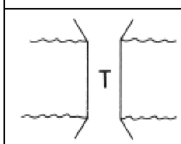
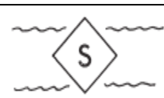
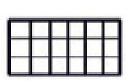
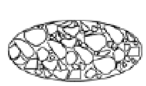
4.0 OVERVIEW OF MANAGEMENT PRACTICES

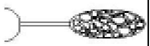
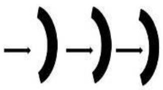
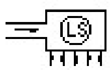
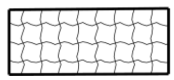
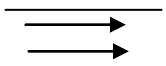
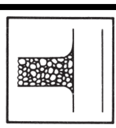
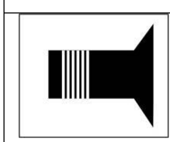
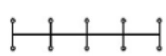
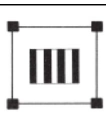
This section covers each management practice in a manner to help the user understand when each practice can or should be used. It should be the first step towards determining which practices should be incorporated into the Stormwater Pollution Prevention Plan (SWPPP). This section does not contain design information and guidance. Section 7 of this manual should be consulted for that information.

4.1 SYMBOLS

The following table contains standard symbols for structural management practices. Note that Site Preparation management practices (Practices 7.1 through 7.5) are a component of the initial site planning and overall site management and therefore do not have specific symbols. Management practices are grouped by management practice category: Site Preparation, Stabilization, Pollution Prevention, Runoff Control and Management, Sediment Control, and Stream Protection Practices.

Table 4.1 Management Practices Symbols

STREAM PROTECTION PRACTICES		**POLLUTION PREVENTION PRACTICES**	
STREAM BUFFER DO NOT DISTURB	7.41 Stream Buffers	CONCRETE WASHOUT	7.16 Concrete washout
	Stream Diversion Channel	VEHICLE MAINTENANCE	7.17 Vehicle maintenance
	7.43 Temporary Stream Crossing	CHEMICAL STORAGE	7.18 Chemical storage
	7.44 Bioengineered Stream Bank Stabilization	DEBRIS MANAGEMENT	7.19 Trash and debris
RUNOFF CONTROL PRACTICES		**STABILIZATION PRACTICES**	
	7.20 Check Dam	MU	7. 6 Disturbed Area Stabilization with straw mulch
	7.21 Dewatering Treatment Practice	MO	7.7 Disturbed area stabilization with other mulches
	7.23 Outlet Protection	PS	7.8 Disturbed Area Stabilization with Permanent Vegetation

	7.24 Slope Drain	SO	7.9 Disturbed Area Stabilization with Sod
	7.25 Tubes and Wattles	TS	7.10 Disturbed Area Stabilization with Temporary Vegetation
	LEVEL SPREADER 7.26 Level Spreader		7.11 Rolled Erosion Control Products
	7.27 Channels	HYD	7.12 Hydro Applications
SEDIMENT CONTROL PRACTICES		B	7.13 Soil binders and tackifiers
	7.28 Construction Exit	PLAS	7.14 Emergency stabilization with plastic
	7.29 Tire washing facility	SE	7.15 Soil Enhancement
	7.30 Filter Ring	**SEDIMENT CONTROL PRACTICES**	
	7.31 Sediment Basin	CRS	7.36 Construction Road Stabilization
	7.32 Sediment Trap		7.37 Tubes and Wattles (Sediment Control)
	7.33 Baffles	F Berm F Berm F Berm	7.38 Filter berm
	7.34 Silt Fence		7.39 Turbidity curtain
	7.35 Inlet Protection	F	7.40 Flocculants

PRACTICE 7.1: IDENTIFYING SENSITIVE OR CRITICAL AREAS

See Chapter 7, Page 90

Orange safety fencing was used as a visual marker to keep construction activity out of a stream buffer.

Purpose and Application. Identifying sensitive areas on a development site in preparation for construction has many benefits, including lowering the cost of the development. Protecting these areas is much more cost effective than replacing or repairing them after they have been impacted by construction.

Description. Before construction begins on the project, locate and visually mark sensitive areas such as streams and Aquatic Resources Alteration Permit boundaries, buffers, wetlands, sinkholes, caves, critical habitat, and historical areas. Markers can include brightly colored flagging or barrier fencing but should be different from other construction marking and flagging. Areas that pose certain neighborhood danger should also be marked such as sediment ponds.

Limitations Local requirements for tree protection may be more stringent than orange construction fencing such as requiring chain link fence.

Maintenance. Whatever method is chosen to identify sensitive or critical areas must be maintained to ensure the measures remain in good repair and visible. This is especially important when there are multiple subcontractors on a project which may be otherwise unaware of the sensitive or critical areas.

PRACTICE 7.2: CONSTRUCTION SEQUENCING

See Chapter 7, Page 93

The construction sequence noted that fill slopes were to be stabilized as construction above the slopes continued.

Purpose and Application. Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of minimizing erosion and controlling sediment during construction. The removal of surface ground cover leaves a site vulnerable to accelerated erosion. Construction procedures that limit land clearing, provide the timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

Description. The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for a project. The construction schedule must be included in the SWPPP and be modified in the field as site conditions change. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

TN Requirements. There may be specific sequencing requirements such as the time of year that clearing can occur on a project due to the presence of endangered or threatened species.

Limitations. Construction sequencing is done on every project to some degree by necessity due to the various trades that may be employed to construct a project. Erosion prevention and sediment control needs to be a factor considered in the construction schedule while balancing other scheduling demands. For example, a clearing contractor may want to make one trip to a project to clear the entire area even though active grading may progress more slowly resulting in cleared areas that will be subject to erosion for a long period of time placing a greater demand on sediment control measures.

Maintenance. Revising the construction schedule to continually consider the erosion prevention and sediment control factor along with the other competing factors such as weather, subcontractor availability, coordination of different trades, etc. is essential.

PRACTICE 7.3: TOPSOILING

See Chapter 7, Page 95

The contractor applied topsoil over the cut slope before applying seed and mulch.

Purpose and Application. Topsoil provides the major zone for root development and biological activities for plants, and should be stockpiled and spread wherever and whenever (i.e. in a timely manner) practical for establishing permanent vegetation.

Description. Topsoiling is a common practice where ornamental plants or high maintenance turf will be grown. It may also be required to establish vegetation on shallow soils, soils containing potentially toxic materials, very stony areas, and soils of critically low pH.

Advantages of topsoil include higher organic matter, more friable consistency, and greater available water-holding capacity and nutrient content. In addition, infiltration can be enhanced by re-spreading topsoil in areas that have been disturbed by construction activity. In some cases, however, handling costs may be too high to make this practice cost-effective. In site planning, the option of topsoiling should be compared with that of preparing a suitable seedbed in the existing subsoil.

Limitations. Do not place topsoil on slopes steeper than 2:1 without additional engineered slope stabilization practices to avoid slippage.

Maintenance. Establishment of vegetation as soon as possible after spreading topsoil is essential for preventing erosion of the topsoil.

PRACTICE 7.4: TREE PRESERVATION

See Chapter 7, Page 98

The contractor installed chain-link fence around the "drip line" of the trees prior to construction.

Purpose and Application. Preserving and protecting trees can often result in a more stable and aesthetically pleasing site. Trees stabilize the soil and help prevent erosion, decrease storm water runoff, moderate temperature, provide buffers and screens, filter pollutants from the air, supply oxygen, provide habitat for wildlife, and increase property values.

Description. Some desirable characteristics to consider in selecting trees to be protected include: tree vigor, tree species, tree age, tree size and shape, tree location, and use as wildlife food source. Trees on stream banks may be required to be protected if they are located in a regulated stream buffer area.
Construction activities are likely to injure or kill trees unless adequate protective measures are taken close to the trees. Direct contact by equipment is the most obvious problem, but damage is also caused by root zone stress from filling, excavating, or compacting too close to trees. Trees to be saved should be clearly marked so that no construction activity will take place within the "drip line" of the tree.

Limitations. Isolating the areas around trees may severely limit the available land at a construction site and may require special planning by the contractor to access some parts of the project.

Maintenance. Tree preservation methods must be maintained to ensure the measures remain in good repair and visible. This is especially important when there are multiple subcontractors on a project which may be otherwise unaware of the sensitive or critical areas.

PRACTICE 7.5: SURFACE TRACKING

See Chapter 7, Page 102

This slope has been tracked, seed applied and then mulched. Tracking helps control erosion, hold seed in place, and aids uniform vegetation germination.

Purpose and Application. Roughening a sloping bare soil surface with horizontal depressions helps control erosion by aiding the establishment of vegetative cover with seed, reducing runoff velocity, and increasing infiltration. The depressions also trap sediment on the face of the slope.

Description. Tracking is typically performed with a bulldozer, working up and down a slope. Tracking should always leave horizontal tracks, as opposed to vertical tracks. Equipment such as bulldozers with rippers or tractors with disks may also be used. The final face of slopes should not be bladed or scraped to give a smooth hard finish.

Limitations. Consider tracking on all slopes. The amount of tracking required depends on the steepness of the slope and the type of soil. Stable rocky faces of a slope may not require tracking or stabilization, while erodible slopes steeper than 3:1 require special surface roughening. This measure needs to be used in conjunction with other practices such as temporary seeding and mulch to prevent erosion and sedimentation.

Maintenance. Seed and mulch should be applied as soon as practicable on a tracked slope.

PRACTICE 7.6: STABILIZATION WITH STRAW MULCH

The cut slopes have been rough graded but not final graded. Straw mulch provides a temporary groundcover that reduces erosion until the final grading can occur.

See Chapter 7, Page 104

MU

Purpose and Application. Surface mulch is the most effective, practical means of controlling erosion on disturbed areas before establishing vegetation. Mulch protects the soil surface, reduces runoff velocity, increases infiltration, slows soil moisture loss, helps prevent soil crusting and sealing, moderates soil temperatures, and improves the microclimate for seed germination.

Description. Organic mulch such as straw is effective for general use where vegetation is to be established. Straw mulch is most effective when it has been anchored with matting, crimping or a tackifier to prevent its movement. In recent years a variety of mats and fabrics have been developed that make effective mulches for use in critical areas such as waterways and channels. Various types of tacking and netting materials are used to anchor organic mulches. Netting is generally not effective when used alone.

TN Requirements. Application of temporary or permanent stabilization must be initiated within 14 days to disturbed areas of a site where construction activities have temporarily or permanently ceased.

Limitations. Mulch is not intended to withstand the shear stress of concentrated flow; therefore, mulching a ditch must be accomplished in conjunction with other velocity reducing measures such as check dams or through the use of an engineered ditch lining material such as a turf reinforcement mat.

Maintenance. Maintenance of a good cover of mulch is one of the most effective erosion prevention measures because it helps prevent movement of the soil thereby reducing the need for sediment control measures. Maintenance of mulch can include but is not limited to applying more mulch where it has blown or washed away, securing the mulch through such actions as crimping or diverting run-on storm water from the mulched area to prevent future wash-outs.

PRACTICE 7.7: STABILIZATION WITH OTHER MULCH MATERIALS

See Chapter 7, Page 107

MO

Shredded wood chip mulch applied 2-3" thick can be used as temporary stabilization

Purpose and Application. Surface mulch is the most effective, practical means of controlling erosion on disturbed areas before establishing vegetation. Mulch protects the soil surface, reduces runoff velocity, increases infiltration, slows soil moisture loss, helps prevent soil crusting and sealing, moderates soil temperatures, and improves the microclimate for seed germination.

Description. There are many types of mulches. Selection of the appropriate type of mulch should be based on the type of application, site conditions, and compatibility with planned or future uses. Besides straw mulch (practice 7.6), other materials can be used as mulches, including wood chips, shredded bark and gravel. Use of onsite materials as mulch is strongly encouraged to reduce the environmental footprint of the site. For example, trees and other vegetation cleared from the site can be ground and used as mulch material for the site.

TN Requirements. Application of temporary or permanent stabilization must be initiated within 14 days to disturbed areas of a site where construction activities have temporarily or permanently ceased.

Limitations. Some mulch materials float when in contact with stormwater runoff and should not be placed in areas receiving concentrated flow. In addition, offsite mulch materials should be certified as free from fire ants. Mulch is not intended to withstand the shear stress of concentrated flow; therefore, mulching a ditch must be accomplished in conjunction with other velocity reducing measures such as check dams or through the use of an engineered ditch lining material such as a turf reinforcement mat.

Maintenance. Maintenance of a good cover of mulch is one of the most effective erosion prevention measures because it helps prevent movement of the soil thereby reducing the need for sediment control measures. Maintenance of mulch can include but is not limited to applying more mulch where it has blown or washed away, securing the mulch through such actions as crimping, or diverting run-on storm water from the mulched area to prevent future wash-outs.

PRACTICE 7.8: TEMPORARY VEGETATION

A temporary ground cover was applied to this area because final grading was not to occur until spring.

See Chapter 7, Page 109

TS

Purpose and Application. Protective cover must be established on all disturbed areas within 14 days after a phase of grading is completed. Temporary seeding and mulching are the most common methods used to meet this requirement. Temporary vegetation is used to protect earthen sediment control practices and to stabilize denuded areas that will not be brought to final grade for several weeks or months. Temporary vegetation can also provide a nurse crop for permanent vegetation, provide residue for soil protection and seedbed preparation, and help prevent dust during construction.

Description. Annual plants that are adapted to site conditions and that sprout and grow rapidly should be used for temporary plantings. Proper seedbed preparation and the use of quality seed are also important.

TN Requirements. Application of temporary or permanent stabilization must be initiated within 14 days to disturbed areas of a site where construction activities have temporarily or permanently ceased.

Limitations. Because temporary seedings provide protective cover for less than one year, areas must be reseeded annually or planted with perennial vegetation.

Maintenance. Generally, the more effort put into proper seedbed preparation, applying appropriate and adequate seed and mulch, and initial watering during germination, the less maintenance needs such as overseeding, reapplying mulch, and extended watering will be required.

PRACTICE 7.9: PERMANENT VEGETATION

See Chapter 7, Page 113

PS

Permanent vegetation is the most effective erosion prevention practice.

Purpose and Application. Permanent vegetation controls erosion by physically protecting a bare soil surface from raindrop impact, flowing water, and wind. Vegetation binds soil particles together with a dense root system and reduces the velocity and volume of overland flow. It is the preferred method of surface stabilization wherever site conditions permit.

Description. Seeding with permanent grasses and legumes is the most common and economical means of establishing a protective cover. The advantages of seeding over other means of establishing plants include the relatively small initial cost, wide variety of grasses and legumes available, lower labor input, and ease of application. Problems to consider are potential for erosion during the establishment period, the need to reseed areas, seasonal limitations on seeding dates, weed competition, and the need for water during germination and early growth. Give special attention to selecting the most suitable plant material for the site and intended purpose. Good seedbed preparation such as topsoiling (see practice 7.3), adequate liming and fertilization, and timely planting and maintenance are also important for good germination and establishment of a permanent groundcover.

TN Requirements. Application of temporary or permanent stabilization must be initiated within 14 days to disturbed areas of a site where construction activities have temporarily or permanently ceased.

Limitations. Establishing permanent vegetation within concentrated flow paths such as swales and ditches will likely require special considerations such as rolled erosion control products (see practice 7.11) to protect the seed and seedbed during (and possibly after) germination.

Maintenance. Generally, the more effort put into proper seedbed preparation, applying appropriate and adequate seed and mulch, and initial watering during germination, the less maintenance needs such as overseeding, reapplying mulch, and extended watering will be required.

PRACTICE 7.10: SOD

See Chapter 7, Page 122

SO

Sod is a fast and effective method of stabilizing bare soils.

Purpose and Application. Sodding provides an immediate and effective groundcover. It allows the use of vegetation to protect channels, spillways, and drop inlets where design flow velocities may reach the maximum allowable for the type of vegetation to be used. Sod is preferable to seed in waterways and swales because of the immediate protection of the channel after application. The installation of sod should also be considered in locations where a specific plant material cannot be established by seed or when immediate use is desired for aesthetics such as landscaping. Some additional advantages of sod are nearly year-round establishment capability, less chance of failure, freedom from weeds, and immediate protection of steep slopes.

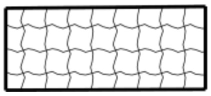
Description. Sod consists of grass or other vegetation-covered surface soil held together by matted roots.

Limitations. Disadvantages include high installation costs, especially on large areas, and the necessity for irrigation in the early weeks. Sod also requires careful handling and is sensitive to transport and storage conditions.

Maintenance. Soil preparation, installation, and proper maintenance are as important with sod as with seed. Choosing the appropriate type of sod for site conditions and intended use is of utmost importance. Sod may need to be pinned in place on steep slopes and in channel applications.

PRACTICE 7.11: ROLLED EROSION CONTROL PRODUCTS

See Chapter 7, Page 126



Turf reinforcement mats are appropriate where concentrated flows exceed the design sheer stress for the channel. (source: NCSU)

Purpose and Application. Rolled erosion control products (RECPs) hold seed in good contact with the soil to promote seed germination and soil stabilization.

Description. These products are temporary degradable or long-term nondegradable material manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation. Use RECP's to help permanent vegetative stabilization of slopes 2:1 or greater and with more than 10 feet of vertical relief, as well as, channels when sheer stress in the channel exceeds the allowable sheer stress for the 2 year storm event.

Limitations. Installation is critical to the effectiveness of these products. When close ground contact is not properly achieved, runoff can concentrate under the product causing significant erosion.

Maintenance. Monitor the products on a regular basis to avoid significant problems caused by rainfall and high flows.

PRACTICE 7.12: HYDRO APPLICATIONS

Hydraulically applied seed, mulch and binder

See Chapter 7, Page 129

HYD

Purpose and Application. Hydro applications such as hydroseeding and bonded fiber matrices (BFM) are an economical means of applying and securing seed. Its greatest applications are on steep slopes with limited equipment access or on flat terrain where there will be very limited sheet flows.

Description. BFMs contain fibers joined together by adhesive and mineral binders to create a continuous, three dimensional erosion control blanket, which adheres to the soil surface. Hydroseeding materials typically consist of a slurry of seed, fertilizer, mulch, and a tackifier.

Limitations. Hydraulic mulch applications do not provide erosion protection on slopes generally greater than 4:1 or 5:1. However, BFM can be applied on steeper slopes effectively. Failure of either material is typically due to low application rates or improper mixing of materials.

Maintenance. Ensuring that adequate coverage of the slurry is applied is critical; otherwise, maintenance needs such as reapplication or supplementing with other forms of temporary or permanent stabilization will increase.

PRACTICE 7.13: SOIL BINDERS AND TACKIFIERS

See Chapter 7, Page 131

A soil binder is sprayed over a bare soil surface that has been properly tracked (see practice 7.5).

Purpose and Application. Soil binders are materials that are typically used alone to provide erosion control and surface protection for exposed soils. In general, soil binding materials do not provide the microclimatic modification that is provided by mulches or blankets and therefore do not have the same successful germination that mulches provide. They work by binding the upper layer of soil together, forming a crust on the surface so that soil particles resist being suspended in surface flows. Although they form a surface crust, most of the materials do not seal the surface to the point where infiltration is prevented, so they do not prevent the establishment of vegetation.

Description. Tackifiers are materials used to bind mulches together to achieve better adhesion of materials to the soil. When straw or hay mulch is spread, it must either be crimped or bound together with a tackifier to keep it from blowing away or migrating down the slope. The tacking material must be applied uniformly over the surface of the mulch or soil. The result of a properly applied tackifier is a continuous and connected blanket of mulch and tackifier.

TN Requirements. Application of temporary or permanent stabilization must be initiated within 14 days to disturbed areas of a site where construction activities have temporarily or permanently ceased.

Limitations. Soil binders are temporary and must be re-applied after exposure to rain.

Maintenance. Soil binders or tackifiers need to be re-applied after exposure to rain if these measures continue to be necessary because construction activities have ceased temporarily.

PRACTICE 7.14: EMERGENCY STABILIZATION WITH PLASTIC

See Chapter 7, Page 137

PLAS

Temporary covering was used to protect the topsoil stockpile from erosion.

Purpose and Application. Exposed slopes are common around box culvert construction, utility work and stockpile areas. Often, temporary seeding of these areas is not feasible due to the slope or activity on or around them. In situations where soils are exposed and in close proximity to receiving streams, plastic sheeting can provide a temporary ground cover that prevents erosion and off site sediment discharges.

Description. Plastic sheeting must be anchored or held in place to prevent the material from moving. Rocks or other weight can be placed on the sheeting or the sheeting can be trenched in at the top and toe of the slope.

Limitations. Plastic sheeting is a very short term practice for use on exposed slopes in close proximity to streams or wetlands.

Maintenance. Plastic sheeting should be replaced when torn, and care should be taken when overlapping sections of plastic by doing so in a shingle fashion to shed storm water.

PRACTICE 7.15: SOIL ENHANCEMENT

See Chapter 7, Page 139

SE

Development practices often lead to compacted soils, drought sensitive lawns, and high storm runoff contributing to downstream flooding.

Purpose and Application. Soil enhancement refers to techniques employed at a construction project that can enhance infiltration and establishment of a permanent groundcover. Any portion of a construction site that has been graded can benefit from soil enhancement techniques.

Description. Soil enhancement includes the addition of materials to promote vegetative establishment and infiltration. Urban areas are plagued with drainage problems caused, in part, by poor soil management practices at new development sites. Removing the existing vegetation and disturbing and compacting soils is inherent to construction. When disturbance is unavoidable, several techniques can be employed at a site to reverse at least a portion of the damage caused to the soil structure and to increase infiltration. Those techniques include preserving and redistributing topsoil over disturbed areas, deeply tilling disturbed soils to break any crusted or hard panned soils, adding organic matter such as compost to the top 6 inches of soil, reintroducing soil biota, adjusting soil fertility to support vegetation, and planting deep rooted vegetation.

Limitations. These techniques must be used in conjunction with other techniques, such as rolled erosion control products, seed and mulch, to establish a permanent vegetative cover.

Maintenance. Continue to maintain sediment controls down gradient from areas where soil enhancement techniques are being employed. Repair erosion rills early to avoid reapplication or reworking areas where soil enhancement has been applied.

PRACTICE 7.16: CONCRETE WASHOUT

Concrete washout areas should be provided on each construction site where concrete work occurs.

See Chapter 7, Page 142

CONCRETE WASHOUT

Purpose and Application. Concrete washout areas are areas on a construction site designated for concrete trucks and other equipment to clean liquid or slurry concrete off the equipment without causing stormwater pollution. When washout areas are used, the slurry is given time to harden and then can be removed without discharging pollutants from the project.

Description. Concrete is a very common building material which is used in road and street construction, drainage structures, retaining walls, footings and foundations, building construction and many other applications. Concrete slurry has the potential to pollute storm water runoff, especially when washout occurs next to natural drainage channels or storm drain inlets. Concrete is most harmful to streams in the slurry form, though once hardened, it can cause blockage of storm drain systems and severely reduce the capacity of the storm drain system or waters of the state. Designated locations for concrete washout should be provided with clearly visible signage on each construction site. Concrete washout areas can be constructed above ground or below ground. They include a storage area lined with a geotextile fabric to allow infiltration of water while preventing the discharge of solids. Some liners are impermeable and rely on evaporation and concrete hardening to remove the liquid. Once the concrete has hardened, it can be busted up and removed from the project.

TN requirements. Measures must be contained in the SWPPP and reflected in the field to control construction related wastes, such as concrete slurry, and prevent the discharge of pollutants from the site.

Limitations. Do not locate concrete washout areas close to streams, sinkholes, wetlands or other sensitive features.

Maintenance. Remove concrete once hardened to ensure there is storage for additional concrete washout. Inspect the liner for rips and replace when necessary.

PRACTICE 7.17: VEHICLE MAINTENANCE

See Chapter 7, Page 145

VEHICLE MAINTENANCE

When fuel or lubricants are stored on a construction project, measures must be taken to prevent spills from causing storm water pollution. No measures were taken around the tanks above.

Purpose and Application. Materials used to maintain and service vehicles onsite can mix with stormwater and discharge pollutants off the construction project and into waters of the state. Where solvents, fuels and other chemicals are stored on a project, precautions must be taken to prevent pollutant discharge.

Description. Equipment on construction sites may need maintenance during the life of the project. It is preferable for equipment to be serviced and maintained off the construction project in a location that has a treatment system in place to prevent pollutant discharges such as oil or vehicle spills. However, offsite maintenance may not be an option. Maintenance activities on construction equipment or vehicles on the construction project require specific attention to potential sources of pollution, such as fuel and lubricant drums. These materials must be handled and disposed of in a manner that prevents the material from mixing with stormwater and discharging into the storm drain system or waters of the state.

Use controls such as drip pans and containment barriers when maintenance activities occur on a project to prevent stormwater contamination. If maintenance activities require fuel and lubricant storage tanks to be stored on the project, secondary containment or weatherproof covers must be provided to prevent spills. Designate an area for vehicle maintenance and keep spill containment and cleanup materials at this location.

Limitations. Where spills have occurred and soils are saturated, contact TDEC's EFO. Soils may have to be excavated and treated or disposed of offsite.

Maintenance. Watch for signs that construction equipment needs maintenance, such as soil staining from oils and lubricants, and have equipment repaired to prevent discharges.

PRACTICE 7.18: CHEMICAL STORAGE

See Chapter 7, Page 147

CHEMICAL STORAGE

Pouring chemicals into storm drains causes an illicit discharge of pollutants that ultimately reach waters of the state.

Purpose and Application. Proper storage and disposal of chemicals on a construction site prevents or reduces the discharge of pollutants to stormwater from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials.

Description. Accidental releases of materials from aboveground liquid storage tanks, drums, dumpsters, or other containers have the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from storage containers and dumpsters may accumulate in soils or on the surfaces and be carried away by stormwater runoff into waters of the state. Chemicals stored on a construction site should be stored in a weatherproof building or container. Other options include storing chemicals within a containment system. Store chemicals in a centralized location. Keep spill containment and cleanup materials at the chemical storage area. Do not washout or pour leftover chemicals into the storm drain system.

Limitations. Specific spill containment and clean up procedures should be developed for each site, based upon the materials being stored. Use MSDS sheets provided with the chemicals for guidance on storage, cleanup and disposal.

Maintenance. Ensure all employees and subcontractors on the construction project have been trained on the proper use, storage and disposal of the chemicals.

PRACTICE 7.19: TRASH AND DEBRIS MANAGEMENT

Construction material waste and trash should be isolated and managed in designated areas to prevent offsite damage and pollution.

See Chapter 7, Page 149

DEBRIS MANAGEMENT

Purpose and Application. Construction inherently produces waste materials, including building waste debris, employee-generated trash, waste concrete and asphalt. These materials can mix with stormwater and discharge off the construction site.

Description. Designated waste management areas should be identified throughout the construction project, separating trash from reusable or recyclable materials. Materials prone to leaching should be stored in covered dumpsters. All materials should be stored in a manner to prevent wind from blowing the material off site.

TN Requirements. The Construction General Permit states that the SWPPP shall include a description of controls used to reduce pollutants from materials stored on site, including storage practices to minimize exposure of the materials to storm water, and spill prevention and response.

Limitations. Locate trash and debris stockpile areas away from streams, storm drains, sinkholes and other sensitive features.

Maintenance. Ensure that any debris containment measures are in good working condition. Pick up and dispose of trash located throughout the project. Educate employees and contractors about the proper disposal of all waste.

PRACTICE 7.20: CHECK DAM

See Chapter 7, Page 152

Check dams can be used to reduce velocities in channels to aid in permanent stabilization. (source: NCSU)

Purpose and Application. Check dams are structures installed in channels to reduce velocities and erosion. Check dams also provide some sediment control benefit. Check dams may be installed to reduce velocity in small temporary channels that are degrading, but where permanent stabilization is impractical due to their short period of usefulness; or to reduce velocity in small eroding channels where construction delays or weather conditions prevent timely installation of non-erosive liners.

Description. A check dam is a small, temporary structure constructed across a drainageway (not a stream). Most check dams are constructed of rip rap. However, other manufactured check dam devices are available. Check dams must contain a center spillway section that is lower than the check dam sides. When rip rap is used, geotextile or filter fabric must be installed at the soil-rock interface. Place washed stone on the face of the rip rap check dam.

Limitations. The drainage area is limited to 5 acres maximum. Problems with check dams typically occur at the abutments when the sides are lower than the middle spillway, causing erosion around the abutments. Erosion can also occur at the downstream toe of the check dam. These measures must be monitored and sediment cleaned out from behind the structures to prevent overtopping and failure. In addition, ponding behind the structures must not cause a traffic hazard.

Maintenance. Sediment should be cleaned out from behind check dams when 50% of the storage capacity has been filled with sediment. Particular attention must be given to check dam abutments and the downstream toe, as these areas are susceptible to erosion.

PRACTICE 7.21: DEWATERING TREATMENT PRACTICE

See Chapter 7, Page 155

Dewatering structures are often needed when working in a stream on the construction of box culverts.

Purpose and Application. Dewatering treatment practices treat water that is pumped from excavations into the treatment areas. Treatment can include filtering, chemical flocculation, or settling of sediments prior to discharging stormwater. Dewatering treatment practices are typically necessary in conjunction with utility work and instream construction activities such as box culvert, pipe or bridge construction.

Description. Dewatering treatment practices are temporary practices that include manufactured and non-manufactured products. Where fine clay soils are present in stormwater runoff, chemical treatment with flocculants may be necessary. These practices must be identified and sited during SWPPP preparation to ensure that there is room for the practice and that the practice can be maintained while in use.

Limitations. Problems with dewatering structures typically occur when the pump discharges a higher volume of water than the structure can handle or when the structure is not maintained. Removal and disposal of geotextile bags, like the one shown above, can also cause problems if overfilled or located too close to a stream.

Maintenance. Ensure that the treatment practice is either cleaned out or removed once the storage is full. Visually verify that discharges from the treatment practices are not turbid. Filter bag removal method must be considered before relying on a filter bag for dewatering treatment.

PRACTICE 7.22: DIVERSION

Diversions convey stormwater around or through a site. They can be temporary or permanent measures.

See Chapter 7, Page 160

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Purpose and Application. Diversions carry runoff around a construction area; to reduce slope length and minimize erosion; or to carry sediment laden runoff to a treatment practice. They can be designed as temporary or permanent measures and must be stabilized accordingly.

Description. Diversions can be created through excavation or by building a ridge. This practice applies to construction areas where runoff can be diverted and disposed of properly to control erosion, sedimentation, or flood damage. Specific locations and conditions include above disturbed existing slopes, and above cut or fill slopes to prevent runoff over the slope; across unprotected slopes, as slope breaks, to reduce slope length; below slopes to divert excess runoff to stabilized outlets; where needed to divert sediment-laden water to sediment traps; at or near the perimeter of the construction area to keep sediment from leaving the site; and above disturbed areas before stabilization to prevent erosion, and maintain acceptable working conditions. Temporary diversions may also serve as sediment traps when the site has been over excavated on a flat grade. They may also be used in conjunction with silt fence.

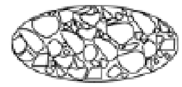
Limitations. Unless stabilized, diversions can exacerbate erosion prevention and sediment control on a project.

Maintenance. After diversions have been constructed, stabilize them against erosion. Sediment deposits should be removed to prevent overtopping of the diversion. Additional erosion controls, such as check dams, may be necessary to reduce erosion.

PRACTICE 7.23: OUTLET PROTECTION

Outlet protection is necessary at the outlets of pipes, ditches and other conveyances where sheer stress exceeds the allowable sheer stress for grass-lined channels.

See Chapter 7, Page 165



Purpose and Application. Outlet protection provides permanent stabilization for the material at the outlet of the pipe, channel or other conveyance system. Outlet protection is also needed at outlets to temporary slope drains to prevent scour while the slope drain is in place.

Description. Outlet protection can be constructed of many different types of erosion-resistant materials but must be designed based upon the velocity and sheer stress at the outlet of the conveyance. Rip rap is a common outlet protection material. Outlet protection must be keyed into the existing ground and constructed as close to a zero grade as possible. For rip rap outlet protection, a geotextile underlayment or filter fabric is required to prevent piping.

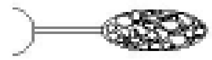
TN Requirements. Outfall installation and outlet protection at the end of a stream crossing within a stream must always be specifically permitted through the Aquatic Resource Alteration Permit for the culvert or bridge.

Limitations. An often-overlooked consideration in outlet protection installation is the over excavation required to sufficiently key in the riprap. In addition, the size of riprap required to withstand the force of the water exiting the pipe may be prohibitive (i.e. too large) and other methods may need to be considered.

Maintenance. Monitoring for bypassing of the outlet protection and scour of the surrounding area is critical. This is a common problem when the outlet protection has either not been sufficiently keyed into the soil or the outlet protection is not sufficiently wide.

PRACTICE 7.24: SLOPE DRAIN

See Chapter 7, Page 173



The goal of a slope drain is to convey stormwater down a slope to prevent erosion while the slope is being stabilized.

Purpose and Application. Slope drains are temporary measures that are used where sheet or concentrated storm water flow could cause erosion as it moves down the face of a slope to prevent erosion from sheet or concentrated flow on or below the slope. Special attention is needed at entrance, tight joints, pipe anchors, and exit. These structures are removed once the slope has been stabilized and the permanent storm water conveyance system has been installed.

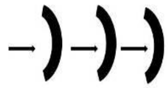
Description. Temporary slope drains consist of flexible tubing or conduit extending from the top to the bottom of a cut or fill slope. Sediment controls are installed at the inlet and erosion controls at the outlet. Prior to installing slopes drains, the slope being protected must be stabilized.

Limitations. The maximum drainage area to any one slope drain is 1 acre.

Maintenance. Stabilize the diversion berm at the top of the slope. Ensure that the slope drain is located in the low point above the slope. Remove sediment from the sediment control practice when 50% of the sediment storage volume has been filled. Ensure that the slope drain has been secured properly to the slope to prevent disconnection of pipe joints. Failure of the slope drains can occur when the anchor berm installed over the slope drain at the top of the slope hasn't been compacted or stabilized.

PRACTICE 7.25: TUBES AND WATTLES

See Chapter 7, Page 177



Wattles are used primarily as a flow interruption device to slow the velocity of storm water runoff across slopes and in roadside ditches and swales.

Purpose and Application. Wattles and tubes may be utilized on slopes or in small ditches to reduce flow velocities. While they are generally used at regular intervals on a slope, they may also be placed at the top or toe of the slope or at breaks in grade.

Description. Wattles and tubes consist of flexible tubes of biodegradable netting or geotextile fabric filled with natural fibers, hardwood mulch or other porous material. The filler material must have sufficient density to hold its shape when saturated, but must also have sufficient open space to allow sediment-laden water to pass through. These measures act to slow flow velocities so that sediments being carried in the runoff can drop out. The middle section of the wattle, tube or sock should be lower than the ends to prevent scour around the ends, and they must be securely staked in place. Manufacturer's installation instructions must be followed.

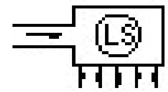
Limitations. Biodegradable wattles and tubes have a limited lifespan and may have to be replaced during the project. Wattles and tubes may have to be stacked to provide adequate erosion control.

Maintenance. Ensure flow is not bypassing the structures and that no evidence of scour is present on the downstream toe. Remove deposited sediments when 50% of the storage height is filled.

PRACTICE 7.26: LEVEL SPREADER

Level spreaders convert concentrated flow into sheet flow. (Source: NCSU)

See Chapter 7, Page 180



Purpose and Application. Level spreaders convert concentrated flow to sheet flow. The most prevalent application of level spreaders is converting concentrated flow into sheet flow before discharging into stream buffers.

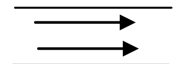
Description. Level spreaders can be constructed out of many different materials. They consist of a conveyance (a channel or diversion), energy dissipation, a ponding area, and a level lip. Stormwater should flow as sheet flow across the level lip. Construct level spreaders in undisturbed soil. The lip must be level to ensure uniform spreading of storm runoff, and the outlet slope uniform to prevent the flow from concentrating. Water containing high sediment loads should enter a sediment trap before release in a level spreader. The drainage area limitation is 5 acres and the spreader must be sized based on design runoff.

Limitations. If the lip of the level spreader is not level, stormwater will re-concentrate and cause erosion.

Maintenance. All areas draining to the level spreader must be stabilized. Sediment and other debris must be removed from the ponding area to prevent bypassing. Repair erosion areas.

PRACTICE 7.27: CHANNEL LININGS

See Chapter 7, Page 184



Stabilized channels convey stormwater non-erosively, encouraging infiltration and filtering runoff.

Purpose and Application. Channels are permanent structures that convey concentrated runoff. Many methods of permanent stabilization are available, including vegetation, vegetation with a permanent liner, rip rap, and concrete.

Description. The preferred channel lining is vegetation. Grass lined channels provide benefits above simply conveying stormwater runoff while maintaining a stable channel. The grass provides some filtering of stormwater after the site has been stabilized. In addition, grass lined channels are typically on gentle slopes with low velocities and promote infiltration. As shear stresses and slopes increase, rolled erosion control products (RECPs) should be incorporated into the channel stabilization design, leaving rip rap and concrete lined channels as the last options for stabilization, only where site conditions will not allow stabilization with grass and a liner (temporary or permanent). Temporary linings should be designed based upon the 2 year storm, while permanent linings are designed based upon the 10 year storm.

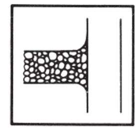
Limitations. Channels are designed based upon the 2-year and 10-year storm events. Storms larger than the design storm can cause channel linings to fail.

Maintenance. Once established, grass lined channels are easier to maintain long term than rip rap and concrete lined channels. However, once the channels are temporarily or permanently stabilized, they should be protected from construction activity – particularly runoff with heavy loads of sediment.

PRACTICE 7.28: CONSTRUCTION EXIT

Rock construction exits should be installed at each location that construction traffic leaves the construction project.

See Chapter 7, Page 205



Purpose and Application. Construction exits are temporary sediment control devices installed where ever construction traffic leaves an active construction site. Most often, construction exits are constructed of clean stone. However, several manufactured construction exits are available that do not include stone.

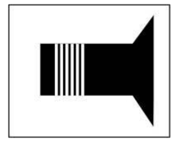
Description. Construction exits reduce or eliminate the transport of sediment from the construction site onto a public right of way. Rock construction exits should be constructed with 2”-3” sized clean stone, installed at least 6” deep. A geotextile underliner must be installed under the rock to prevent sediment from piping up through the rock from the underlying soil surface. In addition, the geotextile fabric underliner makes maintenance of construction exists easier. The rock construction entrance should extend the full width of the entrance area, sufficiently long for vehicles to drop mud and sediment and stable enough for construction traffic. Avoid entrances on steep grades or at curves in public roads. Stormwater must be properly managed around the construction exit to prevent washing sediment off the construction exit. In situations where a properly installed and maintained construction exit does not adequately clean tires before leaving the construction site, a more robust tire washing facility (see practice 7.29) may be necessary.

Limitations. Soils that contain a high percentage of clay may require a more robust tire washing facility.

Maintenance. When visual inspections note an excessive build up of sediment on the construction exit, the sediment and rock should be removed and replaced with clean stone. Sediment tracked off the construction project must be cleaned up before the next rain event or within 7 days, whichever is shorter.

PRACTICE 7.29: TIRE WASHING FACILITY

See Chapter 7, Page 209



Where tire washing facilities are installed, particular attention should be given to runoff management to prevent sediment from being discharged from the site.

Purpose and Application. Tire washing facilities should be used where rock construction exits do not provide adequate protection from tracking sediment and mud off the construction sites. Sites with high clay content soils may benefit from tire washing facilities. Long term construction projects may also benefit from tire washing facilities.

Description. Several different types of tire washing facilities can be constructed based upon the project longevity and the desire for an active or passive washing facility. Washing facilities can simply be a cattle guard design coupled with a water source and hose with sprayer or more robust such as a pre-fabricated tire washing facility. The washing facility must have provisions for intercepting and treating the sediment-laden wash water and directing it into a deposition area.

Limitations. If using this practice, an adequate source of water must be provided. In addition, the dirty water generated by the washing activity must be directed to a sediment basin or trap to be treated before being discharged. Stormwater runoff and process water handling around the tire washing facility must be adequately addressed in the SWPPP and throughout the life of construction to avoid traffic hazards and the discharge of untreated process water.

Maintenance. When visual inspections note sediment deposition in the wash water treatment practices, sediment must be removed and properly disposed. Sediment tracked off the construction project must be cleaned up before the next rain event or within 7 days, whichever is shorter.

PRACTICE 7.30: FILTER RING

See Chapter 7, Page 212

Filter rings should be part of an overall system of BMPs. Above, the filter ring is providing sediment control while the mulch is providing erosion control.

Purpose and Application. Filter rings are temporary sediment controls, constructed of rip rap and installed at the entrance to storm drains and culverts. To enhance settling, washed stone is placed on the upstream face of the filter ring.

Description. Filter rings include the rock berm and sediment storage area. They are installed at the entrance to storm drains and prevent sediment from entering, accumulating in and being transferred through the culvert or storm drain system. Filter rings are installed with a sediment storage area on the upstream side of the filter ring to aid in sediment deposition. Geotextile fabric is installed at the interface between the rock and soil to prevent piping under the structure.

Limitations. These practices are used at storm drain inlets with large drainage areas or at drop inlets that receive high velocity water flows, possibly from many directions. Sediment is captured in an excavated depression surrounding the inlet. When drainage area exceeds 1 acre, additional measures are necessary. This practice must not divert water away from the storm drain.

Maintenance. Sediment deposits must be cleaned out when half the storage capacity of the sediment deposition area has been filled. **It is important that all stormwater flow over the structure into the storm drain, and not past the structure.** Temporary diking below the structure may be necessary to prevent bypass flow.

PRACTICE 7.31: SEDIMENT BASIN

See Chapter 7, Page 215

A slotted drain pipe has been installed to dewater this basin. Note that discharge doesn't occur from this basin until the water level in the storage area reaches the bottom of the slotted drain pipe.

Purpose and Application. Sediment basins are temporary engineered structures designed to capture sediment from construction site stormwater runoff prior to being discharged.

Description. Sediment basins contain the following components: an embankment, a sediment storage area, a permanent pool, a sediment forebay, a principal and emergency spillway system, outlet protection at the outlet of the spillway barrel, and a dewatering mechanism. Sediment basins are constructed by building a low earthen dam across a drainageway, by excavating a storage area, or by a combination of both to form the sediment storage pool. A properly designed spillway outlet system with adequate freeboard is essential. The embankment should be well compacted and vegetated. A permanent pool of water is required to provide better settling efficiency, and dewatering from the top of the basin pool is required to also aid in settling efficiency.

TN Requirements. For an outfall in a drainage area of a total of 10 or more acres, a temporary sediment basin (or equivalent controls) is required that provides storage and a spillway system for controlling runoff from a 2 year, 24 hour storm for each acre drained. For impaired and high quality waters, sediment basins are required for a drainage area of 5 or more acres, and the basin must be designed to control volume of runoff from a 5 year, 24 hour storm. A permanent pool must be designed into the sediment storage zone. In addition, a sediment forebay is required to aid in maintenance. Discharges from sediment basins cannot cause an objectionable color contrast with the receiving stream.

Limitations. Sediment basins must be designed by an engineer or landscape architect. Basins typically require large areas for adequate settling, as the crucial design component for basins is available sediment storage zone surface area. A 4:1 length to width ratio is required.

Maintenance. Ease of basin cleanout and spoil disposal must be considered in site selection. The forebay decreases the frequency of dredging or cleaning out the sediment storage area in the basin.

Practice 7.32: Sediment Trap

See Chapter 7, Page 241

Half of the sediment storage volume should be in wet storage or a permanent pool to increase settling efficiency.

Purpose and Application. Sediment traps are temporary ponding areas formed by excavating a sediment storage area and constructing an earthen embankment with a simple rip rap spillway. They serve small drainage areas.

Description. Sediment traps have sediment storage areas, a permanent pool, an embankment, a spillway, and often also have porous baffles. Sediment traps should be constructed as a first step in any land disturbing activity, often in conjunction with diversions and other temporary measures. Geotextile fabric is installed at the interface of the rock spillway and soil. Sediment trap trapping efficiency can be improved by installing one or more baffles in the sediment storage area to remove turbulent flow, increasing the flow length through the measure, or facing the rip rap spillway with washed stone.

Limitations. The drainage area limitation for sediment traps is 5 acres or less of total contributing area. Supplemental stormwater runoff treatment may be necessary for clayey soils to lower the turbidity.

Maintenance. Sediment should be removed when 50% of the storage capacity has been filled with sediment to prevent overtopping and failure of the measure. Access to the sediment trap must be considered in the design and location of traps to facilitate cleanout. Ensure that stormwater doesn't bypass the measure by constructing diversions and/or berms to direct flow into the trap.

PRACTICE 7.33: BAFFLES

See Chapter 7, Page 246

Baffles increase the settling efficiency of sediment traps and basins.

Purpose and Application. Porous barriers installed in sediment basins, sediment traps, or skimmer basins to reduce the velocity and turbulent flow of the water flowing through the structure. Baffles facilitate settling and sediment before discharge.

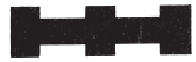
Description. Baffles are constructed out of porous materials such as jute or coir and installed perpendicular to flow through the practice. Two to three baffles should be installed in each sediment storage area to divide the storage area into deposition zones. Polymers, such as polyacrylamide, can be used in conjunction with baffles to greatly improve settling in the practice.

Limitations. Baffles should not be installed immediately down gradient from pipe outlets. It is essential to install the measure securely to avoid blow outs and other malfunctions. If baffles aren't installed correctly, short-circuiting around the sides or scour along the toe can occur.

Maintenance. The design life of the fabric is 6-12 months, but may need to be replaced more often if clogging occurs. Also, the majority of the settling in the sediment storage area will occur above the first baffle, making clean out of basins and traps easier.

PRACTICE 7.34: SILT FENCE

See Chapter 7, Page 250



Properly installed silt fence provides good sediment control around the perimeter of a construction site.

Purpose and Application. Silt fence is a permeable sediment barrier erected near small disturbed areas to capture sediment from sheet flow. Silt fence reduces the velocity of flow, allows deposition, and retains sediment. Silt fence should be installed along the contour to encourage sheet flow.

Description. Temporary silt fence is composed of woven geotextile fabric supported by steel or hardwood posts, buried at the bottom. The permeability of the fabric is fairly low, so that water can pass through it only slowly. This causes stormwater runoff from disturbed areas to form a pool on the upstream side of the fence so that sediments can settle out, thus preventing them from leaving the construction site. Because silt fence is not designed to withstand high heads, the drainage area must be restricted and the fence located so that water depth does not exceed 1.5 feet at any point. Silt fence may be designed to store all the runoff from the design storm, or located to allow bypass flow when the temporary sediment pool reaches a predetermined level.

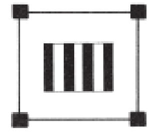
Limitations. The maximum drainage area to a section of silt fence is ¼ acre per 100 feet of silt fence. However, as drainage area slopes increase, the treatment capability of silt fence decreases. In addition, silt fence is not allowed in areas of concentrated flows, as flow capacities of the silt fence fabric will be exceeded and the silt fence will fail. Concentrated flow areas include channels and pipe outlets. Where sections of silt fence are joined, these joints can become failure points if the joints are not constructed correctly.

Maintenance. The effectiveness of silt fence is largely dependent on the proper installation and maintenance. Sediment should be removed from behind the silt fence when half the storage depth has been filled. If runoff concentrates along the toe of the silt fence, erosion will occur. J-hooks or stable silt fence outlets should be considered in these areas. Silt fence should be maintained or replaced when it begins to sag, as sagging points typically are points of overtopping and downstream scour. The design life of silt fence fabric is 6-12 months.

PRACTICE 7.35: INLET PROTECTION

The effectiveness of inlet protection is dependent on routine maintenance.

See Chapter 7, Page 258



Purpose and Application. Inlet protection is installed at the entrance to storm drain systems to prevent sediment from construction sites from getting into the storm drain system.

Description. Inlet protection practices can be manufactured devices or can be constructed on the project. All inlet protection devices have the following components: a sediment storage area, a sediment barrier or filter, and a stormwater overflow mechanism to manage larger storm events. Inlet protection measures provide filtration or a temporary detention area to allow settling. Where filtration is the primary means of providing protection careful maintenance of the filter media is essential. Silt fence inlet protection must have bracing installed to prevent inward collapse of the structure.

Limitations. Inlet protection devices can only manage runoff from one acre or less per structure. These devices should be installed as secondary sediment control measures, as their effectiveness is low. Ponding behind inlet protection can cause a traffic hazard, if the device is located near travel lanes. Drop inlets are often in series, and when an upstream measure is bypassed due to clogging or lack of storage, downstream measures will fail as the drainage areas for downstream measures will increase.

Maintenance. If filter fabric gets clogged, significant ponding will occur and the BMP is likely to fail. Replace the filter fabric when evidence of clogging is visually noted. Sediment should be removed when 50% of the sediment storage volume has been filled with sediment or other debris. Diversions and/or berms may be needed to prevent stormwater runoff from bypassing treatment.

PRACTICE 7.36: CONSTRUCTION ROAD STABILIZATION

See Chapter 7, Page 269

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The construction roadway has been stabilized with stone to prevent erosion of the roadbed.

Purpose and Application. Construction road stabilization techniques should be applied to all temporary or permanent construction access routes, haul roads, on-site vehicle transportation routes, and construction parking areas to prevent erosion. This will reduce erosion and subsequent re-grading of permanent roadbeds between time of grading and final stabilization. Unstabilized roadways can generate sediment and/or dust. During wet weather, unstabilized roads can become unusable, causing a delay in construction.

Description. Construction roads and parking areas should be stabilized early in the project. Different types of materials can be used to stabilize these areas; however, gravel and other types of rock are the most prevalent material used for stabilization. If crusher run is used, the fine material in the mix must be managed so it does not contribute to off-site sedimentation or turbidity. Maintain and monitor construction exits when crusher run is used for construction road stabilization (crusher run is NOT allowed for construction exits). Regardless of the material used, controlling surface runoff from the roadway and adjoining areas is a key erosion control consideration.

Limitations. Avoid steep slopes, wet or rocky areas, and highly erosive soils.

Maintenance. Where material migrates off the roadway or wears thin, the construction roadway or parking area may need another application of rock. Topdress with new gravel as needed. Inspect drainage ditches and other areas for evidence of rock and sediment migration from the roadway.

PRACTICE 7.37: TUBES AND WATTLES (SEDIMENT CONTROL)

See Chapter 7, Page 273

Wattles and tubes perform as velocity reduction and sediment reduction practices, and many are biodegradable.

Purpose and Application. Wattles and tubes can be used as velocity reduction or sediment control practices, depending on the application. For this practice, the focus is on sediment control. Their primary sediment control applications are: 1) installed on slopes to slow sheet flow, promote infiltration, trap sediment and reduce runoff volume; 2) installed around storm drain inlets to prevent sediment from migrating into the storm drain system; and 3) installed along the perimeter of a small site with minimal slope to slow sheet flow and promote sediment deposition. These practices can be used in place of silt fence at the perimeter of a small site. They are very good practices to install on a residential lot.

Description. Wattles and tubes have a mesh or netting material around an inner filter media material. Some wattles and socks are fully biodegradable, while others have degradable components. All wattles and tubes must have an intimate contact with the ground to prevent piping under the measure. The ends of wattles and tubes should extend up the sides of channels and ditches when installed in areas of concentrated flow. Design is based upon the primary application as either a velocity control in channels and ditches or as sediment control.

Limitations. Common diameters of these practices are from 8” to 20”. Sediment storage area behind these measures is, therefore, limited. Wattles and tubes must be staked down so they can’t be installed on pavement or rock.

Maintenance. Depending on the material, these practices can have a very short life span (3-6 months) or a longer life span (12 months or more). The maintenance plan accompanying the EPSC plan should clearly identify the expected life span for the practice being used. An advantage of using biodegradable wattles or socks is realized when construction is complete and measures are being removed. For many wattles and socks with biodegradable filter material inside webbing, the webbing can be cut and removed, leaving the filter media in place.

PRACTICE 7.38: FILTER BERM

Filter berm installed with silt fence to prevent mulch migration (Source: TDOT, SR840, Williamson County)

See Chapter 7, Page 276

Purpose and Application. Filter berms act first by reducing runoff flow velocities so that eroded sediments can be settled upstream of the filter. They also act to filter the runoff as it passes through the materials in the berm. Filter berms are installed along the contour to intercept sheet flow. Filter berms may also be used where silt fence would not be feasible due to exposed rock or other conditions which would prevent the fence from being trenched in.

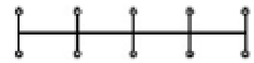
Description. Filter berms are a linear sediment trapping measure composed of wood chips. Woody material that is ground onsite can be used to construct filter berms if the material is not composted before use. To prevent the migration of mulch materials, the berms can be installed in conjunction with other measures such as silt fence (see the picture at the top). Compost material should be avoided, due to its potential to leach nutrients and cause a color contrast. The maximum drainage area to a section of filter berm is ¼ acre per 100 feet of berm. However, as drainage area slopes increase, the treatment capability of filter berms decreases.

Limitations. Mulch is highly effective at solids reduction. However, some filter berm materials can leach nutrients and should not be installed near nutrient sensitive streams. Filter berms should not be installed in areas of concentrated flow. Even in areas of high sheet flow, filter berm material may have a tendency to migrate due to the buoyancy of the mulch material.

Maintenance. Repair filter berms if material migrates or the berm is breached. It may be necessary to install additional downstream measures to prevent mulch migration, such as silt fence. Once the project has been completed, filter berms can be knocked down and seeded.

PRACTICE 7.39: TURBIDITY CURTAIN

See Chapter 7, Page 279



Turbidity curtains isolate active work areas in a stream or on the bank of a stream from the rest of the stream, minimizing sediment movement from the work area.

Purpose and Application. Turbidity curtains may be applied adjacent to the shoreline of a river or lake to contain sediments which may be carried into the water by construction site runoff. They should be considered only where adequate or conventional shoreline sediment control measures are not feasible or possible. They may also be used to surround a work site within the channel of a river (i.e. bridge pier construction, dredging or filling) or within a larger water body in order to prevent worksite sediments from being dispersed.

Description. An in-stream sediment control measure is designed to trap or filter sediment, not to halt the movement of the water itself. This device consists of a filter fabric curtain suspended from floats and held vertically in the water by means of a bottom ballast chain. This measure is placed around a construction site located either adjacent to, or within a water body, to provide an isolated work zone where sediments generated by the project can settle. In this way, it prevents the migration of these sediments into the larger remaining water body.

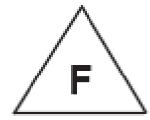
Limitations. Turbidity curtains should not be considered a primary sediment control and should not be installed across flowing water. This practice should not be applied where anticipated flow velocities will exceed 5 ft./sec.

Maintenance. Repair ripped or separated sections. If water elevation changes significantly causing the floating turbidity curtain to fail, the mooring and anchoring system may need to be adjusted.

PRACTICE 7.40: FLOCCULANTS

A floc log has been installed at the end of the pipe in turbulent flow to mix the flocculant and stormwater. A sediment basin has been installed below this pipe to provide a settling zone for the flocs.

See Chapter 7, Page 282



Purpose and Application. Flocculants are chemicals that are used to reduce turbidity in stormwater runoff. Construction sites with clayey soils benefit from the addition of a flocculant. Flocculants are typically applied in a treatment train approach that provides a mixing zone, settling zone and polishing zone.

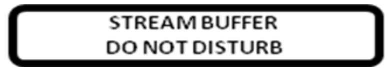
Description. Flocculation is the process of causing small, suspended materials to stick to each other to form "flocs". These flocs more readily settle out compared to the individual particles. Soil that is exposed during construction or stormwater runoff can be picked up and carried to the nearest water conveyance. As the flow rate slows, the larger sand or pebble particles will settle out of the water, however, the smaller particles take a much longer time to settle out. The flocculants will cause the clay particles to clump together and settle out more quickly. Many types of flocculants are available such as Polyacrylamide (PAM), gypsum and other coagulants. However, sediment at each site must be evaluated for responsiveness to the flocculant. PAM comes in solid (floc logs), liquid, and powder form. Most other flocculants come in powder form. Flocculants are typically introduced in ditches or at pipe outlets to encourage mixing. The treatment train approach is necessary to provide mixing zones in a ditch or other turbulent flow area, a settling area such as a sediment basin, and final polishing through a skimmer or other dewatering device. Anionic PAM is acceptable for use in TN. Cationic PAM is not allowed because of its toxicity to fish and aquatic life.

Limitations. A treatment train must be provided that introduces the flocculant upgradient from the settling zone.

Maintenance. The flocculant will need to be replaced routinely, with the frequency of replacement directly tied to the form of flocculant used. Visual monitoring of the discharge quality of runoff below the treatment train system using flocculant should be performed to ensure that the flocs are settling in the settling area.

PRACTICE 7.41: STREAM BUFFERS

See Chapter 7, Page 286



While the vegetation may not look desirable, the buffer area between the construction project and the river has not been disturbed.

Purpose and Application. Stream buffers have numerous benefits including increased stormwater infiltration and reduced runoff; final polishing of storm water before it's discharged to a stream; habitat creation or protection; and stream corridor protection. Deep rooted vegetation in the buffer area also provides streambank protection and shade to the stream.

Description. A stream buffer is a strip of undisturbed, natural, restored or enhanced vegetation between an active construction site and a stream. Stream buffers are not primary sediment controls and are easily overwhelmed by sediment-laden runoff. Primary sediment controls should treat stormwater runoff prior to discharging into a buffer. Buffers should be identified prior to the start of land disturbing activities and clearly marked throughout the life of the construction activity. Construction equipment should be prevented from entering or disturbing buffers. Construction related materials should not be stored in buffers. Stormwater must be maintained as sheet flow across the length of the buffer to prevent erosion.

TN Requirements. For sites that contain and/or are adjacent to a receiving stream designated as impaired or Exceptional Tennessee waters a 60-foot natural riparian buffer zone adjacent to the receiving stream shall be preserved, to the maximum extent practicable, during construction activities at the site. The natural buffer zone should be established between the top of stream bank and the disturbed construction area. The 60-feet criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 30 feet at any measured location.

A 30-foot natural riparian buffer zone adjacent to all streams at the construction site shall be preserved, to the maximum extent practicable, during construction activities at the site. The riparian buffer zone should be preserved between the top of stream bank and the disturbed construction area. The 30-feet criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 15 feet at any measured location.

Limitations. Stormwater must enter and flow through the buffer as sheet flow. Level spreaders may be required to turn concentrated flow into sheet flow.

Maintenance. Where sediment deposits are identified in buffers, the sediment should be removed by hand, raked out and stabilized, or seeded in place if the deposition will not negatively affect flow through the buffer. Erosion in the buffer must be repaired once identified. Level spreaders should be installed to maintain sheet flow through the buffer.

PRACTICE 7.42: STREAM DIVERSION CHANNEL

See Chapter 7, Page 289

When work is occurring in the natural stream channel, the stream is often diverted around the work area and carried in a stabilized diversion channel.

Purpose and Application. Stream diversion channels are constructed to allow construction in the natural stream channel under dry conditions. Lined stream diversions non-erosively carry the stream flow while isolating it from the active work zone.

Description. Stream diversion channels are temporary structures that non-erosively convey streams around the work zone and reconnect with the natural stream channel below the work zone. Materials that can be used to stabilize the diversion include geotextile fabric, heavy plastic sheeting, and rock. They are used to allow in-stream work to be completed in the dry, separate from flowing water. This reduces the amount of sedimentation which will occur in the stream as a result of the construction activity. Upstream and downstream plugs must be installed in the natural channel to prevent the stream from flowing into the natural channel and into the work zone. Once the work in the natural channel has been completed, the stream is directed back into the stabilized natural channel and the stream diversion channel is removed.

TN Requirements. **All work in a stream must have prior approval from TDEC through the Aquatic Resource Alteration Permit process and all conditions of the ARAP must be followed.**

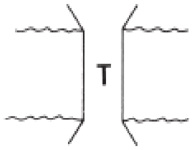
Limitations. Space limitations around the stream must be considered when preparing the stream diversion channel design. Sediment controls cannot be placed in the diversion channel while it is carrying the stream flow. Work around a stream should be planned to minimize the length of time the diversion will be required.

Maintenance. When a storm event occurs that breaches a stream diversion plug, the plug must be re-established as soon as possible. A non-erodible lining must be maintained on all sections of the stream diversion channel and replaced or repaired if torn or loose.

PRACTICE 7.43: TEMPORARY STREAM CROSSING

Clean stone should be used in temporary stream crossings to prevent the migration of fines into the stream.

See Chapter 7, Page 299



Purpose and Application. Temporary stream crossings allow construction equipment to cross a stream without negatively impacting the stream. They should be installed anywhere construction activity crosses a stream channel, even when the channel is dry.

Description. Stream crossings are of three general types: bridges, culverts, and fords. In selecting a stream crossing practice consider: frequency and kind of use, stream channel conditions, overflow areas, potential flood damage, surface runoff control, safety requirements, and installation and maintenance costs. Temporary crossings may overflow during peak storm periods, however, the structure and approaches must remain stable. Clean stone should be used for temporary stream crossings. If fines are included in the stone mix, the fines can migrate downstream and cause sedimentation or water quality problems. The stream should also be isolated from the active work area.

TN Requirements. **All work in a stream must have prior approval from TDEC through the Aquatic Resource Alteration Permit process and all conditions of the ARAP must be followed.**

Limitations. Incorrectly designed or installed stream crossings can be direct sources of water pollution and flooding. They can also be expensive to construct. If washed out or damaged, they can also cause costly construction delays.

Maintenance. Ensure that flow is maintained through the stream crossings. Remove debris and any blockages. Isolate the stream from the active work areas.

PRACTICE 7.44: BIOENGINEERED STREAMBANK STABILIZATION

See Chapter 7, Page 303

Vegetation and structural components are used together to stabilize streambanks. In the picture above, the coir rolls are used to reinforce the toe against erosive velocities.

Purpose and Application. Bioengineerd streambank stabilization incorporates natural and readily available plant material as well as engineered controls. Anywhere streambanks are disturbed, the preferred method for stabilization is to use bioengineered techniques.

Description. Bioengineered streambank stabilization involves using natural materials such as root wads, coconut fiber rolls, and rock veins to direct stream flow away from eroding banks and stabilize the bank. Bioengineering is the preferred method of streambank stabilization.

Some streambank stabilization designs involve redirecting stream forces through deflection or creating settling zones. It is highly recommended that individuals with specialized geomorphological design experience be consulted when working in the stream and changing flow patterns. Improperly designed or placed veins or deflectors can cause more damage to the streambank. Such detailed geomorphological analysis and design of streams is not covered in this design manual.

TN Requirements. **All work on streambanks must be conducted in accordance with a valid Aquatic Resource Alteration Permit.**

Limitations. Vegetative and structural materials used to stabilize the stream must not reduce the hydraulic capacity of the stream channel. Sediment control must be practiced to isolate the active construction area from the stream to the extent feasible.

Maintenance. The streambank being stabilized must be monitored while vegetation is getting established to quickly repair damaged vegetation and erosion that may occur. In addition, the channel may need to have routine maintenance on the vegetation after it has established to maintain the hydraulic capacity of the channel.