capable of being vegetated.

Vegetation

A mix of erosion resistant plants that form a dense mat and effectively bind the soil (see Permanent Seeding).

Slope

Uniform, even and relatively flat (5 percent or less) with a level spreading device (level lip, weir, etc.) across the top edge of the vegetative buffer strip.

Minimum Width

Should conform to those in Table 6.16.

Minimum Length

At least as long as the contributing runoff area, but no less than 50 feet plus 4 feet for each one percent increase in slope.

Table 6.16 Minimum Width of Vegetative Buffer Strip

Slope of Land	Width of Vegetative Buffer Strip	Width of Vegetative Buffer Strip
(Percent)	For Grassed Areas (ft.)	For Forested Areas (ft.)
0	10	25
2	12	29
4	14	33
6	16	37
8	18	41
10	20	45
15	25	55

Construction

Site Preparation

- Natural wooded strips in addition to grass strips should be considered. At the start of development, designate, identify and fence off any areas to be preserved. Avoid storing debris from clearing and grubbing activities and other construction waste material in these areas during construction.
- If a vegetative buffer strip is constructed, clear and grub the vegetative buffer strip area before the impervious area is completed.

Grading

- If the adjacent area does not meet the buffer on a uniform contour, grade a swale along the contour directly adjacent to the top edge of the vegetative buffer strip. The swale will serve as a “level spreader” to collect overland flow and distribute the runoff evenly to the vegetative buffer strip. By discharging to the vegetative buffer strip uniformly along the top of the strip, rill and gully formation due to concentration of flow is minimized.
- Line the swale with rock or other erosion resistance material.
- Sod or seed, fertilize and protect the vegetative buffer strip area with an appropriate rolled erosion control product per the specifications.

  Note: Some fertilizing activities may be prohibited near wetlands and other eco-sensitive areas. Consult a qualified professional if needed.
- Vegetated buffer strips should be protected from excessive sediment laden storm water runoff during construction operations because excess sediment will kill the vegetation. This protection can be in the form of silt fence or other sediment control best management practices placed at the top of the slope to pretreat runoff headed for the buffer strip. If excessive sediment is deposited in the buffer strip, appropriate measures should be taken to reestablish the vegetative strip, including complete regrading and reseeding or sodding of the area.

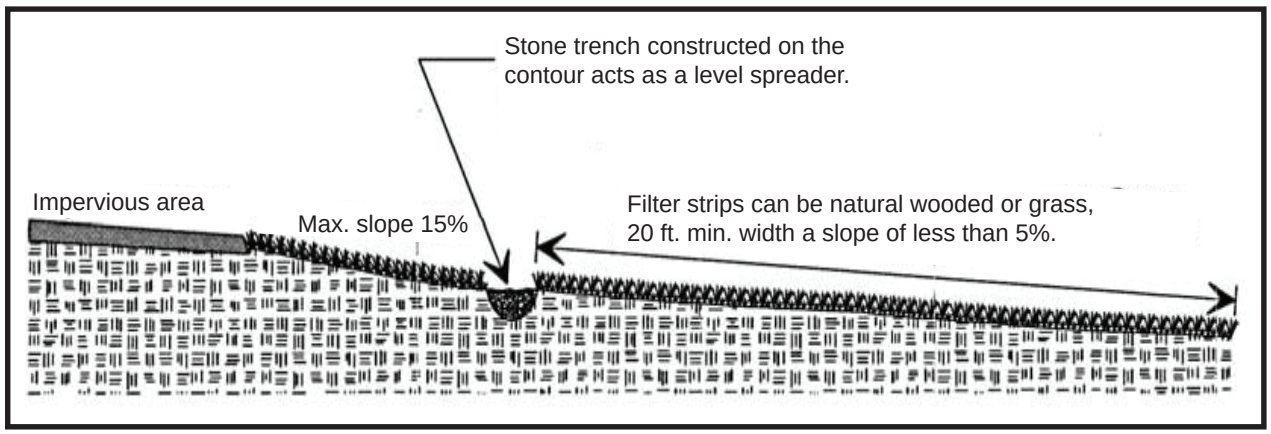


Figure 6.87 Vegetative Buffer Strip

Erosion Control

- Minimize the size of all disturbed areas and stabilize as soon as each phase of construction is complete.
- Direct all overland flow to the vegetative buffer strip or the level spreading swale at low velocities.

Safety

- Store all construction materials and waste material well away from the vegetative buffer strip.
- Follow all local, state and federal guidelines in constructing utility trenches. If utility lines are buried beneath the vegetative buffer strip, do not perform final grading until all trench settlement has taken place. Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.
- Provide temporary fencing and warning signs until vegetation is established.

Construction Verification

Check the finished grades and configuration of all earthwork, level spreaders and diversions.

Maintenance, Inspection and Removal

- Check for eroded channels in the vegetative buffer strip after every storm event. Fix eroded areas and reseed, mulch and fertilize the affected area. Modify the Storm Water Pollution Prevention Plan to prevent further issues.
- Apply fertilizer in accordance with soil test recommendations and always consider application timing and rates that will protect water quality – i.e. do not apply more than is necessary and do not apply when rain will likely carry fertilizer off to the stream system. Excessive fertilizer can cause a change in pH that allows heavy metals and other toxic compounds to become mobile and available for uptake by aquatic plants and animals. The change in pH can also prohibit nutrient uptake by the targeted vegetation.
- Remove sediment deposits accumulating in the vegetative buffer. This should be done very carefully to avoid damage to the vegetation.
- Protect new plantings from livestock or wildlife.
- Mow grass strips to a height of 6- to 12-inches two to three times a year to suppress weeds and woody vegetation unless natural, woody vegetation is indicated on the plan.
- Repair foot paths and traffic ruts.
- Remove the temporary vegetative bufferstrip and stabilize the site prior to filing *Form H: Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter One - Missouri Permit Requirements).

Troubleshooting

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

- Variations in topography on-site indicate vegetative buffer strip will not function as intended.
- Design specifications for fill, rock, sod, seed, mulch or fertilizer cannot be met; substitution may be required. Unapproved substitutions could lead to the vegetative buffer strip not operating as designed after construction activities have been completed.
- Naturally vegetated areas intended for use as buffer strips have been damaged or inadvertently reduced in width.

Common Problems and Solutions

Problem	Solution
Inadequate vegetation causing erosion of vegetative buffer strip due to too great a length of overland flow, too great a slope or high flow rates due to a drainage area greater than 5 acres.	Repair erosion damage and reevaluate erosion protection measures.
Inadequate vegetation causing erosion of vegetative buffer strip due to malfunctioning irrigation or lack of proper watering to establish the vegetation.	Repair erosion damage and possible irrigation issues, provide sufficient water for plant establishment and reevaluate erosion protection measures.
Settlement of soil in utility trenches or settlement of fill creates ponding within the vegetative buffer strip.	Fill low areas and regrade to provide proper drainage.
Uneven slope or debris clogging the trench at top of vegetative buffer strip creates a diversion of flow around vegetative buffer strip.	Remove debris and regrade as needed to provide proper drainage.
Sediment and debris clogging upper end of vegetative buffer strip creates a reduction in flow across vegetative buffer strip.	Replace clogged portion of vegetative buffer strip.

Sediment Basin

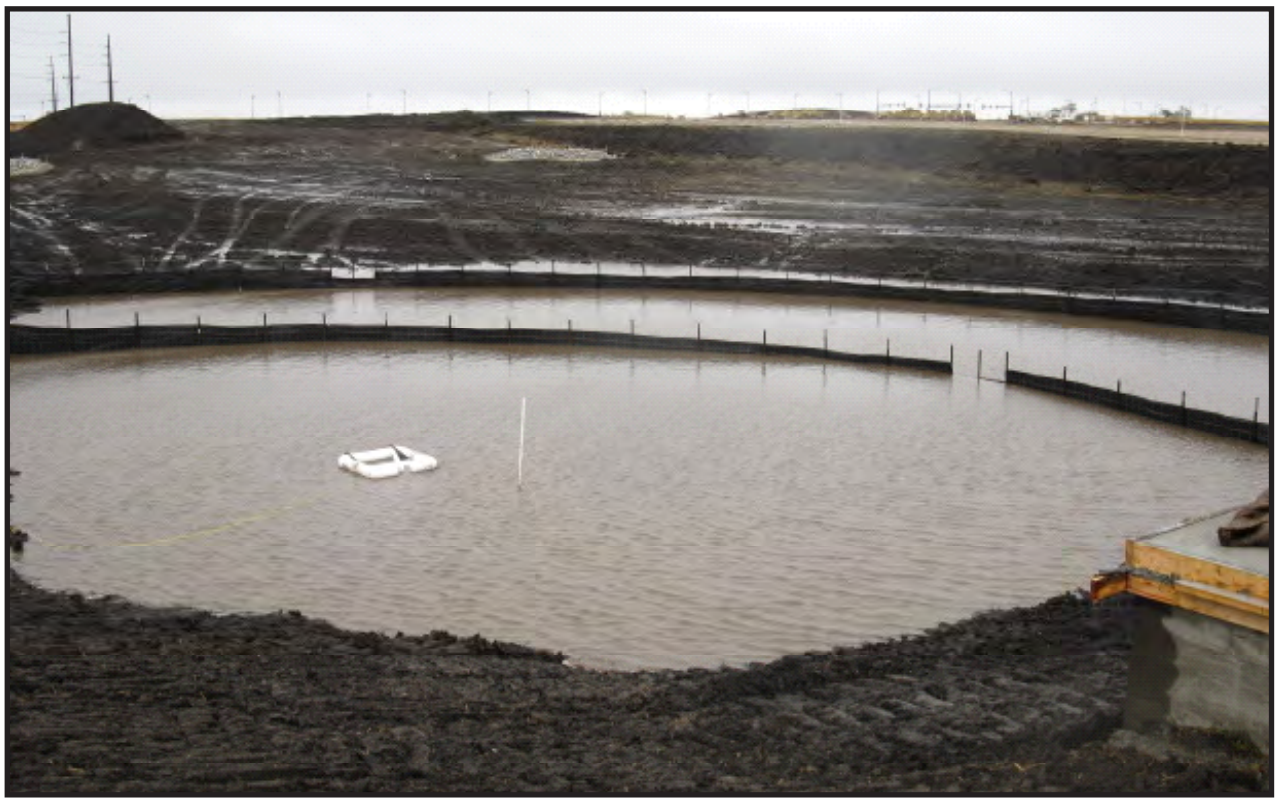


Figure 8.89 A sediment basin can be used to pretreat sediment-laden water before it discharges from the construction site.
Source: BFA Inc.

Practice Description

A sediment basin is a temporary pond constructed to contain sediment-laden storm water for an extended period of time prior to the storm water discharging from the basin. A sediment basin is temporary and should be removed or retrofitted prior to any final construction activities that would make these features a permanent detention or retention pond, after the entire contributing drainage area is stabilized.

This practice applies where other erosion control measures are insufficient to prevent off-site sedimentation. The purpose of a sediment basin is to detain sediment-laden runoff from disturbed areas in wet storage long enough for most of the sediment to settle out.

Recommended Minimum Requirements

Prior to the start of construction, sediment basins should be designed by a registered design professional. Plans and specifications should be referred to by the site superintendent and field personnel throughout the construction process and anytime maintenance practices are required.

Build the sediment basin according to planned grades and dimensions.

Dam Height

10 feet or less.

Contributing Drainage Area

On project sites greater than 10 acres, contributing area is limited to 20 acres or less.

Structure Life

Limited to 10 years.

Detention

At least 24 hours or per local requirements.

Storage Volume

Minimum of 3,600 cubic feet per acre of contributing drainage area (pervious or impervious).

Trap Efficiency

The length to width ratio of the basin should be 2:1 or greater; 5:1 is optimal to capture fine sediments. Locate the inlet as far as possible upstream from the outlet.

Short Circuiting

Design the inflow to the pond as far away from the discharge point as possible. If not possible, design a baffle, weir or wall between the inflow and outflow to increase distance and travel time so there is maximum settling time prior to storm water discharge.

Embankment

- Top Width: At least 6 feet.
- Side Slopes: 2.5:1 or flatter; 3:1 where maintained by tractor or other equipment.
- Settlement: Allow for at least 10 percent.
- Fill material: Stable moist soil compacted in lifts less than 8 inches.

Anti-seep Devices

Either of the following is recommended:

- Use at least two watertight anti-seep collars around the outlet conduit; collars should project 1- to 3-feet from the pipe.
- A sand diaphragm (see Glossary).

Risers

- Hold risers in place with an anchor or large foundation to keep them from becoming buoyant.
- Install appropriate inlet protection on the riser.
- Pipe size for the primary conduit should restrict discharge into the natural drainage area at a rate and volume of storm water that meets the local regulatory requirements and the design plan.

Emergency Spillway

- Constructthe spillway in undisturbed soil in a location that will not erode the dam.
- Cross Section: Trapezoidal-shaped with side slopes of 3:1 or flatter
- Control Section: Level, straight and at least 20 feet long. The spillway should have a minimum width of 10 feet.
- Stabilization: Stabilize with vegetation, erosion control blankets or other erosion control stabilization practices. Install rip-rap, turf reinforcement mats, transition mat or other appropriate material to finished grade if the spillway is not to be vegetated.

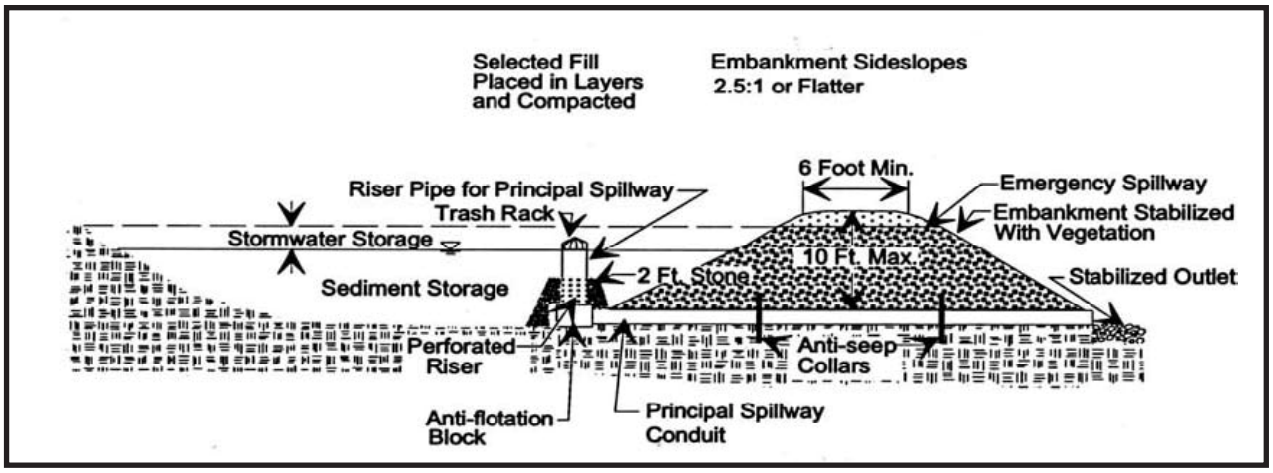


Figure 6.90 Typical Sediment Basin

Construction

Locate the sediment basin as close to the sediment source as possible, considering soil type, pool area, dam length, spillway conditions and proximity of sensitive habitats.

Site Preparation

- Prior to excavation activities of any type, call 1-800-DIG-RITE (344-7483) to obtain utility locations.
- Follow all federal, state and local requirements for impoundments. Clear, grub and strip the dam foundation, removing all woody vegetation, rocks and other objectionable material.
- Dispose of trees, limbs, logs and other debris in designated disposal areas.
- Excavate the foundation (outlet apron first), stockpiling any surface soil having high amounts of organic matter for later use.

Principal Spillway

- Construct a level sediment pool bottom to aid in sediment clean out. Situate the spillway barrel (pipe) and riser on a firm, even foundation. Prepare the pipe bedding.
- Place a 4-inch layer of moist, clayey, workable soil (not pervious material such as sand, gravel or silt) around the barrel, and compact with hand tampers to at least the density of the foundation soil. Don't raise the pipe from the foundation when compacting under the pipe haunches.

  Perforate the lower half of the riser with 1/2-inch diameter holes spaced 3 inches apart or use a manufactured perforated riser.
- Embed the riser at least 12 inches into concrete, which serves as an anti-flotation block. The weight of the concrete should balance the buoyant force acting on the riser.

$$\text{Buoyant Force} = \text{Volume of Riser} \times 62.4 \text{ lbs/ft}^3$$

- Surround the riser with 2- to 3-inch diameter clean stone to the height of the perforations on the riser. The stone footprint diameter should be 2 feet for every 1 foot of height.
- Place a domed inlet protector or steel trash rack around the riser inlet. The inlet protection should include overflow design. Trash rack openings should be no more than 4- to 6-inches square.
- At the pipe outlet, install a riprap apron at least 5 feet wide and 10 feet long to a stable grade.

Embankment

- Scarify the foundation of the dam before placing fill.
- Use fill from predetermined borrow areas. It should be clean, stable soil free of roots, woody vegetation, rocks and other debris; and must be wet enough to form a ball without crumbling, yet not so wet that water can be squeezed out.
- Place the most permeable soil in the downstream toe and the least permeable in the center portion of the dam.
- Compact the fill material in 6- to 8-inch continuous lifts over the length of the dam.
- Protect the spillway barrel with 2 feet of fill compacted with hand tampers before traversing over the pipe with equipment.

Emergency Spillway

- Construct and compact the dam to an elevation 10 percent above the design height to allow for settling.
- Place a reference stake indicating the sediment clean out elevation (50 percent of design elevation).
- Construct the spillway in undisturbed soil around one end of the embankment and locate it so that any flow will return to the receiving channel without damaging the embankment.

Stabilize the spillway as soon as grading is complete with vegetation, erosion control blankets or other erosion control stabilization practice; install riprap, TRM, transition mat or other appropriate material to finished grade if the spillway is not to be vegetated.

Erosion Control

- Minimize the size of all disturbed areas. Vegetate and stabilize all disturbed areas as soon as construction is complete.
- Divert runoff from undisturbed areas away from the basin.
- Use temporary diversions to prevent surface water from running onto disturbed areas.
- Divert sediment-laden storm water runoff to the upper end of the sediment basin (as far from the outlet or spillway as possible) to improve trap effectiveness. A forebay may also be incorporated at the basin inlet to dissipate energy.
- Direct all runoff into the basin at a low velocity (channel slope less than one percent).
- Vegetate and stabilize all disturbed areas immediately after construction.

Safety

Because sediment basins that impound water are hazardous:

- Avoid steep slopes; slopes around the sediment basin should be 2.5:1 or flatter; 3:1 where maintained by tractor or other equipment.
- Fence the area and post warning signs if trespassing is likely.
- Drain the basin between storm events.

Construction Verification

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

Maintenance, Inspection and Removal

- Inspect the sediment basin weekly and after each storm event.
- Remove and properly dispose of sediment when it accumulates to one-half the design volume. Proper disposal of sediment may entail placement at a stock pile or other area up gradient of the pond. Spread it out to allow drying and then stabilize it.
- Check the embankment, emergency spillway and outlet for erosion damage, piping, settling, seepage or slumping along the toe or around the barrel and repair immediately.
- Remove trash and other debris from the riser, emergency spillway and pool area.
- Clean or replace the gravel around the riser if the sediment pool does not drain properly.
- Remove the basin after the drainage area has been permanently stabilized, inspected and approved. Do so by draining any water (see Dewatering), removing the sediment to a designated disposal area, smoothing the material to blend with the surrounding area; and then stabilize. If this temporary sediment basin is to be converted to a permanent storm water control measure, or SCM, such as a detention, retention or infiltration basin, refer to your plans and specifications. Make sure the site is entirely stabilized before the permanent device becomes operational (no sediment-laden water should be entering the SCM.)
- Remove the temporary device and stabilize the site prior to filing *Form H - Request for Termination of a General Permit*, Form--MO 780-1409 (see Chapter 1 -Missouri Permit Requirements) for termination of permit coverage.

Common Problems and Solutions

Problem	Solution
Seepage is encountered during construction.	It may be necessary to install drains.
Variations in topography on-site indicate sediment basin will not function as intended.	Consult with registered design professional.
Design specifications for fill, pipe, seed variety or seeding dates cannot be met.	Substitutions may be required. Unapproved substitutions could lead to failure.
Piping failure along conduit caused by improper compaction, omission of anti-seep collar, leaking pipe joints or use of unsuitable soil.	Repair embankment using proper construction methods and materials.
Erosion of spillway or embankment slopes caused by inadequate vegetation or improper grading and sloping.	Repair using proper grades and slopes. Stabilize with vegetation, erosion control blankets or other erosion control stabilization practices. install rip-rap, turf reinforcement mats, transition mat or other appropriate material to finished grade if the spillway is not to be vegetated.
Riser and barrel blocked with debris	Remove debris and install trash guard.

Problem	Solution
Overtopping of the principal and emergency spillway caused by undersized principal or spillway design.	Repair erosion damage and reevaluate spillway design.
Frequent operation of emergency spillway and increased erosion potential caused by lack of maintenance.	Clean the sediment out of the basin on a regular basis.
Frequent operation of emergency spillway and increased erosion potential caused by undersized principal spillway.	The sediment basin was designed with insufficient volume. Enlarge the basin or install additional sediment traps upstream in the watershed.
Slumping or settling of embankment caused by inadequate compaction or use of unsuitable soil.	Repair damage with suitable, well compacted material.
Slumping failure caused by steep slopes.	Flatten slopes.
Severe erosion below principal spillway caused by inadequate outlet protection.	Install adequate outlet protection.
Turbid water coming out of outfall pipe; small clay particles do not have sufficient time to settle out. The primary problem is that too much sediment is coming from above. Take needed steps to reduce the overloading of sediment to the basin.	Consult with the registered design professional to pursue additional features such as installation of a pre-sediment basin, addition of baffles or addition of particle curtains.

Do not apply water clarifying chemicals such as polymers to the final sediment basin. If the choice is made to use water clarifying chemicals earlier in the treatment process, see Chemical Application for Turbidity Reduction. Note any restrictions or controls required in federal, state or local regulations.